2 PROJECT DESCRIPTION

2.1 INTRODUCTION

ANNEX IV of the EIA Directive sets out the details to be included in the description of the Project at paragraph 1 as follows:

a) a description of the location of the project;

(b) a description of the physical characteristics of the whole project, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases;

(c) a description of the main characteristics of the operational phase of the project (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used;

(d) an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation) and quantities and types of waste produced during the construction and operation phase

This Chapter of the EIAR provides a description of all elements of the Project. This forms the basis of the assessments presented within Chapters 4 to 17. This Chapter provides details of the construction, operational and decommissioning phases.

This Chapter includes an overview of the Project followed by a detailed description of the main components and their method of construction. Measures that have been built into the design of the Project to reduce effects, also known as 'Embedded Mitigation' measures, are set out throughout the EIAR. In addition to these Embedded Mitigation measures, Chapters 4 to 17 also present mitigation and enhancement measures where specifically relevant to their assessment topic. Potential cumulative impact projects are identified in this chapter for impact assessment in Chapters 4 to 17.

This Chapter of the EIAR is supported by Figures in **Volume III** and the following Appendix documents provided in **Volume IV**:

- Construction Environmental Management Plan (CEMP) in **Appendix 2.1**
- TLI Technical Notes related to electrical Grid Connection in **Appendix 2.2**
- List of Projects for Cumulative Assessment in **Appendix 2.3**

Common acronyms used throughout this EIAR can be found in **Appendix 1.2**.

2.2 PROJECT OVERVIEW

The Proposed Development will comprise the construction of 13 No. wind turbines (to be known as Firlough Wind Farm), an on-site 110 kV loop-in substation and all ancillary works and the construction of an underground Grid Connection via a looped connection between the Wind Farm Substation and the existing 110 kV overhead powerline north of Bunnyconnellan village, Co. Mayo. The Proposed Development will also include a Hydrogen Plant comprising 80 MW of modular alkaline electrolyser and all associated infrastructure including; compressors, cooling equipment, refuelling points, water abstraction, storage and processing, and the Hydrogen Plant Substation which will be connected to the Wind Farm via an underground electrical Interconnector. These elements constitute the "**Proposed Development"** as shown in **Figure 1.1**.

The Proposed Development will comprise of the following main components:

- Construction of 13 no. wind turbines with an overall ground to blade tip height of between 177 m and 185 m inclusive. The wind turbines will have a rotor diameter of between 149 m and 155 m inclusive and a hub height of between 102.5 m and 110.5 m inclusive.
- Construction of permanent crane hardstand areas and temporary laydown/storage areas and turbine foundations.
- Construction of new permanent internal Wind Farm Site access roads and the upgrade of existing internal bog tracks to include passing bays and all associated drainage infrastructure.
- Development of a site drainage network for the Wind Farm Site including sediment control systems.
- All associated underground electrical and communications cabling connecting the wind turbines to the Wind Farm Substation.
- Construction of a permanent on-site 110 kV wind farm electrical substation including two no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- All works associated with the permanent connection of the wind farm to the national electricity grid, which will be via a loop-in 110 kV underground cable, in permanent cable ducts from the proposed permanent wind farm substation in the townland of Carrowleagh, and through the townlands of Carha, Carrownaglogh, Rathreedaun, Drumsheen and Bunnyconnellan West County Mayo into the existing 110 kV overhead line in the townland of Rathreedaun County Mayo, with two new 16 m high steel lattice loop-in/out masts at the connection point.

- Construction of a Wind Farm Site Temporary Construction Compound with associated temporary site offices, parking areas, welfare facilities and security fencing.
- Construction of a temporary construction materials storage area for use during construction of the Wind Farm.
- Forestry felling to facilitate construction and operation of the Wind Farm Substation and any onsite forestry replanting.
- Upgrade works on the section of the turbine delivery route which is common to both the Killybegs Turbine Delivery Route and Galway Turbine Delivery Route to include the following to facilitate the delivery of abnormal loads and turbine component deliveries:
    - Improvement of the N59 and L-2604-0 junction in the townland of Ballymoghany, County Sligo to include for the temporary widening of it. The associated accommodation works will include the installation of new drainage pipes, the construction of a 1.2 m high concrete retaining wall and the erection of timber stock proof fencing and 2 no. agricultural gates.
    - Localised widening of the L-2604-0 road in the townland of Cloonkeelaun, County Sligo. The associated accommodation works will include the construction of a 1.2 m high concrete retaining wall and the erection of concrete post and timber rail stock proof fencing and 2 no. agricultural gates.
    - Localised widening of the L-2604-0, L-5137-0 and L-5137-9 local roads in the townlands of Ballymoghany, Muingwore and Cloonkeelaun County Sligo and Carrowleagh County Mayo to achieve a surfaced road width of 4.5 m.
    - Localised widening of the L-5137-9, L-5136-0 and L-6612 roads in the townlands of Carraun and Knockbrack County Sligo, and Carha and Carrowleagh County Mayo to establish passing bays.
- Upgrade works on the Galway Turbine Delivery Route to include the following to facilitate the delivery of abnormal loads and turbine component deliveries:
    - Localised road widening at the N17/N5 roundabout in the townland of Ballyglass East County Mayo.
    - Localised road widening at the road junction with the N5 in the townland of Ballyglass East County Mayo.
    - Alterations to the embankments at the N5 junction with the L-5339 and L-1331 roads in the townland of Cloonmeen West County Mayo.
    - Localised road widening at the junction of the L-5339 and L-1331 in the townland of Lavy More County Mayo.

- Construction of a new Wind Farm Site entrance off the L-5137-9 in the townland of Carrowleagh County Mayo with the creation of a splayed entrance to facilitate the delivery of abnormal loads and turbine component deliveries.
- Construction of a Hydrogen Plant and an access road to it along with, upgrades to the L-6612-1 and the construction of a roundabout. The Hydrogen Plant includes the electrolyser building measuring 130 m by 110 m, and 16 m in height, and equipment, underground water storage tanks, drainage system, constructed wetlands, hydrogen dispensing station, tube trailer parking, water treatment building, fin fan coolers, fire water tanks, compressors, offices and welfare facilities and all ancillary equipment.
- Construction of a permanent on-site 110 kV Hydrogen Plant Substation in a compound of 3,520 m^2 including 2 no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- Abstraction of groundwater from 2 no. boreholes in the townland of Carraun County Sligo and pumping to the proposed hydrogen plant site and all associated ancillary works.
- Construction of a Hydrogen Plant Site Temporary Construction Compound with associated temporary site offices, parking areas, materials storage and security fencing for use during construction of the Hydrogen Plant Site.
- All works associated with the permanent connection of the Wind Farm to the Hydrogen Plant comprising a 110 kV underground cable in permanent cable ducts from the proposed, permanent, on-site wind farm substation, in the townland of Carrowleagh Co. Mayo and onto the townlands of Carha Co. Mayo, Knockbrack Co. Sligo and terminating in the Hydrogen Plant Substation in the townland of Carraun, Co. Sligo.
- Demolition of agricultural shed C and partial demolition of agricultural shed B in the townland of Carraun to facilitate the construction of the upgraded L-6612-1 and roundabout.

A 10-year planning permission and 40-year operational life from the date of commissioning of the Firlough Wind Farm is being sought.

A permanent planning permission is being sought for the Grid Connection, Hydrogen Plant and Hydrogen Plant Substation as these are to remain in place upon decommissioning of the Wind Farm. The Wind Farm Substation will become an asset of the national grid under the management of EirGrid.

The Proposed Development includes activities which are subject to an Industrial Emissions License from the Environmental Protection Agency. In addition, the Proposed Development relates to an establishment which falls within the requirements of the Major Accidents Directive and which will be subject to regulation from the Health and Safety Authority.

While the Project is primarily comprised of the Proposed Development the Project for the purpose of the EIA also includes the following elements for which development consent is not being sought at this time:

- Demolition of an existing dwelling and agricultural sheds D and E and the demolition of the remainder of shed B and construction of a new house and shed in the townland of Carraun.

In the North Mayo and Sligo region, the full renewable energy generation potential of the area cannot be realised due to physical shortcomings and restrictions in the electricity network. The Hydrogen Plant would provide a viable off-take and route to market for renewable energy that otherwise would have been lost due to these constraints. The Hydrogen Plant production capacity will be scaled up to a maximum 80 MW, to meet demand for green hydrogen in the Irish market. The physical infrastructure of the entire Hydrogen Plant, (i.e. buildings, roads, water treatment, cooling and fuelling, etc) will be built during a single construction phase with the modular electrolyser system installed in 5 MW batches. In terms of the split of electricity going to the grid and the Hydrogen Plant, the smallest initial batch of electrolyser capacity will be 10 MW (using 12-15% of electricity produced at the Wind Farm) and will produce a maximum of 4,000 kg of green hydrogen per day leaving 55 to 68 MW (84-87% and based on a turbine range of between 5 and 6 MW) of installed capacity of the Wind Farm dispatching to the electricity grid. This will be phased up to an 80 MW electrolyser producing a maximum of 31,200 kg of green hydrogen per day and consuming the whole output of the Wind Farm. The green hydrogen will be transported in tube trailers, at the lowest installed capacity the maximum number of tube trailers daily will be 11, at the maximum capacity this will be 26 (see Section 2.6.6.12).

2.3 SITE LOCATION AND ENVIRONS

The Proposed Development associated with the Project is primarily located on two distinct sites which, for the purposes of this EIAR are denoted the Wind Farm Site and the Hydrogen Plant Site. Other elements of the Project are located on lands connecting these sites as well as other discrete locations which are required to facilitate the Project. This section describes the location and locational context of the Wind Farm Site, the Hydrogen Plant Site and the other lands associated with the Project.

2.3.1 Wind Farm Site

The Wind Farm Site as shown in **Figure 2.1,** has an area of approximately 445 hectares and is mainly cutover blanket bog with an extensive network of bog tracks, which were laid out in the 1930's to provide access to turf cutting plots. Almost the entire Wind Farm Site is subdivided into turbary plots lying primarily on a north south axis between the east west alignments of the road network. There are over 620 individual plots each measuring 50 m x 180 m. There is a network of bog roads on the Wind Farm Site, to provide access for turf cutting plots. There are a number of small gravel borrow pits on and in the immediate vicinity of the Wind Farm Site, these were used to source material for the construction of the bog roads. Continual turf extraction on the Wind Farm Site has meant that deep drains and heavily truncated areas of peat are common. No large scale or industrial scale peat cutting has taken place during the history of the site. The peat cutting has been characterised by single turbary plot cutting for residential/individual use. The Wind Farm Site has multiple ownerships who are involved as stakeholders in the Project.

The Wind Farm Site is located within a broad area of peatland in the townland of Carrowleagh (Kilbride), Co. Mayo, within the lower northwestern foothills of the Ox Mountains, adjacent to the county boundary between Mayo and Sligo. The site elevations range from 120 m O.D. in the northwest up to circa 170 m O.D. in the southeast. Notable towns and villages in the area include Bunnyconnellan (Co. Mayo) 4 km to the southwest, Corballa 6.5 km (Co. Sligo) to the north-west, Culleens 7.5 km (Co. Sligo) to the north, Enniscrone (Co. Sligo) 11 km to the north. The nearest large settlement is the town of Ballina (Co. Mayo.) 12 km to the west.

Housing density in the surrounding area is generally very low, there are no inhabited houses on one side as the topography rises towards the Ox Mountains. Inhabited houses only start to appear lower down to the west and south of the Wind Farm Site within farmland and are primarily farmhouses, one-off-houses and some ribbon development nearer to village.

There are no inhabited houses within the mandatory minimum setback distance of 500 m from any turbine. There is one inhabited house located within 740 m of the turbines (4 x maximum tip height as specified in the Draft Wind Energy Guidelines), which is located 725 m from T3. The owner and occupier of this house is financially involved in the Project and has provided written agreement accepting the reduced setback distance and has no objection to the proposed wind energy development. There are 18 houses within a 1.5 km radius of the turbines, comprising one off houses and farm holdings. There are 46 houses within a 2 km radius of the site (32 occupied) (**Figure 1.2**). The housing density generally increases on the approaches to settlement centres.

The principal land use in the general area is comprised of a mix of peat bogs, agricultural lands, commercial forestry and the Carrowleagh Wind Farm adjacent to the east and the Carrowleagh Wind Farm Extension which is adjacent to the northeast. The extensive Ox Mountains are the dominant feature to the east and south of the site rising to a height of 545 m at Knockalongy. The lowland landscape of the west is marginal pasture with the large fields lined by low scrubby hedgerows.

There is a court-tomb located within the Wind Farm Site, this has been avoided by design and will be protected with non-ground intrusive temporary fencing during the construction phase. There are a number of heritage features in the wider area and the two most significant of these are Rosserk Friary and Moyne Friary. Both are situated on the western side of the mouth of the River Moy 11 km and 14 km respectively to the west of the Wind Farm Site. The principle public amenities in the area are the network of 'waymarked' regional walking routes that include the Western Way, the Foxford Way and the Sligo Way. These walking routes all meet near the western end of 'The Gap', which is a low valley through the Ox Mountains some 4 km to the south of the Wind Farm Site. From here the Sligo Way runs to the north-east, the Foxford Way to the south-west, and the Western Way to the northwest. Ballina and the River Moy (12 km west of the Wind Farm Site) are synonymous with Salmon fishing.

2.3.2 Hydrogen Plant Site

The Hydrogen Plant Site as shown in **Figure 2.2**, has an area of approximately 6.5 ha and is currently an agricultural field used for grazing horses. It is located in County Sligo in the townland of Carraun, adjacent to the Co. Mayo border, 6 km west of the Wind Farm Site and 0.6 km from the N59 national road. Site elevations range from 53 m OD at the north-west corner to 45 m OD along the southern boundary. A watercourse runs 70 m at the closest point along the south of the Hydrogen Plant Site which forms the Co. Sligo/Mayo County boundary and Carraun (Sligo)/Dooyeaghny (Mayo) townland boundary.

There is an area of cutover, boggy peat adjacent to the south of the Hydrogen Plant Site boundary which has been avoided. It is 5.3 km north-west of the village of Bunnyconnellan (Co. Mayo) and 2.9 km south of the village of Corballa (Co. Sligo). The nearest large settlement is the town of Ballina (Co. Mayo.) 5.5 km to the south-west. It is accessed by the L-6612-1 local road and a newly designed roundabout and a site access road proposed to lead to the facility.

The Hydrogen Plant Site is located in a rural setting, set back from the clusters of ribbon development along the N59. Population density is 19 persons per km^2, much lower than the national average in Ireland of 72 persons per km^2. There are 22 inhabited houses within 1 km of the Hydrogen Plant Site and the closest inhabited house is 299 m to the northeast (**Figure 1.4)**. The Project includes the demolition of an existing dwelling and sheds located along the L-6612-1 to allow for proposed upgrades to the road and the construction of a roundabout. Construction of a new house and shed located within the landholding is included in the Project, but not part of the Proposed Development for which development consent is being sought and will be subject of a separate planning application.

The principal land uses in the surrounding area is agricultural lands, individual dwellings, the N59 national primary road and commercial conifer plantations. Developments in the wider surrounding area includes Ballina Beverages 4.8 km to the southwest, Ballina Engineering works 6.3 km to the southwest, construction companies and skip hire companies and numerous retail developments in Ballina and industrial development in Killala 9.7 km to the northwest including iron works manufacturing, packaging manufacturing and a “peaking" power station.

2.3.3 Grid Connection

The proposed 110 kV underground Grid Connection, extends over a length of 6.65 km, from the Wind Farm Substation to the Glenree – Moy 110 kV over-head line of which 250 m is within the Wind Farm Site, 6,040 m is located along the public road corridor and 355 m is located off road in third party lands. The third party lands are agricultural pasture. Leaving the Wind Farm Substation, the Grid Connection Route follows the access road for 250 m and turns north on to the L-5137-9 for 60 m. The route turns west to converge on to the L-5136-0 where the underground cables will be required to cross beneath existing ESBN cables and existing water utilities. It continues on the L-5136-0 for 2.66 km. It then turns south on the L-1102 for 610 m where it crosses underneath the Loughnagore stream by Horizontal Directional Drill (HDD). It re-joins the roadway, now the L-1102 for 585 m where it crosses the Glenree river by HDD. It continues south for 575 km crossing beneath the Fiddaun Stream by HDD then back into the roadway of the L-1102. It then continues south for a further 1.14 km before crossing the Srafaungal River by HDD then back into the roadway of the L-1102 for 385 m. The route then turns in an easterly direction along a permanent access track for 355 m to the tie in towers beneath the existing Moy to Glenree OHL in the townland of Rathreedane. The route traverses the townlands of Carrowleagh, Carha, Carrownaglogh, Rathreedaun, Drumsheen and Bunnyconnellan West.

2.3.4 Interconnector

The Interconnector underground cable route connects the Wind Farm Substation to the Hydrogen Plant Substation through the townlands of Carrowleagh, Carha, Knockbrack and Carraun. The overall length of the Interconnector Route is 8.2 km, of which 6.7 km is located along the public road corridor, 0.44 km is in the Wind Farm Site along existing roads and the remaining 1.05 km is located off road in third party lands. The third party lands are currently used for horse grazing and will be the location of the proposed Hydrogen Plant Site access roads. Leaving the Wind Farm Substation, the Interconnector Route follows the Wind Farm access road for 435 m and turns north on to the L-5137-9 for 60 m. The route turns west to converge on to the L-5136-0 where the underground cables will be required to cross beneath existing ESBN cables and existing water utilities. The Interconnector Route continues on the L-5136-0 for 2.67 km, then encounters a T-junction, where it proceeds turning right onto the L-1102 local road which it follows northwest for approximately 400 m. At this point the Interconnector Route keeps left onto the adjoining L-6612 local road. The Interconnector Route continues northwest along the L-6612 local road for approximately 735 m before the UGC reaches the L-6612/L-5131 Crossroads. The Interconnector Route continues west through the crossroads, remaining within the L-6612 local road for an additional 2.47 km. Along the L-6612 local road, the route crosses the Brusna River by HDD. The Interconnector Route then heads southwest via the L-6612-1 local road for 360 m. The underground cable leaves the public roadway, utilizing the proposed Hydrogen Plant access track, traveling southeast for 1.05 km before reaching the Hydrogen Plant Substation location.

2.3.5 Turbine Delivery Routes

The wind turbine components will be delivered from either Killybegs Port or Galway Port to the Wind Farm Site.

Killybegs Turbine Delivery Route; From Killybegs Port the turbine nacelles, tower hubs and rotor blades will be transported to the N56 some 4 km northeast of the harbour. The route primarily follows the national road network namely the N56, N15, N4 and N59 before turning left onto the local road L-2604-0, L-5137-0 and L-5137-9 towards the Wind Farm Site entrance.

Galway Turbine Delivery Route; From Galway Port the turbine nacelles, tower hubs and rotor blades will be transported to the N83 some 3 km north of the harbour. The route primarily follows the national road network namely the N83, N17, N5, N4 and N59 before turning left onto the local road L-2604-0, L-5137-0 and L-5137-9 towards the Wind Farm Site entrance.

Whichever turbine delivery route is selected, temporary works will be required to accommodate the delivery of the turbine components. These temporary works are included as part of this application and are located in the townland of Ballymoghany at the junction of the N59 and L-2604-0, on the L-2604-0 in the townland of Muingwore and Cloonkeelaun and in the townland of Carrowleagh on the L-5137-0 and L-5137-9.

If the Galway Turbine Delivery Route is used, upgrade works are required on the N17/N5 roundabout in the townland of Ballyglass East, the N5 in the townland of Bracklagh and Cloonmeen West and L-1331 in the townland of Lavy More are required. Works are mainly in the public road with some works requiring works to private property adjacent the public road. Consent for these works has been obtained from the landowners.

2.3.6 European Sites

The Wind Farm Site is not positioned within any designated or protected area (SPA, SAC, NHA). However, directly adjacent to the land holding is the Ox Mountains Bogs SAC (EU_Site_Code:IE0002006). Surface waters draining the east of the Site flow through this SAC. Further downstream, surface waters draining the west of the Wind Farm Site eventually meet the River Moy SAC, c. 12 km west. The nearest national designated site is Ox Mountains Bogs Proposed Natural Heritage Area, bordering the Wind Farm Site also to the south and east.

The Hydrogen Site is not positioned within any designated or protected area (SPA, SAC, NHA). However similar to the proposed Wind Farm Site it is hydrologically linked to the Killiala Bay / Moy Estuary SAC. The River Moy SAC is 2.29 km to the south. The nearest national designated site is the Killala Bay/Moy Estuary Proposed Natural Heritage Area (pNHA) 6.29 km to the west of the Hydrogen Plant.

The Grid Connection Route and Interconnector Route do not traverse any European Sites, the closest is the River Moy SAC, located 0.95 km west of the Grid Connection Route and 1.7 km southwest of the Interconnector Route.

The works to the turbine delivery routes is not located in within any designated or protected area (SPA, SAC, NHA). The closest to the works in Ballymoghany is the Killala Bay/Moy Estuary SPA and pNHA 5 km to the northwest. The closest to the works in Cloonkeelaun is the Ox Mountains Bogs SAC and pNHA 2.8 km to the east.

2.3.7 Wind Farms in the Area

There are ten wind farms within 20 km of the Wind Farm Site. The nearest operational wind farms are the Carrowleagh Wind Farm adjacent to the east of the Wind Farm Site and Carrowleagh Wind Farm Extension which is adjacent to the north-east. **Figure 2.3** shows the location of proposed, permitted and operational wind farms within a 20 km radius of the Wind Farm Site.

Figure 2.3 reflects the suitability of the area for wind farm development in meeting the requirements of Mayo County Council and the Department of the Environment, Climate and Communications for such developments. The wind farms adjacent to the Wind Farm Site are also on similar cutover peatlands. Wind farms within 20 km are included in **Appendix 2.3** for cumulative assessment.

2.3.8 Land Ownership

A portion of the Wind Farm Site is owned by John Duffy, this forms part of a wider landholding held in multiple ownerships which are financially involved in the Wind Farm. The Hydrogen Plant Site is currently owned by a 3rd party landowner and will be purchased subject to planning permission. The Grid Connection, Interconnector and Turbine Delivery Route are located within public roads and third party lands with option agreements in place.

2.4 WIND RESOURCE

Due to the location in the northwest of Ireland, which boasts consistent and high wind speeds and currently generates relatively high levels of wind energy, and elevation, the Wind Farm Site experiences high average annual wind speeds. The Irish Wind Atlas, produced by the Sustainable Energy Authority of Ireland, shows that wind speeds on the Wind Farm Site are consistent with those that can facilitate a windfarm development (8.2 m/s at 75 m, 8.7 m/s at 100 m and 9.6 m/s at 150 m). This is evidenced by the area's designation as "Preferred Large Wind Farms" in the Renewable Energy Strategy for County Mayo 2011-2022 and the location of the neighbouring Carrowleagh Wind Farm. Mayo has strong wind resources and is a leader in wind development having Ireland's first commercial wind farm at Bellacorick, Co Mayo in 1992.

In the summer of 2010, as part of investigations for the Existing Permission, the Developer erected a 60 m anemometry mast on the Wind Farm Site which measured wind speeds and wind direction. The anemometry mast was equipped with industry standard calibrated anemometers and wind vanes. Using the recorded data, an assessment of the wind resource of the Wind Farm Site was undertaken, which confirmed that the Wind Farm Site has a good wind resource.

An analysis using the Wind Atlas Analysis & Application Programme (WAsP) computer software, developed in conjunction with the European Wind Atlas, again showed that the Wind Farm Site has a good wind resource.

In 2019, the Developer erected a new 80 m anemometry mast on the Wind Farm Site to supplement the data collected from the original 60 m anemometry mast. The original anemometry mast was decommissioned following irreparable damage sustained during storms.

2.5 WATER RESOURCE

Water is required as an input to the hydrogen production process. Water demand requirements for the Hydrogen Plant will be variable month to month depending on wind energy production, the utilisation of the energy and the utilisation capacity at the Hydrogen Plant. As a result, the Hydrogen Plant will have largest demand in February due to the highest wind resource, with lowest volumes in summer months.

Due to the location in the northwest of Ireland, the Hydrogen Plant Site experiences consistently high rainfall. Belmullet is located 68 km to the west of the Proposed Development and is the closest Met Éireann climate station with the longest running data set. Mean annual rainfall according to the 30-year average climate data set 1981-2010 (the most recent available data, at the time of writing; January 2023), period was 1,244.8 mm[1]. This compares to a mean annual rainfall at Dublin Airport 758 mm[2].

[1] Met Éireann. 30 YEAR AVERAGES. https://www.met.ie/climate/30-year-averages, Accessed 01/12/2022
[2] Met Éireann. 30 YEAR AVERAGES https://www.met.ie/climate-ireland/1981-2010/dublin.html

RSK Group Ltd was commissioned by the Developer to carry out a groundwater supply assessment for the water supply for the Hydrogen Plant (Report is available in **Appendix 9.8**). The conclusion of the Ground Water Supply Assessment, was that sustainable yields of 2.25 Litres per Second (l/s) (194 cubic metres per day (m^3/d)) and 0.44 l/s (38 m^3/d) have been established for two boreholes, with a cumulative yield of 232 m^3/d (84,680 m^3/year) which is consistent with the two boreholes being able to meet the water demand of the plant (annual average water budget of 65,021 m^3 or 178 m^3/d) (see **Section 2.6.6.3** and **Chapter 9: Hydrology and Hydrogeology**). Hydrochemical testing on the groundwater was carried out during site investigations, the results show that the water quality is suitable for the electrolysis process following water treatment. This combination of high rainfall and productive groundwater supply shows that the Hydrogen Plant Site has a good water resource.

2.6 PROJECT CHARACTERISTICS

2.6.1 Comparison of Existing Approved Development and the Proposed Development

Planning permission was granted on the 1st of August 2013 for the construction of 21 wind turbines under An Bord Pleanála Reference PL16.241592. The revised proposal involves the reduction in the number of wind turbines. A comparative table of the approved wind farm and the Proposed Development is set out in **Table 2.1**.

Table 2.1: Comparative Table of the approved development and the revised proposal

	Planning Approval	Revised Proposal; The Proposed Development
No. of WTGs	21	13
Turbine	2.3 MW	5 - 6 MW
Hub Height	85 m	102.5 to 110.5 m
Rotor Ø	71 m	149 m to 155 m
Tip Height	120.5 m	177 m to 185 m
Capacity	c.48 MW	65 - 78 MW

2.6.2 Wind Farm Site Layout Design

The layout of the Wind Farm Site layout has been modified to take account of advances in wind turbine design, to maximise the energy yield while at the same time avoiding where possible, and where not appropriately mitigating, any significant environmental impacts.

The layout is shown in **Figure 2.1**. The layout design was informed by the following constraints and buffers in accordance with best industry practice:

- No works will occur within a distance of at least 50 m from watercourses (excluding watercourse crossings). No works will occur within a distance to land drains of at least 20 m.
- No works will occur within a distance to archaeological monuments and structures of at least 100 m.
- No works will occur within a distance from turbines to inhabited houses of at least 750 m except for 1 no inhabited house, 725 m from T3, the owner and occupier of this house is financially involved in the Project and has provided written agreement accepting the reduced setback distance and has no objection to the proposed wind energy development, this is inline with the Wind Energy Guidelines 2006.
- Setback distances from the neighbouring Carrowleagh wind turbines in accordance with the Wind Energy Guidelines.
- Avoidance of ground slopes of greater than 10 - 14%.
- Avoidance of existing telecommunications infrastructure.
- Avoidance of sensitive habitats, e.g., marginal grassland habitats containing Hen Harrier (*Circus cyaneus*) and/or watercourses containing Freshwater Pearl Mussel (*Margaritifera margaritifera*) (note there are none on the Wind Farm Site, the nearest records of Freshwater Pearl Mussel to the Wind Farm Site is on the Gowlan River approx. 3.5 km downstream.
- Positioning of turbines on cutaway and cutover areas to minimise peat excavation.
- Positioning of turbines to maximise use of existing bog tracks to minimise habitat disturbance and cause minimal disruption to natural hydrology.

The ITM coordinates of the turbines are listed in **Table 2.2.**

Table 2.2: Proposed Wind Turbine Coordinates

Turbine No.	ITM Easting [m]	ITM Northing [m]
T1	536362.593	820481.128
T2	536013.850	820710.273
T3	535912.952	821225.900

Turbine No.	ITM Easting [m]	ITM Northing [m]
T4	535913.900	821770.840
T5	535621.377	822154.673
T6	535411.984	822586.395
T7	536129.943	822539.852
T8	536696.930	822452.830
T9	536574.320	821892.728
T10	536500.610	821221.929
T11	536932.984	820877.771
T12	537029.608	821486.231
T13	537133.800	822271.680

2.6.3 Hydrogen Plant Site Layout Design

The Hydrogen Plant Site was selected for its proximity to the national road network in order to reduce traffic impacts on local roads, as well as its limited visual impact from public vantage points, distance from houses and access to underground water resource. The Hydrogen Plant Site layout design was informed by the following constraints and buffers in accordance with best industry practice:

- No works will occur within a distance of at least 70 m (excluding water treatment) to the watercourse to the south of the south of the Hydrogen Plant Site.
- No works will occur within a distance of at least 20 m to land drains.
- No works will occur within a distance of at least 100 m of archaeological monuments and structures.
- No works will occur within a distance of 200 m to inhabited houses
- Avoidance of ground slopes of greater than 10 - 14%.
- Avoidance of sensitive habitats, e.g., marginal grassland habitats containing Hen Harrier (*Circus cyaneus*) and/or watercourses containing Freshwater Pearl Mussel (*Margaritifera margaritifera*).
- Avoidance of the Sensitive Rural Landscape area to the south of the Hydrogen Plant Site.

Alternative sites for the Hydrogen Plant and alternative layout designs were considered, the details can be found in **Chapter 3: Alternatives**.

2.6.4 Wind Turbines

The wind turbines will be of modern design and will be a three-bladed, rotor up wind of the tower, variable speed, pitched blade regulated machine. The wind turbines appearance will be a matt non-reflective finish in a white, off-white or grey colour. The foundation-to-tip height will be between 177 m and 185 m.

The wind turbines will have a circular based tower, sitting on a reinforced concrete foundation. The tower will support the nacelle (a housing containing the turbine, gearbox etc, rotor hub, and rotor blades. Commercial wind turbine towers are typically made of steel or a hybrid of steel and concrete. The components within the nacelle are mainly metal (steel, copper, aluminium, etc.) with a metal/plastic/glass-reinforced plastic (GRP) body. The blades can be made of a matrix of glass-fibre reinforced polyester or wood-epoxy or similar composite materials.

Each wind turbine will have a generator with a capacity of 5 to 6 MW. The wind turbines may be direct drive machines or may contain a gearbox. The final wind turbine model will be chosen in a competitive tendering process, after all necessary consents have been secured.

This EIAR assessment considers and assesses all scenarios within the range of turbine parameters. The range of turbine parameters can be seen in **Table 2.3.** A schematic drawing of the candidate wind turbines is shown on **Figure 2.4**.

Table 2.3: Wind Turbine Parameters

Wind Turbine Parameter	Assessment Envelope
Wind Turbine Blade Tip Height	177 m to 185 m
Rotor Diameter	149 m to 155 m
Hub Height	102.5 m to 110.5 m

2.6.5 Turbine Foundation and Turbine Hardstands

The Turbine Hardstand is designed to accommodate the delivery, laydown, and assembly of wind turbine components (in particular rotor assembly) prior to wind turbine lifting and assembly and is shown in **Figure 2.5**. The Turbine Hardstands are needed to support the cranes during wind turbine construction, the operational and maintenance phase, and for decommissioning. The Turbine Hardstands will be constructed first and used to facilitate Turbine Foundation construction, such as steel reinforcement delivery, placing and pouring of concrete.

Construction of the Turbine Hardstands will require the excavation of soils, the laying of a geotextile material on the formation surface and placing engineered stone and a top dressing. The main Turbine Hardstands and associated storage and assembly areas will each cover an area of 3,600 m^2 as shown on Drawing No. 6129-PL-601. It will be 0.6 m in depth depending on the local bedrock profile and the varying soil depth. The total surface area for the 13 no. of 46,800 m^2 for the 13 no. wind turbines

The Turbine Foundation comprises two elements, the first, the main turbine foundation, will be located below ground level and will be between 22 m and 25.5 m in diameter and have a depth ranging from 2.5 to 2.85 m. The second, the central part of the foundation as seen on Drawing No. 6129-PL-701 and 6129-PL-702, will range between five and six metres in diameter and will be raised 0.15 m above ground level. It will encompass a cast-in insert or bolts to connect to the bottom of the turbine tower and reinforced bar structural elements. The Turbine Foundation design will depend on the turbine type and will be decided by the structural engineers at detailed design stage and will be within these design parameters. The area around and above the Turbine Foundation will be backfilled with compacted stone or crushed rock. Traditional gravity foundations are considered for EIA purposes. These are concrete structures that depend on their own weight to achieve sufficient stability against overturning and sliding.

Turbine Foundations will need to be taken down to a level where the underlying soil or rock can bear the weight of a structure without shifting or compressing. This will be done by excavating through the peat / soil, subsoil and rock where necessary (depending on the various geological locations).

The method of construction for a Turbine Foundation is described as follows:

- Install temporary drainage around the perimeter of the excavation
- Excavate peat / soil and rock
- Back fill the foundation with excavated rock
- Form a level working area to build the foundation
- Install formwork and reinforcement

- Pour the concrete
- Once the concrete has set and the earthing system is in place, backfill the foundation with suitable excavated material
- Use the soil to build up the area around the Turbine Foundation

2.6.6 Hydrogen Plant

The Hydrogen Plant will comprise of a number of components contained within the 6.4 ha Hydrogen Plant Site, including an electrolyser building, measuring 130 m by 110 m, and 16 m in height (incorporating electrolyser stacks and gas processing equipment), water supply equipment, water treatment building measuring 31.4 m by 13.4 m and 8 m high, compressor (and back up), buffer storage cylinders, a dispensing station with a 2 m wide, 1 m high platform with 7 no 4.5 m wide filling bays, and 9 no. modular fin fan coolers of 7.5 m in height. The majority of equipment will be contained within their own housing/building for security and to reduce noise and negative visual impact. The cooling units, buffer storage cylinders and filling station will not be housed within a building. Tube-trailers will be filled with green hydrogen at the dispensing station. The layout is shown in Drawing No. 410135-1000-G1000. The elements are described in more detail in the following sections.

The Hydrogen Plant has been designed in accordance with the relevant standards set out in **Table 2.4.**

Table 2.4: Firlough Green Hydrogen Project Relevant Standards and Codes of Practice

Hazard/Area	Standard Identifier	Title
Fire/Explosion	EN 1363 to 1366	Fire resistance tests (select parts for application)
	IEC 60695-1-11	Fire hazard assessment.
	EN 14373	Explosion suppression systems.
	EN 14460	Explosion resistant equipment.
	EN 16020	Explosion diverters.
	EN 15089	Explosion isolation systems.
	EN 14797	Explosion venting devices.
	EN 14986	Designs of fans working in potentially explosive atmospheres.
	EN 1127-1	Explosive atmospheres – Explosion prevention and protection – Basic concepts and methodology.
	BS EN 50495	Safety devices required for the safe functioning of equipment with respect to explosion risks.
	PD CEN/TR 15281	Guidance on inerting for the prevention of explosions.
	BS EN 62305	Protection against lightning.
	EN 60079	Explosive Atmospheres.
	BS 60080	Explosive and toxic atmospheres. Hazard detection mapping. Guidance on the placement of permanently installed flame and gas detection devices using software tools and other techniques.
	ISO 26142:2010	Hydrogen detection apparatus. Stationary applications.
	ISO 22734:2019	Hydrogen generators using water electrolysis – Industrial, commercial and residential applications.
	IGEM/SR/25 Edition 2	Hazardous Area Classification of Natural Gas Installations
	ISO 16111	Transportable gas storage devices. Hydrogen absorbed in reversible metal

Hazard/Area	Standard Identifier	Title
		hydride.
Hydrogen	ISO/TR 15916:2015	Basic considerations for the safety of hydrogen systems.
	EN 17533:2020	Gaseous hydrogen – Cylinders and tubes for stationary storage.
	ISO 15399	Gaseous hydrogen – Cylinders and tubes for stationary storage.
	EN ISO 19884	Gaseous hydrogen – Cylinders and tubes for stationary storage.
	BCGA CP 33*	The Bulk Storage of Gaseous Hydrogen at Users' Premises 2012.
	BCGA CP 39*	In-service requirements of pressure equipment (Gas storage and gas distribution systems) 2017.
	BCGA GN 7*	Guidance Note 7: The safe use of individual portable or mobile cylinder gas supply equipment.
	HSE RR175**	HSE Report: Installation permitting guidance for hydrogen and fuel cell stationary applications.
	HSE RR1133**	HSE Report: Maintaining the integrity of of process plant susceptible to high temperature hydrogen attack Part I.
	HSE RR1134**	HSE Report: Maintaining the integrity of of process plant susceptible to high temperature hydrogen attack Part II.
	NFPA 55*	Compressed gases and cryogenic fluids code.
	EIGA IGC 15/06	Gaseous hydrogen stations.
	ASTM D7265-12	Standard Specification for Hydrogen Thermophysical Property Tables.
	NFPA 2	Hydrogen Technologies Code
	ISO 19880	Gaseous Hydrogen – Fueling stations
Pressure Systems	HSE GS4**	HSE Guidance Notes: Safety requirements for pressure testing.
	HSE RR509**	Management of equipment containing hazardous fluids or pressure 2006.
	BS 1427	Guide to on-site test methods for the

Hazard/Area	Standard Identifier	Title
		analysis of waters.
	BS 5429	Code of practice for safe operation of small-scale storage facilities for cryogenic liquids
	EN 286-1	Simple unfired pressure vessels designed to contain air or nitrogen.
	ASTM D7327	Standard Practice for Handling, Transportation and Storage of IG-100 (Nitrogen).
Water Systems	ASTM D5127 - 13	Standard Guide for Ultra-Pure Water Used in the Electronics and Semiconductor industries.
Electrical Systems	BS 7870	LV and MV polymeric insulated cables for use by distribution and generation utilities.
	EN IEC 60076	Power transformers.
	EN 50110	Operation of electrical installations.
	NFPA 70E*	Standard for Electrical Safety in the Workplace.
	NFPA 70*	National Electrical Code.
	EN 50588	Medium power transformers.
Other	HSE CRC 363**	Best practice for risk-based inspection as a part of plant integrity management.
	IEC 31010:2019	Risk Management
	EIGA Doc 75/21	Methodology for Determination of Safety and Separation Distances

*Whilst not considered applicable in Ireland, considered best practice

** or Irish equivalent

2.6.6.1 Electrolyser Building

Hydrogen has been produced and used for over 100 years worldwide and for the last 25 years in Ireland. Hydrogen is a multi-million-dollar industry globally will a demand of between 70 and 90 million tonnes per year worldwide. Ireland currently consumes around 2,000 tonnes of hydrogen per year. Details of hydrogen demand, markets and uses can be found in section 1.6, Need for the Development in **Chapter 1: Introduction**. Since demand is almost entirely supplied from fossil fuels, hydrogen is responsible for over 830 million tonnes of CO_2 emissions globally per year.

Hydrogen produced through electrolysis of water removes direct production of CO_2, when the energy used for production is renewable this is considered emissions free, green hydrogen. Water electrolysis is the process of splitting water (H_2O) into its basic components, hydrogen (H_2) and oxygen (O_2), using an electric current in an electrolyser. Through this process, electrical energy can be stored as chemical energy in the resulting hydrogen. The newly formed chemical energy can be utilised as a fuel or converted back to electricity when required. Water is an ideal source for producing hydrogen because it only releases oxygen as a by-product which is vented to the atmosphere. The Hydrogen Plant will produce hydrogen via electrolysis powered by renewable wind energy and thus be considered green hydrogen with zero greenhouse gas emissions. The Wind Farm configuration consists of 13 wind turbines, with an overall installed capacity of 65-78 MW. The electrolyser has been designed to consume the full output of the Wind Farm once built to full capacity.

The electrolyser will be housed in a portal frame building measuring 130 m by 110 m (14,300 m^2), and 16 m in height. It will have a metal panel roof, roof vents and roller doors, finished in the style of an agricultural shed. The foundations will be 1.2 m x 1.2 m pad foundations. This is shown in Drawing No. 410135-1000-G2000 and 410135-1000-A4000.

The electrolyser building will include the following equipment (housed inside the building so not visible):

- Electrolyser Stacks; 16 no. (Operating at 80 degrees centigrade).
- Transformers: The electrolyser package has four no. oil immersed transformers that step down the voltage to the low voltage requirements (400V)
- Rectifiers: The voltage is converted from AC to DC
- Gas cleaning: Gas/lye separators and gas scrubber then remove any residual lye from the oxygen and hydrogen flow channels. Oxygen is then vented to atmosphere.
- Gas holder: A small gas holder is installed to maintain positive pressure of the system and to act as a buffer between the electrolyser compressor.
- Initial Compression: Hydrogen is compressed to 30 bar from 0.02 bar. The compressor technology will most likely be reciprocating piston compressor, however, this will be confirmed during final design.
- Deoxidizer: The hydrogen stream is passed through a small catalytic reactor which removes residual oxygen.

- Dryer: The hydrogen stream is passed over a bed of water vapor adsorbent to remove any moisture.
- Electrolyte tanks.
- Gas holders (H2 and O2).
- Ventilation.
- Nitrogen production equipment to compress air from the atmosphere to produce nitrogen on demand for purging the system as required.
- Control room.
- Associated piping and electrical infrastructure.

An Alkaline Water Electrolyser (AWE) has been selected for the Proposed Development. Alkaline electrolysis (AEL) is the most mature form of electrolysis with around 96 years of operational experience[3], with the first large alkaline electrolysis plant installed in Norway in 1927. In Cusco (Peru), Industrias Cachimayo has been producing hydrogen using a 25 MW alkaline electrolyser since 1965 to manufacture ammonium nitrate. The largest currently in operation is a 150 MW AWE electrolyser in Ningxia, China which has been producing green hydrogen since December 2022 and is producing approximately 23,700 tonnes per year. Phase one of the Ningxia project included a 30 MW electrolyser which has been operational since 2021. Years of research and development and practical experience have made it possible to develop rigorous engineering controls and guidelines to mitigate the risks of producing, transporting, and using hydrogen.
Table 2.5 shows the electrolyser specifications and requirements.

Table 2.5: Proposed Electrolyser Specifications and Requirements

Parameter	Performance
No. of stacks	16
Maximum Hydrogen production at full capacity	31,200 kg / day
Stack AC (Alternating Current) system power consumption at full capacity (excl. ancillary loads)	80 MW
Stack efficiency at nominal H_2 production	4.2 kWh/Nm^3
Stack efficiency at minimal H_2 production	3.8 kWh/Nm^3

[3]United Kingdom Government. (2021). Hydrogen Production Costs. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011506/Hydrogen_Production_Costs_2021.pdf

Parameter	Performance
Hydrogen purity at module outlet	99.99%
Hydrogen contaminants	Water, N_2, O_2
Electrolyte Solution	Lye
Start-up time	< 10 min
Load range	15-100%

Each electrolyser stack is made up of a series of cells which each include an anode and cathode. DC voltage is applied between the first and last electrode, thereby producing a current flow through the cells. Electrolyte is introduced to the cells via distribution channels, and hydrogen and oxygen are produced as a result of the current flow. The gases are separated and collected by flow ducts.

Potassium hydroxide (KOH), also known as lye, is an alkaline and can be an irritant to skin and other tissues and can cause damage to lungs if inhaled. Potassium hydroxide is moderately toxic to aquatic organisms. It dissociates in water and can elevate the pH of systems that are not well buffered. It can also disrupt the pH balance of soils which can kill a plant species and bacteria. It is used in industrial applications such as chemical manufacturing and petroleum refining, product manufacturing such as soaps, drain cleaners, and in food products, potassium hydroxide acts as a food thickener, pH control agent and food stabilizer. Potassium hydroxide has been selected as the electrolyte for the electrolyser stacks and will be stored as a 25 % KOH solution bunded in tanks within the electrolyser building. The solution is made by dissolving KOH pellets in demineralized water within storage tanks. Typical alkaline electrolysers use approximately 25 m^3 of lye per 2.5 MW of installed electrolyser capacity. This would equate to 800 m^3 of lye for an 80 MW system, therefore storage tanks of a combined volume of 200 m^3 will be required. The storage tanks will be bunded within the electrolyser building to contain any potential spillages. The electrolyte is recycled through the system and is not consumed by the electrolysis process. Minor losses do occur as KOH droplets can exit the electrolyser in the hydrogen and oxygen streams. Lye/gas separators and gas scrubbers remove residual KOH, this is returned to the electrolyte storage tank, making it a closed system. Any spills will be taken offsite rather than discharged in wastewater. If there is a need to remove large volume of lye (for example if a tank is damaged or the solution is contaminated) then this can be taken off site for disposal. The engineering design of the Hydrogen Plant will ensure the safe handling of KOH.

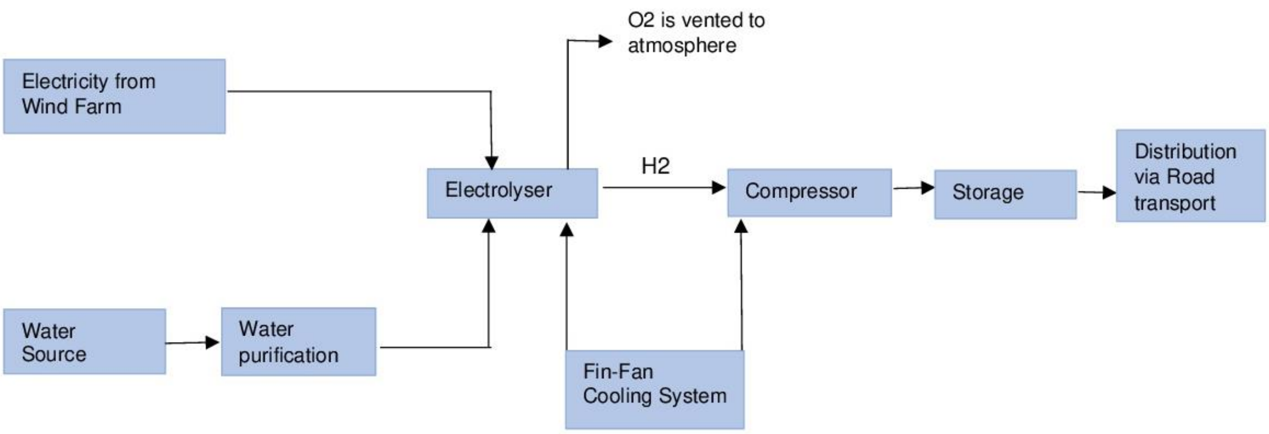
Nitrogen gas will be used at the Hydrogen Plant to purge equipment and piping for both safety and maintenance purposes. Air, oxygen and other oxidisers must be purged from a system before introducing hydrogen to avoid creating an explosive mixture. Hydrogen will also need to be purged from systems prior to maintenance. Nitrogen production equipment will be housed in the electrolyser building. This will include air separation equipment which compresses and filters atmospheric air, then binds the oxygen and allows the nitrogen to pass through. The purified nitrogen is produced on demand and is not required to be stored at the Hydrogen Plant. Nitrogen is an inert gas and so is not toxic but can pose a risk as an asphyxiant if accumulated in enclosed spaces. Appropriate venting will be installed to ensure prevent this. The engineering design of nitrogen production and handling is proven regarding safety and environmental risks.

While sensitive terrestrial biodiversity receptors have not been identified within the site of the Hydrogen Plan or the immediate surroundings, in the absence of mitigation there is a risk that contaminants released in the event of an industrial accident could enter local watercourses. This is assessed in **Chapter 6: Aquatic Ecology**, **Chapter 9: Hydrology and Hydrogeology** and **Chapter 16: Major Accidents and Natural Disasters** as well as the NIS.

Oxygen (O_2) is produced as a biproduct of the green hydrogen production process at a volume of 8 kg O_2 for 1 kg hydrogen. It is anticipated that the Hydrogen Plant will not be built initially with a capacity of 80 MW but is more likely to commence operation at a capacity of 10 MW and expand in modules as demand increases and the hydrogen market matures. At 10 MW it is expected that the Hydrogen Plant will produce a maximum of 4,000 kg of hydrogen per day. At 80 MW it will produce a maximum of 31,200 kg of hydrogen per day. This gives a maximum daily oxygen emission of between 32,000 kg with a 10 MW electrolyser and 240,000 kg when the Hydrogen Plant is operating at full capacity of 80 MW. This is released to the atmosphere via a vent stack of 5.5 m. The oxygen vent stack is separated from the hydrogen vent outlets and away from building air takes. Sufficient ventilation will be installed inside the electrolyser building to prevent accumulation of oxygen. Oxygen could potentially be collected as a by-product however, this does not form part of the Proposed Development.

On production, the green hydrogen will be compressed (500 bar) and transferred to temporary 'buffer' storage. This will consist of a series of cylinders that will allow the smoothing out of the tube-trailer filling operation. Hydrogen will be filled into tube-trailers at dedicated filling points. The tube trailers will be removed from site and transported to customers. Tube trailers are currently used to transport a variety of compressed gases and have a proven safety record. The electrolyser will be capable of producing up to circa 31,200 kg of hydrogen in 24 hours at maximum output. Given the available input electricity from the Wind Farm, and the presence of other onsite loads, the Hydrogen Plant will have a daily maximum output of 31,200 kg, giving rise to a maximum storage requirement of 26 tube trailers filled from empty. As the production of green hydrogen at the Hydrogen Plant is dependent on the wind resource, the actual volumes of green hydrogen produced daily will often be below the daily maximum output. While production of green hydrogen is expected to be a 24 hour a day process, the Developer intends to restrict tube trailers from entering and leaving the premises between the hours of 19:00 and 07:00 as part of a wider traffic management plan, full details are in **Chapter 15: Traffic and Transport**.

The green hydrogen production process is outlined in **Graphic 2.1**.



Graphic 2.1: Green Hydrogen Production Process

The Hydrogen Plant production capacity will be scaled up to a maximum 80MW, to meet demand for green hydrogen in the Irish market. The physical infrastructure of the entire Hydrogen Plant as per **Figure 2.2**, (i.e. buildings, roads, water treatment, cooling and fuelling, etc) will be built during a single construction phase with the modular electrolyser system installed in 5 MW batches. The smallest initial batch of electrolyser capacity will be 10 MW. Subsequent electrolyser capacity will be delivered via HGV with no abnormal loads required and no need for further construction works. The subsequent electrolyser capacity will be installed into existing physical infrastructure and integrated into existing electrolyser capacity and ancillary infrastructure such as cooling fans, water treatment.

2.6.6.2 Health and Safety systems for the Hydrogen Plant

Health and safety has been a key consideration in the design of the Hydrogen Plant, and the approach has incorporated good practice principles such as inherently safer design and the hierarchy of controls. The Seveso III Directive (Directive 2012/18/EU), the main EU legislation dealing specifically with the control of onshore major accident hazards involving dangerous substances, along with the Chemical Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 which implements the SEVESO directive, applies to the hydrogen produced at the Hydrogen Plant. The ATEX Directive (Directive 1999/92/EC) which sets out a system of precautions and controls to be put in place where explosive atmospheres may be present due to flammable dusts vapours or gases. The ATEX Directive is transposed into Irish Legislation by Part 8 of the Safety, Health and Welfare at Work (General Application) Regulations 2007 and these regulations also apply to the Hydrogen Plant. Strict ignition controls (relevant design standards can be found in **Table 2.4**) have been incorporated into the design of the Proposed Development in line with COMAH and ATEX regulations, these are explained in more detail in **Chapter 16: Major Accidents and Natural Disasters**. Hydrogen is the primary substance of concern, there are no other substances of quantities that would be relevant to COMAH or ATEX.

The Hydrogen Plant is expected to be designated a lower-tier COMAH site due to the provision of 26 tube trailer bays onsite, which based on current tube trailer technology could store a total of 31.2 tonnes of hydrogen at any one point in time. Maximum onsite capacity to store hydrogen is 40.128 tonnes, with 26 filled tube trailers occupying the tube trailer bays, plus 7 filled tube trailers, one at each of the filling stations plus the buffer tank capacity of 528 kg. The upper-tier threshold is 50 tonnes.

Design standards specific to hydrogen production facilities (NFPA 2, NFPA 55, ISO 22734, ISO 19880 and ISO 15916 as shown in **Table 2.4**) have been used throughout the preliminary design phase and regulations and separation distances required by industry good practice have been incorporated into the design. Site specific safety measures in accordance with COMAH, ATEX, Safety, Health and Welfare at Work Act and Regulations and other relevant standards and codes will be in place for the full life of operation. An outline Major Accident Prevention Policy has been prepared and is included in **Appendix 16.2**. An Emergency Response Plan (recommended, not required for lower-tier COMAH sites) will be produced for the plant. A risk management programme, ATEX Assessment and Safety Management System will be in place for the facility.

Safety equipment installed will include:

- Leak/fire detection + isolation/automatic shut-off
- Emergency stops
- Building ventilation (passive + active)
- Piping pressure/flow rate monitoring
- Impact sensors at dispensers
- Audible and visual alarms
- Fire protection and suppression equipment
- Pressure-relief systems will be installed on relevant equipment.
- 24 hour monitoring by staff

Consultation with the Health and Safety Authority of Ireland and the Sligo Fire Service was undertaken during the design phases. Their comments and recommendation for the design and operation of the Hydrogen Plant are included in **Chapter 1: Introduction Section 1.10.2.**

The detection system in place at the Hydrogen Plant will be capable of detecting hydrogen gas or hydrogen fire and a Supervisory Control and Data Acquisition ("SCADA") system will monitor the facilities performance. Fire-fighting systems will include alarms, water spray deluge systems, sprinkler systems, carbon dioxide suppression systems and mobile fire protection equipment in accordance with the relevant codes and standards shown in **Table 2.4.**

Water for firefighting purposes will be contained within two dedicated fire water storage tanks of 636 m^3 designed for 120 minute operation in the event of a fire. These will have sprinkler and manual hose operation. This will be reviewed during further design stages.

The Hydrogen Plant Site location is a significant distance from most receptors. The public would have no access to the Hydrogen Plant. The nearest public road L-6611-1 is 600 m to the west and the nearest buildings which are not associated with the facility are 299 m away.

Tube trailers (described in **Section 2.6.6.11**) and the high pressure storage tanks (described in **Section 2.6.6.9**) will be designed to standards shown in **Table 2.4** and will be filled by a trained and competent professional.

Limiting the volume of hydrogen stored on site mitigates accidents. Should external factors limit the removal of hydrogen from the Hydrogen Plant Site for transportation, a shutdown system will stop production in order to stay within COMAH lower tier regulation volumes. To prevent loss of oxygen containment increasing fire risks, the oxygen systems would be physically separated from the hydrogen systems and stores of any combustible materials in line with good practice design standards.

Chemicals stored at the Hydrogen Plant include:

- Potassium Hydroxide (KOH) for the electrolysis process (lye) stored as a 25 % KOH solution bunded in tanks within the electrolyser building. Potassium hydroxide is used only in the closed-loop electrolysis process and will not enter the waste water stream.
- Oils used by hydraulic systems, compressors and transformers and diesel, stored in a bunded area with oil separator drainage.
- Sodium bisulphite ($NaHSO_3$) for the de-chlorination of mains water, should it be used. Typically provided in a 1,000 litre tote. Dosage and therefore replenishment periods will be dependent on selected vendors/equipment. Expected levels of treatment that would be required are at most 5 mg/L (5ppm), typically 2-3 mg/L. Sodium bisulphite is regularly used in the treatment of drinking water supplies and is a non-hazardous solution commonly used as a wastewater de-chlorination agent.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e. from build up of salts). Composition will depend on product/manufacturer selected. Typically provided in a 1,000 litre tote. While the specific antiscalant to be used has not been identified, most antiscalants are proprietary organic man-made polymers. These products are considered non-hazardous as defined by the US Occupational Safety and Health Act regulations.
- Glycol for coolant. This is mixed with water, it is not consumed in the process but on site storage is required in case minor system losses need to be replenished.
- Facility cleaning chemicals. Typically provided in a 1,000 litre tote.

All chemicals will be stored in a bunded are on the Hydrogen Plant Site and will be subject to requirements of the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 to 2021 (as amended) and compliance with the requirements of REACH, i.e., European Communities Regulation 1907/2006 for the Regulation, Evaluation, Authorisation and Restriction of Chemicals. Chemicals will be managed in accordance with European Chemicals Agency's Guidance for Downstream Users (2014). Final selection of bulk chemicals will be subject to an assessment of trace elements to ensure that they are within acceptable limits. Storage of large volumes of oils and other hazardous substances will have a secondary containment such as a bund to prevent hydrocarbon contamination to land/water and be separated from any water courses with a buffer of at least 70 m. Waste oils and other chemicals, including oil rags/wipes will be disposed of as hazardous waste. Operational staff will receive training on the handling, containment, use, and disposal requirements for all potentially polluting products on the Hydrogen Plant Site.

2.6.6.3 Water Supply

Water demand requirements for the Hydrogen Plant will be variable month to month depending on wind energy production, the utilisation of the energy and the utilisation capacity at the Hydrogen Plant. As a result, the Hydrogen Plant will have largest demand in February due to the highest wind resource, with lowest volumes in summer months. Proposed water demand figures are shown in **Table 2.6.**

Table 2.6: Water Demand

Month	Water Demand (m3)
January	6,404
February	7,525
March	5,748
April	4,707
May	4,750
June	4,534
July	3,264
August	4,324
September	4,775
October	6,333
November	5,773
December	6,883
Total Annual Demand in M^3	65,021
Litres / day	178,140
Litres / hour	7,422
Litres / minute	124
Litres / second	2.06

This gives an annual average water budget of 65,021 m^3 (or an average of 178 m^3 per day) of untreated water is required for hydrogen production. Water usage patterns will be dependent on the electricity produced by the Wind Farm i.e. higher volumes of green hydrogen produced when wind speeds are higher.

A number of potential sources of water for the hydrogen production process were considered:

- Abstracting groundwater by drilling boreholes and combining with a rainwater harvesting system
- Abstracting water from a nearby watercourse
- Desalination and transporting water in
- Connection to watermain from local group water scheme

It was considered that taking water from nearby watercourses could potentially impact aquatic ecology and downstream hydrology, aquatic ecosystems and fishing. Transporting water in would have negative impacts to traffic and transport and introduce higher emissions from vehicles.

Groundwater abstraction by borehole combined with rainwater harvesting was deemed to be the most suitable method of obtaining water for the plant. **Chapter 3; Alternatives Considered**, section 3.12.4 provides more details on the options considered, the full impact assessment can be found in **Chapter 9 Hydrology and Hydrogeology**.

Water demand and supply:

- Annual average water budget for electrolyser 65,021 m^3 per year.
- Total water available from groundwater abstraction and rainwater harvesting approximately 125,490 m^3 per year.

The Proposed Development will provide 15,057.7 m^3 of underground storage capacity to be maintained using a combination of ground water and rainwater, with an attenuation void to be maintained for 1 in 100 year rainfall events. There will also be a back-up connection to Uisce Éireann with a metered water supply to the Hydrogen Plant. This contingency option could be used in the event of prolonged drought conditions. An application was submitted to Uisce Éireann for a new connection and confirmation was received that the connection is feasible for the required quantity of water.

RSK Group Limited was commissioned by the Developer to carry out a groundwater supply assessment for the water supply for the Hydrogen Plant (Report is available in **Appendix 9.8**). The report assesses the capacity of the ground water and rainwater harvesting to supply the Proposed Development with the required volume and quality of water without impacting nearby water supplies or the aquifer.

Eight boreholes were drilled onsite as part of the site investigations. Water strikes were noted in two boreholes (BH6 and BH7) which were subsequently selected for pump testing. A constant rate discharge pumping test commenced on the 11/07/2022 and pumping continued until the 03/08/2022 (546 hours of pumping in total).

Sustainable yields of 2.25 Litres per Second (l/s) (194 cubic metres per day (m^3/d)) and 0.44 l/s (38 m^3/d) have been established for boreholes 6 and 7, respectively, with a cumulative yield of 232 m^3/d (84,680 m^3/year) which is consistent with the two boreholes being able to meet the water demand of the plant (annual average water budget of 65,021 m^3 or 178 m^3/d).

A neighbouring well at an adjacent dairy farm, used for agricultural purposes was monitored for the duration of the pumping test and recovery period, results are consistent with the pumping having little discernible impact on the well.

The Developer will follow the Environment Agency's modified 8 step Hydrogeological Impact assessment methodology set out in Section 8 of the Groundwater Supply Assessment report, to monitor and mitigate the Proposed Development's impact on sensitive receptors due to groundwater abstraction for the production of green hydrogen.

Rainwater harvesting will reduce the demand of ground water abstraction. Calculations show that an average of 18,275 m^3 of water per year could be harvested from the electrolyser building roof. An additional 33,751 m^3 rainwater per year could be harvested from the remaining non-roofed area. This totals 50,026 m^3 per year from rainwater, accounting for 80% of the entire annual water demand.

Two underground water storage reservoirs will be installed onsite with a combined capacity of 12,815.64 m^3 volume of water which would meet the requirements of the Hydrogen Plant for between 2 and 3 months depending on the time of year. The key water metrics for the Hydrogen Plant are shown in **Table 2.7.**

Table 2.7: Key Water Figures

	Per Year m^3	Per Day m^3
Abstraction Bore Hole 1 during pump tests	70,956	194
Abstraction Bore Hole 2 during pump tests	13,870	38
Rainwater Harvesting		
Roof	18,275	50.07
Non-Roofed Areas	33,751	92.47
Total Water Availability	**136,852**	**374.94**
Hydrogen Plant Site Water Requirement	**65,021**	**178**

Hydrochemical testing on the groundwater was carried out during site investigations, the results show that the water quality is suitable for the electrolysis process following water treatment.

The conclusion of the Ground Water Supply Assessment, that can be found in **Appendix 9.8**, was that the two boreholes can supply the expected water demand of the Hydrogen Plant Site without depleting the aquifer or impacting the wells nearby.

The Groundwater Supply Assessment Report is attached in **Appendix 9.8**, **Chapter 9: Hydrology and Hydrogeology** further addresses this.

2.6.6.4 Water Storage Tanks

Water extracted from groundwater and from rainwater harvesting will be stored in two separate circular underground precast concrete storage tanks, each with a diameter of 45.65 m and a depth of 5 m. Allowing for a 400 mm freeboard, each has a volume of 7,529 m^3. The tank storing the rainwater will include a void for attenuation of 1 in 100 year run off, leaving 5,287 m^3 of volume available for rainwater storage. The total gross storage is 15,057.7 m^3, the usable storage providing for 1 in 100 year attenuation void is 12,816 m^3. These will be located under the tube trailer parking area (Shown in Drawing No. 6129-PL-804).

This provides a total of 12,816 m^3 volume of water, which is stored before it is fed into the water treatment process. This acts as a feed tank, providing a backup water supply which would meet the requirements of the Hydrogen Plant for between approximately one and a half months and four months, depending on the month of the year. This is then fed into the water purification unit. The demineralised water will then be stored in a water storage tank size of 42 m^3.

Two no. 636 m^3 above ground fire water storage tanks designed for 120 minute operation each in the event of a fire, located on the Hydrogen Plant Site access road and Shown in Drawing No. 410135-3000-G1000, will be constructed. These will have sprinkler and manual hose operation.

2.6.6.5 Water Treatment Equipment

The site investigations show the water available at the Hydrogen Plant Site is of sufficient quality to be used in the water treatment system to produce the high purity, demineralised water required for electrolysis. The water treatment process takes place in the water treatment building which measures 31.4 m by 14 m and 13.4 m high and is located in the northeast of the Hydrogen Plant Site and shown in Drawing No. 410135-1000-A4001. The process includes double pass Reverse Osmosis (RO) and Continuous Electrodeionization (CEDI).

The demineralized water treatment system will consist of two no. 100 percent capacity RO-CEDI trains. The demineralized water treatment system receives water from the feed water storage tank to the RO cartridge filters to reduce suspended solids. Antiscalant is fed upstream of the cartridge filters to prevent scaling of the RO membranes. Antiscalant composition will depend on product/manufacturer selected, and is typically provided in a 1,000 litre tote. Dosage and replenishment periods will be dependent on selected vendors/equipment and will be confirmed at procurement stage. Sodium bisulphite is fed upstream of the cartridge filters to remove free chlorine residual and protect the RO membranes from oxidation. This is typically provided in a 1,000 litre tote. Dosage and therefore replenishment periods will be dependent on selected vendors/equipment and therefore cannot be determined at this stage. Feed water from RO cartridge filters then directs to the RO units. The RO reject flow is directed to the wastewater collection sump.

Product water from RO units will be stored in the RO product water storage tank. This tank is for a control break point between the RO equipment and CEDI equipment. The CEDI units further reduce dissolved solids from the RO product water. The CEDI units are fed from the CEDI feed pumps, which also provide RO product water to a shared RO/CEDI clean-in-place (CIP) skid and provide RO product water for RO flushing. Electric current passes through the CEDI cells, which polishes the RO product water to produce high purity demineralized water. The CEDI product is delivered to the demineralized water storage tank. CEDI reject flow is recycled to RO feed.

Control of the demineralized water treatment system will be through the Programmable Logic Controller (PLC) based control system. Water efficiencies are expected of 75 percent and 92 percent for the RO and CEDI stages, respectively which means that 8-25% will be wastewater which will be treated and discharged.

Wastewater

A wastewater collection sump serves as a collection point for the following wastewater:

- Wastewater from water treatment system includes water treatment reject, non-chemical rinse/ drains.
- Oil/water separator discharge

The wastewater collection sump is equipped with two full capacity vertical sump pumps. The wastewater collection pumps are automatically controlled by sump level and pump the wastewater to the plant discharge header, this process is typically used for such plants and is in line with best practice. Wastewater from the RO/CEDI process will be discharged to the constructed wetland treatment system, see **Section 2.6.6.6**.

The RO and CEDI equipment will be regularly maintained and cleaned. Typical cleaning chemicals are citric acid or sodium hydroxide, but chemicals are tailored to what is fouling the system. Citric acid will be contained in 50 kg bags and Sodium Hydroxide in 20 litre palls. The chemical cleaning is done off-line and is expected to be needed every 3-6 months. The cleaning solution will be collected in the tank of 1500 to 2000 litres and disposed of off-site to a licenced facility. Chemical storage containers, and chemical feed pumps will be located in concrete secondary containments built to 110% volume. Secondary containments will be provided with valved drains that are normally closed. The containments will be monitored for chemical spills using level indicators with alarms. If a chemical spill occurs, the operator will use mobile sump pumps to collect the spill and transport to disposal offsite at licenced facilities. Uncontaminated water collected in the containment area will be drained to the wastewater collection sump which is monitored, see section 2.6.6.6 below.

2.6.6.6 Wastewater Discharge

Source water will be treated as part of the hydrogen production process. The wastewater arising from this process will be treated through constructed wetlands and regulated discharge rates before being discharged to the Dooyeaghny River to the south of the Hydrogen Plant. The wastewater generated from the water treatment process will be variable month to month depending on wind energy production, the utilisation of the energy and the utilisation capacity at the Hydrogen Plant. As a result, the Hydrogen Plant will have largest volumes of wastewater generated in February, with lowest volumes in summer months. This is also generally in line with rain fall trends throughout year. Predicted Wastewater Rate per Month is shown in **Table 2.8.**

Table 2.8: Predicted wastewater from Hydrogen Plant per month.

Predicted Wastewater Rate per Month					
Month	**Avg Waste Water (m^3)**	**m^3/day**	**m^3/hour**	**1/hour**	**L/s**
Jan	1,726,89	55.71	2.32	2320	0.64
Feb	2,029.27	72.47	3.02	3020	0.84
Mar	1,550.09	50	2.08	2080	0.58
Apr	1,269.43	42.31	1.76	1760	0.49
May	1,281.02	41.32	1.72	1720	0.48
Jun	1,222.71	40.76	1.7	1700	0.47
Jul	880.17	28.39	1.18	1180	0.33
Aug	1,165.98	37.61	1.57	1570	0.44
Sep	1,287.65	42.92	1.79	1790	0.5
Oct	1,707.79	55.09	2.3	2300	0.64
Nov	1,556.83	51.89	2.16	2160	0.6
Dec	1,855.96	59.87	2.49	2490	0.69
Min	880.17	28.39	1.18	1,180.00	0.33
Max	2,029.27	72.47	3.02	3,020.00	0.84
Mean	1,461.15	48.20	2.01	2,007.50	0.56
Total	17,533.79				

Peak average wastewater equates to 3.04 m^3/hour or c. 0.84 L/s (February). Wastewater will be treated and managed through passive nature based solutions, including constructed wetlands and overland discharge.

There are two wastewater streams from the Hydrogen Plant;

- Hydrogen process wastewater
- Welfare (toilets, canteen etc)

This wastewater will be treated by means of a septic tank (welfare waste) and series of constructed wetland and regulated discharge (combined welfare and processes wastewater). When using abstracted groundwater, the hydrogen water treatment process will treat raw water with 70% efficiency, equating to c. 100% of the mineral or chemical constituents per volume in the raw water concentrated in to 30% of the volume abstracted. Apart from the discharge of the trade effluent from the Hydrogen Plant and effluent from welfare facilities on site, there are additional risks to aquatic environment from the accidental spillage or release of chemicals or other pollutants. A range of chemicals will be used within the Hydrogen Plant which include:

- Potassium Hydroxide (KOH) for the electrolysis process (lye).
- Sodium bisulphite for de-chlorination of mains water, should it be used for process.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e. from build-up of salts and calcite).
- Glycol for coolant.
- Oils used by hydraulic systems, compressors and transformers and diesel,
- Facility cleaning chemicals.

As all chemicals used in the Hydrogen Plant Site will be stored in bunded facilities in accordance with specified legislation (Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 to 2021), the risk of accidental spillage or release is considered to be unlikely.

Potassium hydroxide and glycol are used only in the closed-loop electrolysis process and will not enter the wastewater stream. As the source water for the Hydrogen Plant will be groundwater or rainwater, this should be free of chemicals or dangerous substances. Sodium bisulphite will only be used if mains water is used in the process which would require de-chlorination. In large quantities sodium bisulphite can depress pH and dissolved oxygen, causing mortality of fish. However, expected levels of treatment that would be required are at most 5 mg/L (5ppm), typically 2-3 mg/L. Sodium bisulphite is regularly used in the treatment of drinking water supplies and is a non-hazardous solution commonly used as a wastewater de-chlorination agent. While high concentrations will contribute to elevated chemical oxygen demand in aquatic environments, but it is subject to rapid biological decomposition. Antiscalants will be used in small quantities to prevent/reduce scaling of water treatment equipment and therefore is likely to occur in the wastewater stream. While the specific Antiscalant to be used has not been identified, most antiscalants are proprietary organic man-made polymers. These products are considered non-hazardous as defined by the US Occupational Safety and Health Act regulations.

The wastewater arising from the Hydrogen Plant will be treated through constructed wetlands and regulated discharge rates before being discharged to the Dooyeaghny River to the south of the Hydrogen Plant. Unmitigated discharging to surface waters will potentially impact adversely on the receiving surface water quality and potentially human health if these enter drinking water supplies.

The water treatment process, controls to avoid risks of accidental spillage or release of chemicals, controlled discharge and assimilative capacity of the receiving waters will mitigate this risk. Groundwater and surface water quality, levels and discharge rate in the receiving river will be monitored on a routine and continuous basis. A wastewater storage tank, sized c.1,500 m^3 will be constructed to achieve the ability to stop discharging to constructed wetlands or surface water completely for a minimum duration of one month. This means that should contaminants that could potentially impact human health be found in the wastewater discharge, the discharge can be halted and wastewater stored and recirculated until acceptable levels are attained or taken off site for disposal at registered waste water treatment facilities.

This potential impact will be mitigated with wastewater treatment and controls.

The two wastewater streams will initially be dealt with separately. Welfare wastewater will be run through a septic tank, and then through a welfare constructed wetland (WCW). The WCW will be positioned in the northeast corner of the site and will be approximately 80 m^2 to facilitate the required retention time of c. 12 days to adequately treat the welfare effluent loading.

The outfall of the WCW will be combined with hydrogen process wastewater in storage. The combined wastewater will be pumped to a secondary series of process constructed wetlands (PCW). The remaining area on the site will be utilised to maximise area of PCW and retention time. The PCW will achieve a minimum of 6 days retention time. (This is lower than the required retention time for loading in line with welfare facilities, however the loading from process wastewater will be significantly less than that of welfare wastewater of sewage).

The treatment train flow diagram can be seen in **Appendix 9.7.**

A wastewater storage tank, sized c.1500 m^3 located to the south of the water treatment building, will be constructed to achieve the ability to stop discharging to constructed wetlands or surface water completely for a minimum duration of one month, without having to stop the production process. In line storage throughout the process will facilitate buffering flow and discharge rates. This includes wastewater storage with a view to buffering inflow and regulating discharge from wastewater treatment works on site.

Any particular contaminant which is observed to be excessively high in incoming source water will be targeted with specific wastewater treatment.

Groundwater quality will be monitored on a routine / continuous basis with a view to establishing site specific baseline water quality ranges managing source water and process water chemistry. Surface water quality will be monitored on a routine / continuous basis with a view to establishing site specific Q95 and baseline water quality ranges, and managing source water and process water chemistry. Groundwater levels will be monitored continuously. Surface water levels and discharge rate in the receiving river will be monitored continuously. Continuous monitoring through the life of the Project will be used to review and update methodologies wherever appropriate.

2.6.6.7 Cooling System Requirements

The electrolysis process generates heat through voltage losses. Cooling is required to maintain optimum operating temperatures. In addition, hydrogen is heated during the compression stages and therefore cooling is required for the safe operation of the installed compressors. A fin fan cooling system will be used, these comprise of fans that utilise air as the cooling medium. A system comprising of nine fin fan cooling modules, each with three fans, has been incorporated into the system design and located adjacent to the electrolyser building. This is based on modelling of the cooling requirements for an 80 MW system and compressors. The system is design with an element of redundancy. The fin fan coolers are modular and therefore can be installed in blocks as the Project capacity increases up to the maximum 80 MW electrolyser capacity.

2.6.6.8 High Pressure Compressors

It is proposed that hydrogen will be produced at an outlet pressure of 30 bar from the electrolyser package. A temporary storage pressure of 500 bar will be used for the buffer tank, therefore, further compression will be required. Two high pressure compressors (operational and standby for redundancy) have been incorporated into the plant design and will increase the pressure from 30 bar to 500 bar. The compressor will be contained within an enclosure to mitigate noise located adjacent to the electrolyser building, the position and enclosure details can be seen on Drawing Nos. 410135-1000-G1000 and 410135-1000-A4006. Acoustic fencing could also be added to further reduce noise if required. **Chapter 11: Noise** assesses the potential noise impacts.

2.6.6.9 Hydrogen Buffer Tank

Given the potential variable output of the electrolyser, a buffer tank system has been incorporated into the plant design. The buffer tank will include multiple racks of high-pressure (500 bar) cylinders, 36 no. type IV cylinders of 11.5 m in length will be used. These will be arranged as 3 high stacks (1.6 m in height) with 12 rows in a series.

2.6.6.10 Dispensing Station

The hydrogen buffer tank will be connected to a dispensing station for the off-take of hydrogen via tube-trailers. The dispensing station will include a 2 m wide, 1 m high platform with 7 no 4.5 m wide vehicle filling bays and associated dispensing equipment (controls, hose, nozzle), shown in Drawing Nos. 410135-1000-G1000 and 410135-1000-A4002. The dispensing station will deliver hydrogen from the buffer tank at 500 bar to the tube-trailers at 380 bar. It will be designed to prevent hydrogen from leaking and will have a system built in to shut down the flow of hydrogen if a leak is detected in line with design standards EIGA IGC 15/06 and ISO 19880 and those shown in **Table 2.4**).

2.6.6.11 Compressed Gas Tube Trailers and parking

The off-take method selected for transporting the green hydrogen is via road by high-pressure multiple cylindrical tube-trailers. Based on currently available technology and market direction, composite type four vessels will be the industry preferred option. Tube trailers have fitted temperature and pressure sensors that can be monitored remotely, and detailed telematics solutions monitor vehicle and driver performance. A design pressure of 380 bar has been selected. This equates to a useable hydrogen storage of c. 1,200 kg per 40 ft tube-trailer. Based on the electrolyser output capacity and available wind energy, a maximum of 26 tube-trailers would be required to off-take 24 hours of production. Alternatives were considered including transportation by pipeline and cooled and liquified hydrogen transport by road, more detail can be found in **Chapter 3: Alternatives**.

There will be parking for 26 tube-trailers, this will largely be for trailers waiting to be filled, but could include full trailers prior to leaving the facility. As per industry best practice, the parking area is set back by a minimum of 11 m from equipment and buildings for health and safety. There is a 'sick bay' area which will be used to isolate damaged tube trailers away from other equipment/vehicles prior to repair/removal. No more than 50 tonnes of green hydrogen will be stored at the facility at any one time to ensure compliance with lower-tier COMAH requirements. This includes hydrogen stored in the buffer tank and residual hydrogen in the electrolyser and piping network as well as the potential for 7 tube full capacity tube trailers at each of the filling stations. The quantity of hydrogen stored onsite will be monitored. If there is a reason that trailers cannot leave the site, eg poor weather conditions, hydrogen production will cease to ensure onsite storage does not exceed 50 tonnes.

2.6.6.12 Hydrogen Transportation

The green hydrogen will be transported from the Hydrogen Plant Site using tube trailers, the impact of this on the local road network is assessed in **Chapter 15: Traffic and Transport**. Tube trailers are currently used to transport a number of compressed gas products on Ireland's roads including natural gas, compressed air, nitrogen and oxygen. It is anticipated that tube trailers, powered by zero emissions green hydrogen will be used to transport green hydrogen resulting in no CO_2 or NO_x pollutants, these vehicles only emit water vapour and heat. However, it is recognised that these may not be commercially available or commercially competitive when hydrogen production commences at the Proposed Development, if this is the case then diesel vehicles will be used until hydrogen fuelled vehicles become viable.

The capacity of the hydrogen tube trailers is proposed to be 1,200 kg of hydrogen at 380 bar pressure. These are specifications currently offered by vendors but are not common in the UK and Irish market at the time of writing. It is a working assumption that as the hydrogen market develops, the tube trailer market will also evolve. 380 bar has been selected as the offtake pressure as it was considered a reasonable assumption of the likely distribution pressure common in the market by the time the plant is operating. This assumption results in a maximum predicted number of tube trailers filled with hydrogen leaving the Hydrogen Plant Site per day of 26 when the full capacity of 80 MW is installed. The daily average will be 11. Daily average is based on annual estimated hydrogen production divided by capacity of tube trailers divided by 365 days. Maximum number of tube trailers, filled with hydrogen, leaving the Hydrogen Plant Site is based on maximum daily hydrogen production divided by capacity of tube trailers.

If the Hydrogen Plant was to commence operation with an initial 10 MW of installed electrolyser capacity, the maximum daily hydrogen production would be 4,000 kg. Hydrogen distribution and refuelling trailers currently in operation in the U.K. can hold 384 kg of hydrogen at 380 bar, this gives a maximum daily number of hydrogen trailers, filled with hydrogen, leaving the Hydrogen Plant Site of 11.

However, in practice, maximum daily hydrogen production would rarely be achieved due to the intermittent nature of the input energy source. The wind energy may also be exported to the grid rather than used to produce hydrogen at certain times (depending on commercial aspects such as balancing grid electricity and hydrogen production demands). With all of these factors considered, the maximum number of hydrogen tube trailers, filled with hydrogen, leaving the Hydrogen Plant Site of 26 per day is not expected to be exceeded during the life of the Hydrogen Plant. Daily tube trailer departures from the Hydrogen Plant Site of 26 per day has been adopted in this EIAR as a 'worst-case', conservative approach to the detailed assessment of the potential effect on each of the environmental factors.

EU Directives which are relevant to the movement and transportation of hydrogen include:

- Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods. This Directive applies to the transport of dangerous goods by road, by rail or by inland waterway within or between Member States, including the activities of loading and unloading, the transfer to or from another mode of transport and the stops necessitated by the circumstances of the transport.
- Directive 2010/35/EU, the Transportable Pressure Equipment Directive (TPED) – This Directive applies to the design, manufacture, conformity assessment and periodic reassessment of transportable cylinders, tubes, cryogenic vessels and tanks for transporting gases.
- International Carriage of Dangerous Goods by Road (ADR); a European Agreement concerning the international carriage of dangerous goods by roads

In Ireland, The European Communities (Carriage of Dangerous Goods by Road and Use of Transportable Pressure Equipment) Regulations 2011 to 2021, as amended, apply to the transport of dangerous goods by road in tanks, in bulk and in packages and give effect to Directive 2008/68/EC, Directive 2010/35/EU and the ADR. This includes the consignment, packing, loading, filling and unloading of the dangerous goods in relation to their carriage. They apply the provisions contained in the technical Annexes to the "Agreement Concerning the International Carriage of Dangerous Goods by Road" (ADR).

Tube trailers cylinders are designed to withstand impacts and the trailers have fitted temperature and pressure sensors that can be monitored remotely. Detailed telematics monitor vehicle and driver performance to ensure road safety.

2.6.6.13 Additional Equipment

For the hydrogen production and storage system, transformers will be required to step down the voltage from the Wind Farm substation to 33 kV before use within the Hydrogen Plant. The electrolysers require low voltage, high amperage power, while the rotational equipment (e.g. compressors) require medium voltage power. The largest power consumer is the electrolyser, however, ancillary systems such as the fin fan cooler, compressors and pumps also require power. Hydrogen production equipment will be powered by the Wind Farm. A low voltage grid supply to the Hydrogen Plant is required to maintain essential services, such as lighting and monitoring systems. A lighting plan for the Hydrogen Plant will be designed in compliance with current lighting standards, in the detailed design phase. The Developer has begun engaging with Mayo Dark Skies and will look to incorporate suggested lighting proposals during the detailed design phase in order to reduce excess light pollution. For example, the use of down lighting, energy efficient lighting, movement sensors, selecting area sensitive tones, minimizing lux levels to required standards, unoccupied zones to be unlit to limit excess illumination of the surrounding area. The auxiliary load for equipment to operate the remainder of the plant is estimated to be approximately 10% of the electricity requirement.

2.6.6.14 Welfare facilities

The raw water storage tanks will be used as the source of water for toilet facilities at the Hydrogen Plant Site. A potable water supply will be brought to the Hydrogen Plant Site via connection to the Uisce Éireann mains. Wastewater from the staff welfare facilities in the control building will be run through a septic tank, and then through a welfare constructed wetland (WCW). The WCW will be positioned in the northeast corner of the site and will be approximately 80 m^2 to facilitate the required retention time of c. 12 days to adequately treat the welfare effluent loading. The outfall of the WCW will be combined with hydrogen process wastewater in storage. The combined wastewater will be pumped to a secondary series of process constructed wetlands (PCW) of 800 m^2. The PCW will achieve a minimum of 6 days retention time. It is then discharged to the watercourse to the south of the site under an EPA discharge licence which will be applied for post consent.

2.6.6.15 Demolition of sheds and dwelling and construction of new dwelling

The demolition of agricultural shed C and partial demolition of agricultural shed B is required for the Proposed Development. Demolition of an existing dwelling and agricultural sheds D and E and the demolition of the remainder of shed B will be required as part of the Project and has been assessed in this EIAR but does not form part of the present application and will be subject to a separate application for planning permission.

These are shown in Drawing No. 6129-PL-121 and are located off the L-6612-1, adjacent to the new roundabout leading to the Hydrogen Plant Site access road. Demolition works will be undertaken by a licensed contractor and all wastes will be dealt with according to the waste hierarchy and where possible materials will be sent for recycling and reuse. All wastes will be removed to a licensed waste facility by a licensed contractor.

The Project includes the construction of a dwelling in the townland Carraun, with associated access road, car parking, agricultural shed, landscaping, boundary treatments, site services, drainage works and all associated infrastructure located off the roundabout leading to the Hydrogen Plant Site, as shown on Drawing No. 6129-PL-121. The site is currently a greenfield site used for horse grazing. The proposed construction is envisaged to consist of conventional foundations with some local excavations for services. The dwelling is proposed to be a three bedroom bungalow with a natural local stone finish with a gross floor area of circa 150 m^2.

Key construction activities will include;

- Demolition of existing structures
- Site Clearance
- Stripping topsoil
- Placing foundations
- Building works
- Boundary erection
- Connection to existing services
- Hard surfaces and roads
- Finishes
- Landscaping

The layout of the dwelling and sheds has been designed using best practice principles to enhance the durability and function of the site, while minimising its visual intrusion where possible.

2.6.7 Proposed Development Access

As part of the Proposed Development, a new site entrance to the Wind Farm Site is proposed, which is located in the townland of Carrowleagh, from the local road (L-5137-9) that runs along the western side of the Wind Farm Site and will be used for both wind farms during operation. This is shown in **Drawing No. 6129-PL-113**.

The Wind Farm Site is accessed from the west by a series of local roads. The N59 National Secondary Road is the main Ballina to Sligo road and lies five km to the northeast of the Wind Farm Site at its nearest point. The R294 Regional Road that runs between Ballina and Tobercurry is situated 2.5 km to the south of the Wind Farm Site.

The transportation routes are shown in **Figure 2.6** and consist of:

- **Turbine delivery routes**

  It is intended that the port of entry for the large turbine components will be either Killybegs Port or Galway Port.

  Killybegs Turbine Delivery Route; From Killybegs Port the turbine nacelles, tower hubs and rotor blades will be transported to the N56 some 4 km northeast of the harbour. The route primarily follows the national road network namely the N56, N15, N4 and N59 before turning left onto the local roads L-2604-0, L-5137-0 and L-5137-9 towards the Wind Farm Site entrance.

  Galway Turbine Delivery Route: From Galway Port the turbine nacelles, tower hubs and rotor blades will be transported to the N83 some 3 km north of the harbour. The route primarily follows the national road network namely the N83, N17, N5, N4 and N59 before turning left onto the local roads L-2604-0, L-5137-0 and L-5137-9 towards the Wind Farm Site entrance.

  Whichever turbine delivery route is selected, temporary works will be required to accommodate the delivery of the turbine components and will include the following;

  - Improvement of the N59 and L-2604-0 junction in the townland of Ballymoghany to include for the temporary widening of it. The associated accommodation works will include the installation of new drainage pipes, the construction of a 1.2 m high concrete retaining wall and the erection of timber stock proof fencing and 2 no. agricultural gates.
  - Localised widening of the L-2604-0 road in the townland of Cloonkeelaun. The associated accommodation works will include the construction of a 1.2 m high concrete retaining wall and the erection of concrete post and timber rail stock proof fencing and 2 no. agricultural gates.
  - Localised widening of the L-2604-0 in the townland of Muingwore and the L-5137-0 and L-5137-9 in the townland of Carrowleagh.

If the Galway Turbine Delivery Route is selected the following upgrade works would be required to facilitate the delivery of abnormal loads and turbine component deliveries:

- At the N17/N5 roundabout south of Charlestown in the townland of Ballyglass East requires road widening, street furniture removal and tree pruning on both the offside and nearside areas.
- The connecting road junction with the N5 south of Charlestown in the townland of Bracklagh requires road widening on the nearside of the junction, 2 lampposts to be removed, road signage to be removed and tree pruning on both sides of the roadway.
- At the N5 junction with the unnamed road towards the L-1331 in the townland of Cloonmeen West requires the embankment on the nearside of the junction to be excavated and tree removal at the near side.
- The junction of the unnamed road and L-1331 townland of Lavy More requires signposts on both sides of the junction to be removed, a telegraph pole on the offside to be removed and tree pruning is required on both sides of the junction.
- Modification of street furniture on the turbine delivery route

- **Wind Farm Site Construction Haul Route**

  There are separate construction haulage routes proposed to and from the Wind Farm Site to mitigate impacts to the local residents. The haul route to the Wind Farm Site leaves the N59 north of Carraun taking local road L-6612, then Knockbrack road (L-6612) for 3.4 km and turning right on to the L-1102 for 400 m. It then turns left on to Emlymoran road (L-5136-0) for 2.6 km before turning right on Stockane road (L-5137-9) for 200 m to the Wind Farm Site entrance.

  The route away from the Wind Farm Site travels back along the Stockane road and Emlymoran road, then turns right on to the L-1102 and follows this for 3.4 km to the N59.

- **Hydrogen Plant Site Access**

  The Hydrogen Plant Site has one site entrance, located 600 metres off the N59. The haul route includes 10 metres of local road L-6612-1 and an entrance to the N59 in the townland of Carraun which will be subject to improvement works, including a new round about and a junction that has been designed in consultation with the County Council Roads Department to provide safe entrance and egress to the facility, shown in Drawing No. 6129-PL-120. These will remain throughout the operational phase of the Proposed Development.

Alternative sites for the Hydrogen Plant were considered, including immediately adjacent to the Wind Farm see **Section 3.5.2** in **Chapter 3: Alternatives Considered** for more detail. The Hydrogen Plant Site location is in close proximity to the national road network (c .600 m) namely the N59 and a junction has been designed to ensure safe access to and from the facility.

Consultation on these transportation routes with the Sligo County Council Roads Department took place on the 24th of August 2022 via a site meeting. No concerns were raised with respect to the proposal presented at the meeting.

The turbine delivery routes have been used for previous wind farm deliveries and is generally suitable for HGVs. However, some passing bays and/or minor improvements will be needed. These have been confirmed as part of the completion of AutoTrack analysis of the route and can be found in **Chapter 15: Traffic and Transportation**.

A compressed air wheel wash facility will be located at the entrances to the Wind Farm Site and Hydrogen Plant Site to ensure that construction vehicles exiting the sites will not drag dirt or other construction materials onto the public road.

It is envisaged that imported hardcore material and concrete will be sourced from local suppliers (**Table 2.9**) and will be delivered using standard Heavy Goods Vehicles (HGV), using the national, regional and local road network in the area. Other material deliveries will also use standard HGVs. Workers employed at the Project will use the site entrances but will need to have flexibility in the roads they use to reach the sites.

Table 2.9: Quarries in the site vicinity

Name	Distance to the Wind Farm Site
Killala Rock	18 km
Frank Harrington	20 km
Maloney Quarries	24 km
Molloy Concrete ltd	13 km

2.6.8 Proposed Development Access Roads

The Wind Farm Site access roads are necessary to allow access for cranes and delivery trucks during construction of the Wind Farm and during servicing/repairs to the wind turbines. The existing bog tracks will be used as far as possible to minimise additional land take. These will be upgraded as necessary so that the minimum width will be 4.5 m. Site access roads will be wider at bends and at passing bay locations where a width of 5.5 m occurs. Gradients will be limited to 1 in 8 (12%) and a stone layer provided to provide a good grip during wet weather.

8,772 m of the existing bog track length will be upgraded and used for the Wind Farm Site. This will require 8,684 m^3 of stone material. There will also be 1,323 m^2 of new site access road required for the Wind Farm Site. These will be constructed to provide a width of 4.5 m and require c. 3,929 m^3 of rock. These will be excavated to a level where the underlying soil or rock that can bear the weight of traffic without shifting or compressing and constructed using rock from local suppliers. The design will consist of 150 mm of Cl. 804 or crushed rock on an average of up to 510 mm capping stone layer. The Wind Farm Site access road construction detail is shown in **Figure 2.7.**

The Wind Farm Site access road layout avoids environmental constraints and follows the natural contours of the land. Every effort has been made to minimise the length of road necessary.

The Wind Farm Site is characterised by peat cutting activities and has an extensive drainage network and is drained by a number of mapped surface water bodies i.e. rivers and streams. New watercourse crossings are associated with the proposed new Wind Farm Site access roads. Existing watercourse crossings are associated with existing Wind Farm Site access roads and will require upgrading.

Watercourse crossings over mapped rivers at the Wind Farm Site include the following;

- Brusna (North Mayo)_020:
    - **WCC1:** Existing culvert; (ITM: 535655.0, 822422.7),
    - **WCC2:** Existing culvert; (ITM: 535962.07, 822192.53),
    - **WCC3:** New; Clear Span Bridge (ITM: 535618.8, 821488.6)

There are a number of identified existing culverts that will also require upgrading at the Wind Farm Site, including:

- **WCC4 and WCC4a:** Existing; (ITM: 536307.9, 820831.0)
- **WCC5:** Existing; (ITM: 536333.6, 820511.8)
- **WCC6:** New; (ITM: 536248.3 821365.5)
- **WCC7:** Existing; (ITM: 536219.8, 821696.3)

- **WCC8:** Existing; (ITM: 535928.1, 822525.1)
- **WCC9:** New; (ITM: 537144.7, 822336.6)
- **WCC10:** Existing; (ITM: 537155.3, 822183.6)
- **WCC11:** New (ITM: 536636.0, 822009.3)
- **WCC12:** Existing; (ITM: 536906.3, 821550.5)
- **WCC13:** New (ITM: 535387.5, 822742.1)

It total, three (3 no.) watercourse crossings over mapped rivers were identified at the Wind Farm Site, an additional 10 no. watercourse crossings were identified over significant drainage features associated with peat harvesting activities. One (1 no.) new watercourse crossing is required, details of this crossing are included in Drawing No. 6129-PL-305. Further to consultation with Inland Fisheries Ireland (IFI) crossings have been designed in accordance with Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters, 2016 as set out in Management Plan 2 of the CEMP (**Appendix 2.1**).

The Hydrogen Plant Site will be serviced by an access road of 515 m in length which will be 7 m wide. This will include an access gate for security and a passing area. A roundabout has been designed in consultation with the Sligo Roads Department to ensure safe entrance and egress to the facility. This can be seen in **Figure 2.8.** The Hydrogen Plant Site access roads have been designed to carry a minimum 12 tonne axle construction loading. The design will consist of 150 mm of 50 mm stone or crushed rock on an average of 400 mm capping stone layer.

The surface of the site access roads for the Wind Farm Site and Hydrogen Plant Site will be maintained during the construction phase. All imported stone to the Proposed Development will have undergone appropriate quality testing. When weathered, the stone will not contain any constituents which may be harmful to the environment, especially surface and groundwater. Further details of the prevention of this can be found in the CEMP in **Appendix 2.1**.

2.6.9 Wind Farm Electrical Substation, Control Building and Associated Compound

Following consultations with EirGrid and a comprehensive assessment of available alternative substation design technologies, it has been determined that the Wind Farm Substation will comprise a 110 kV 'loop-in/loop-out' air-insulated switchroom (AIS).

The Wind Farm Substation will provide a connection point between the Wind Farm and the Grid Connection point at the existing Glenree – Moy 110 kV overhead line. Electricity transmitted between the turbines and the Wind Farm Substation will be at 33 kV. The layout of the Wind Farm Substation and compound is detailed in Drawing No. 05806-DR-232.

The Wind Farm Substation will serve two main functions:

1) Provide housing for switchgear, control equipment, monitoring equipment, and storage space necessary for the proper functioning of the wind farm
2) Allow for metering and for switchgear to connect to the National grid

The construction and electrical components of the Wind Farm Substation will be to EirGrid specifications. The Wind Farm Substation compound will have an overall footprint of 13,892 m^2, and will be constructed from engineered stone material using similar construction techniques (as detailed in **Appendix 2.1**) as for the Turbine Hardstands. The overall compound will be enclosed by a 2.65 m high palisade fence for safety and security reasons. It will contain a 450 m^2 single storey 110 kV substation control building, a 214 m^2 single storey IPP building and all necessary electrical equipment and apparatus to facilitate the export of electricity to the national grid. Ancillary infrastructure located within the footprint of the compound will include electrical apparatus, light posts, lightning masts, one no. 110 kV transformer, and associated internal access road. The layout has been designed fully in accordance with current EirGrid specifications. An example of an AIS substation is given in **Plate 2.1**.

Plate 2.1: Example of a 110 kV AIS Substation

Earthing cable will be laid underground around the Wind Farm Substation for connection to the various electrical components during the electrical fit out phase. Cable ducting will be installed from the end mast to the gantry in the Wind Farm Substation compound. A 110 kV cable chair and associated line equipment will be required to divert the existing Glenree – Moy 110 kV overhead lines into the Wind Farm Substation. The support structures will be located outdoors. These will be positioned in bunded enclosures in the Wind Farm Substation compound. The Wind Farm Substation compound will be surfaced with free-draining crushed stone such that rainwater can percolate to ground. The boundaries of the Wind Farm Substation will be landscaped with native species to reduce any visual effects on the landscape.

The control building will contain a battery room, a control room, a generator room, a meeting room and workshop / store and associated equipment such as incoming and outgoing circuit breakers, earth fault, protection devices, metering equipment, computers and servers, small store, an office and also providing welfare facilities for wind farm staff and maintenance personnel.

The control building will be a single story pitched roof structure with traditional rendered finishes. The appearance and finish of the control building will be similar to an agricultural building with a slated roof and nap plaster finish. It will have a suitably sized footpath around it and an adjacent parking area. The final finish of the control building will be an off-white or grey colour.

Permanent access roads will also be installed to allow trafficking in and out of the Wind Farm Substation compound.

Warning / health & safety signage will be displayed as is normal practice for such installations. Motion sensitive lighting only will be used. A rainwater harvesting system will be installed as the source of water for toilet facilities at the Wind Farm Site. A potable water supply will be brought on Wind Farm Site in bottles. Wastewater from the staff welfare facilities in the control building will be collected in a sealed storage tank, fitted with a high-level alarm. This is a device installed in a fuel storage tank that is capable of sounding an alarm, during a filling operation, when the liquid level nears the top of the tank. All wastewater will be tankered off-site by a licensed waste collector, to a wastewater treatment plant in likely to be in Ballina. There will be no on-site treatment of wastewater at the Wind Farm Site. A telecommunication antenna will be fixed externally to the Wind Farm Substation control building for communication and control purposes (e.g. for the Supervisory Control and Data Acquisition (SCADA) System).

The Wind Farm Substation is to be located within a mature commercial forest which will be felled to facilitate construction. Consideration of the approach to afforestation requirements associated with the Proposed Development is attached in **Appendix 13.1** It should be noted that the clear-felling of trees in the State requires a felling licence. The associated afforestation of alternative lands equivalent in area to those lands being permanently clear felled is also subject to licensing ('afforestation licensing'). The Forest Service of the Department of Agriculture, Food & the Marine is Ireland's national forest authority and is responsible for all forest licensing. In light of the foregoing and for the purposes of the Proposed Development, the Developer commits that the location of any replanting (alternative afforestation) associated with the Proposed Development will be greater than 10 km from the Wind Farm Site and also outside any potential hydrological pathways of connectivity i.e., outside the catchment within which the proposed Firlough Wind Farm is located. On this basis, it is reasonable to conclude that there will be no more than imperceptible, indirect or in-combination effects associated with the replanting. In addition, the Developer commits to not commencing the Proposed Development until both felling and afforestation licences are in place and this ensures the afforested lands are identified, assessed and licensed appropriately by the consenting authority. Further details are included in **Chapter 13: Material Assets.**

2.6.10 Hydrogen Plant Substation

The proposed Hydrogen Plant Substation be located in the southeast corner of the Hydrogen Plant Site. The construction and electrical components of the Hydrogen Plant Substation will be to EirGrid specifications. The Hydrogen Plant Substation compound will have an overall footprint of 3,520 m^2 and will be secured by a 2.6 m high palisade fence, with space to allow for future harmonics filter. The compound will include 1 no. 195 m^2 single storey 110 kV substation control building, 1 no 83 m^2 single storey IPP MV Switch room building and associated outdoor electrical equipment, including 1 no. 33/110 kV transformer. A permanent access road will be constructed to allow site vehicular activity in and out of compound. A telecommunication antenna will be fixed externally to the Hydrogen Plant Substation control building for communication and control purposes (e.g. for the Supervisory Control and Data Acquisition (SCADA) System).

The control building works will consist of foundation works, block work, roofing, low voltage electrical fit out, cladding and building finishing works. The transformer, gantry and structural steelwork will be installed in the transformer compound. One cable sealing end will be installed to incorporate the radial underground circuit in and out of the Hydrogen Plant Substation. The busbar compound structural steelwork will be erected with lightning masts also installed. Substation electrical equipment will be installed once the control building and compound is complete. Fencing will be erected around the compound for security/protection. Adequate lighting will be installed around the compound on the lighting masts within the compound. The Hydrogen Plant Substation will connect via the interconnector underground cable circuits to the Wind Farm Substation. 110 kV cable sealing ends and associated accessories will be required to incorporate the interconnector into the Hydrogen Plant Substation. The support structures will be located outdoors. Transformers will be installed in bunded enclosures within the substation compound.

The electrical installation is expected to take 20 weeks and includes the following:

- Delivery and installation of 33/110 kV transformer. These are unusually large, and the deliveries will be managed in accordance with regulations governing the movement of large loads.
- Delivery and installation of all other HV equipment.
- Wiring and cabling of HV/LV equipment, protection and control cabinets.
- Commissioning of all newly installed equipment.

2.6.11 Wind Farm Site Transformers and Internal Cabling

Each wind turbine will be connected to the Wind Farm Substation via underground Medium Voltage (MV) cables. There will be 13,000 m of internal cabling. Fibre-optic cables will also connect each wind turbine to the wind turbine control system located within the Control Building. The electrical and fibre-optic cables running from the wind turbines to the Wind Farm Substation compound will be run in cable ducts 1 m below the ground surface within the Wind Farm Site access roads and/or their verges.

2.6.12 Underground Cabling; Grid Connection and Interconnector

The Wind Farm Substation will be connected to the national grid by two 110 kV UGC circuits to two tower structures that will intersect with the existing Moy - Glenree 110 kV overhead line. The Wind Farm Substation will be connected to the 110 kV Hydrogen Plant Substation via one additional 110 kV UGC circuit. This will conduct electricity from the Wind Farm to the Hydrogen Plant for electrolysis.

The Grid Connection

The overall length of the Grid Connection between the Wind Farm Substation and the existing Glenree – Moy 110 kV overhead line (OHL) is 6.65 km, of which 250 m is within the Wind Farm Site, 6,040 m is located along the public road corridor and 355 m is located off road in third party lands. The Wind Farm Substation will connect largely with underground cabling, with a minor section of works required in the vicinity of the Tie In towers (see section 2.6.15 and **Plate 2.4**) to allow integration between the Firlough Wind Farm and transmission overhead line. The route of this underground Grid Connection is provided in **Figure 2.9.**

Leaving the Wind Farm Substation, the Grid Connection route follows the access road for 250 m and turns north on to the L-5137-9 for 60 m. The route turns west to converge on to the L-5136-0 where the UG cables will be required to cross beneath existing ESBN cables and existing water utilities. It continues on the L-5136-0 for 2.66 km. It then turns south on the L-1102 for 610 m where it crosses underneath the Loughnagore stream by Horizontal Directional Drill (HDD). It re-joins the roadway, now the L-1102 for 585 m where it crosses the Glenree river by HDD. It continues south for 575 km crossing beneath the Fiddaun Stream by HDD then back into the roadway of the L-1102. It then continues south for a further 1.14 km before crossing the Srafaungal River by HDD then back into the roadway of the L-1102 for 385 m. The route then turns in an easterly direction along a permanent access track for 355 m to the tie in towers beneath the existing Moy to Glenree OHL in the townland of Rathreedane.

The Interconnector

The overall length of the Interconnector Route from the Wind Farm Substation to the Hydrogen Plant Substation is 8.2 km, of which 6.7 km is located along the public road corridor, 0.44 km is in the Wind Farm Site along existing roads and the remaining 1.05 km is located off road in third party lands. Leaving the Wind Farm Substation, the Interconnector Route follows the access road for 435 m and turns north on to the L-5137-9 for 60 m. The route turns west to converge on to the L-5136-0 where the UG cables will be required to cross beneath existing ESBN cables and existing water utilities. It continues on the L-5136-0 for 2.67 km. The Interconnector Route then encounters a T-junction, where it proceeds turning right onto the L-1102 local road which it follows northwest for approximately 400 m. At this point the Interconnector Route keeps left onto the adjoining L-6612 local road. This section requires the traversal of Eir & Water service crossings. The Interconnector Route continues northwest along the L-6612 local road for approximately 735 m before it reaches the L-6612/L-5131 crossroads. The Interconnector Route continues west through the crossroads, remaining within the L-6612 local road for an additional 2.47 km. Along the L-6612 local road, the Interconnector Route crosses the Brusna River by HDD. The Interconnector Route then changes direction, heading southwest via the L-6612-1 local road for the final section within the public roadway, circa 360 m in length. The Interconnector Route leaves the public roadway, utilizing the proposed 110kV Hydrogen Plant Site access track, traveling southeast for approx. 1.05 km before reaching the Hydrogen Plant Substation. The route is shown in **Figure 2.10.**

Underground Cabling Construction Methodology

The proposed Wind Farm Grid Connection double circuit sections of UGC will consist of two circuits of three No. 200 mm diameter HDPE power cable ducts and two No. 125 mm diameter HDPE communications duct to be installed in excavated trenches. Each trench will typically be 825 mm wide by 1425 mm deep. The cable ducts will accommodate one No. power cable per duct. Horizontal directional drilling and remedial works in the vicinity of pole sets 15 and 16 beneath the existing OHL, in the townlands of Rathreedane, Cahra, Kilbride and Glenree, Carrowleagh, Bunnyconnellan, Co. Mayo will also be required.

The proposed Hydrogen Plant Interconnector single circuit sections of UGC will consist of one circuit of three No. 160 mm diameter HDPE power cable ducts and two No. 125 mm diameter HDPE communications duct to be installed in excavated trenches. The trench will typically be 600 mm wide by 1,315 mm deep. The cable ducts will accommodate one No. power cable per duct.

The proposed Wind Farm Grid Connection and Hydrogen Plant Interconnector triple circuit sections of UGC will consist of three circuits in individual trenches. The trenches will accommodate power cables enclosed within three No. HDPE ducts and two No. HDPE communications ducts, with a minimum separation distance of 880 mm between power circuits. The combined trench width, including power circuit separation, will be approximately 3300 mm.

The communications duct will accommodate a fibre cable to allow future communications between Firlough Wind Farm Substation, the Hydrogen Plant Substation and the transition network. A concrete communication chamber will be installed at each joint bay location. Whilst the trench is open the ducts will be surveyed to accurately record the location of the buried cable for future identification and as-built records. The ducts will be installed, and the trench reinstated in accordance with the landowner requirements and then the electrical cabling/fibre cable is pulled through the installed ducts. Construction method statements and templates will be implemented to ensure that the UGC is installed in accordance with the correct requirements, materials, and specifications of ESBN and EirGrid (CDS-GFS-00-001-R1).

The trenching methodology for the underground cabling is as follows:

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant.
- Confirmatory drawings for all existing services will be obtained from EirGrid, Gas Networks Ireland, Eir, Local Authorities and Uisce Éireann.
- Immediately prior to construction taking place, the area where excavation is planned will be surveyed by CAT scan (sub-surface survey technique to locate any below-ground utilities) and all existing services will be verified. Temporary warning signs will be erected.
- Clear and visible temporary safety signage will be erected all around the perimeter of the live work area to visibly warn members of the public of the hazards of ongoing construction works.
- A 13-tonne rubber tracked 360-degree excavators will be used to excavate the trench to the dimensions of 600 mm wide by 1,315 mm deep.
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be

fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature.

- Disposal of bituminous materials and soils subsoils at a licenced facility.
- A silt fencing filtration system will be installed on all existing drainage channels before and for the duration of the cable construction to prevent contamination of any watercourse.
- Once the trench is excavated, a 50 mm depth base layer of sand (in road trench) or concrete (off road trench) will be installed and compacted. All concrete will be offloaded directly from the concrete truck into the trench.
- uPVC ducts will be installed on top of the compacted base layer material in the trench.
- Once the ducts are installed, couplers (a device used for joining pipes) will be fitted and capped to prevent any dirt entering the unjointed open end of the duct.
- A layer of concrete (in road) or excavated material (off road) will be installed on top of the duct as a surround material to a level 300 mm below the finished surface level.
- The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to record the exact location of the ducts.
- The co-ordinates will be plotted on as-built record drawings for the Grid Connection and Interconnection cable operational phase.
- When ducts have been installed in the correct position on the trench base layer, sand (in road trench) or concrete (off road trench) will be carefully installed in the trench around the ducts so as not to displace the duct and compacted.
- Timber spacer templates will be used during installation so that the correct cover of duct surround material is achieved above, below and at the sides of the duct in the trench.
- A red cable protection strip will be installed above the layer of material surrounding the duct and for the full length of the cable route.
- Yellow marker warning tape will be installed for the full width of the trench, and for the full length of the cable route, 300 mm from the finished surface level.
- The finished surface of the road will then be reinstated and finished with a bituminous layer. For off-road sections of the Grid Connection and Interconnector, the trenches will be reinstated with the related excavated material.
- Precast concrete cable joint bays will be installed within the excavated trench.
- The junction boxes will be backfilled and the surface above the junction box will be finished with a bituminous layer. The cable junction boxes will be opened a second time during cable pulling and jointing, after which the finished surface above the joint bays will be reinstated again to its original condition.

- When trenching and ducting is complete, the installation of the Grid Connection cable will commence between the Wind Farm Substation and the existing Glenree – Moy 110 kV overhead line and between the Wind Farm Substation and Hydrogen Plant Substation.
- The underground cable will be pulled through the installed ducts from a cable drum set up at one joint bay and using a winch system which is set up at the next joint bay.
- The cables will be jointed together within the precast concrete joint bays.
- The surface above each cable joint bay will be finished with a bituminous layer to the satisfaction of the Local Authority and as good as the pre-existing condition.
- Where required, grass will be reinstated by either seeding or by replacing with grass turves.
- No more than a 100 m section of the trench will be opened at any one time. The second 100 m will only be excavated once the majority of reinstatement has been completed on the first.
- The excavation, installation, and reinstatement process will take on an average of 1 no. day to complete a 100 m section.
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together.

2.6.13 Joint Bays

Joint bays are pre-cast concrete chambers along the Grid Connection Route and Interconnector Route where individual lengths of cables will be joined to form one continuous cable. Joints bays are to be installed approximately every 700 m. A joint bay is constructed in a pit. Each joint bay will be 6 m long x 2.5 m wide x 2.0 m deep (shown in Drawing No. 05806-DR-244). A reinforced concreted slab will be constructed on top of the joint bay.

The joint bay locations have been dictated by suitable terrain and access to facilitate the operation of cable pulling equipment at any phase of the Proposed Development and future operation of the installation in accordance with the EirGrid specifications (CDS-GFS-00-001-R1).

Communication chambers, which are similar to small manholes, will be installed at the joint bay locations to facilitate connection of fibre-optic communication cables. Earth sheath link chambers are also required at every second joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth sheath link chambers and communication chambers are located in close proximity to joint bays and will be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all joint bays, earth sheath link chambers and communication chambers is subject to approval by ESBN. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions.

2.6.14 Directional Drilling Works

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, railways, water courses, etc. in order to install cable ducts under the obstacle where using standard installation methods is not possible. There are four bridges on the Grid Connection and one on the Interconnector Route which will require HDD due to there being insufficient cover in the bridge to accommodate cables within the bridge deck. The details of environmental protection measures and potential impacts can be found in **Chapter 9: Hydrology and Hydrogeology** and the CEMP in **Appendix 2.1.**

Directional drilling is the practice of drilling holes in a horizontal direction for the laying of ducts which contain cables beneath features such as a watercourse. The directional drilling commences at an excavated area known as the launch pit which is the entry point for pipes and ducts to be placed. The drill rods are pushed through the ground from the launch pit to the reception pit (similar to launch pit but at the other side of the watercourse). At the reception pit, the pipes are attached to the lead drill rod and pulled back through the ground to the launch pit. The crossings will comprise 4 x 110 mm High Performance Polyethylene (HPPE) pipes/ducts. Two separate excavations will be made either side of the watercourse to a depth of 2 m to accommodate the directional drilling launch and reception pits. Spoil arisings will be stored adjacent to the pit locations for reinstatement, at a minimum 25 m buffer distance from the watercourse. These temporary spoil mounds will have side slopes battered back to 1:1. Silt fencing will be erected around the base of each temporary mound prior to excavation. The excavation launch and reception pits will be reinstated on completion of drilling and jointing operations.

The drill head will be placed in the open excavation (launch pit) and it will be guided in by the operator for the first 1-2 metres. A series of drill rods will be connected to the head as it travels further along the shaft.

The drill position is always known to the operator and the drill can be manoeuvred in three planes / axes. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded. A drilling lubricant will be required. This will be delivered directly to the drill head by hydraulics. The lubricant will be chemically inert bentonite slurry mixture which lubricates the drill head and removes the drilled earth and stone. Once the crossing is drilled, the drill head is exposed at the reception pit and removed. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side. The drill rods are connected to the duct pipe and the drill is reversed by pulling the pipe back through the channel.

A spoil volume of 4 m^3 will be excavated for each 100 m run of four pipes. This spoil will be largely subsoil material. This material will exit the launch pit within the bentonite slurry mixture. A mobile bunded tank will be located next to the launch pit into which the material/slurry mixture will be pumped. This will be stored outside of the 65 m watercourse buffer zone.

The directional drilling methodology is as follows:

- A works area of circa 40 m^2 will be fenced on both sides of the stream crossing.
- The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5 mm PVC bunds which will contain any fluid spills and storm water run-off.
- Entry and exit pits (1 m x 1 m x 2 m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
- The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
- A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
- The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
- Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
- Once the bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
- The duct will be cleaned and proven, and their installed location surveyed.

- The entry and exit pits will be reinstated to the specification of ESB Networks and Mayo County Council.
- A transition chamber will be installed on either side of the bridge following the horizontal directional drilling as per ESB requirements.

2.6.15 Loop-In Interface Mast

The design for the 110 kV Loop-In from the existing OHL will require two new interface mast structures (see **Plate 2.4**) which will be constructed under the existing Glenree - Moy 110 kV OHL. The existing OHL conductor will be terminated at these two new structures in order to transition from an overhead line to an underground cable arrangement to facilitate the loop into the Wind Farm Substation via cable chairs. The existing conductor will be removed between the Interface Mast structures with the new connection looped through to the Wind Farm Substation.

The new interface mast structure locations have been selected based on ground surveys, ground profiles, allowable angles and ruling span checks. The expected duration of works is approximately four weeks, construction of foundation circa. seven days each with time allowing for curing of the concrete; erection of the interface masts circa five days; all weather dependent.

The Loop-In interface mast methodology is as follows:

- Interface mast sites are scanned for underground services such as cables, water pipes etc. Consultation with the landowner will help to identify and ensure there are no unidentified services in the area.
- For each leg of two towers (eight in total) a foundation circa. 3.0 m x 3.6 m x 3.6 m deep is excavated and the formation levels (depths) will be checked by the onsite foreman. The excavated material will be temporarily stored close to the excavation and excess material will be used as berms along the site access roads.
- To aid construction, a concrete pipe is placed into each excavation to allow operatives level the mast at the bottom of the excavation. The frame of the reinforcing bars will be prepared and strapped to a concrete pipe with spacers as required. The reinforcing bars will be lifted into each excavated foundation using the excavator and chains/slings. The base and body section of each tower will then be assembled next to excavation.
- Concrete trucks will pour concrete directly into each excavation in distinct stages.
- A third pour for the leg of the tower will be 1 m x 1 m plan and will be 300 mm over ground level.

- Once the main concrete pour is cured after circa five days, a preformed metal panel is set in place to contain the concrete called shuttering while it sets. During each pour, the concrete will be vibrated thoroughly using a vibrating poker.
- Once the concrete is set after the five days the shuttering is removed.
- The interface mast foundations will be backfilled one leg at a time with the material already excavated at the location. The backfill will be placed and compacted in layers. All dimensions will be checked following the backfilling process. If the excavated material is deemed unsuitable for backfilling other excavated material from the footprint of the Firlough Wind Farm Substation or from the new permanent access road in Bunnyconnellan will be used. All surplus excavated material and removed from the tower locations and stored in berms adjacent to the Substation Compound.
- The existing overhead line will be de-energised by ESB so work can commence on the construction of the towers.
- An earth mat consisting of copper or aluminium wire will be laid circa 400 mm below ground around the tower. This earth mat is a requirement for the electrical connection of the equipment on the tower structure.
- Once the base section of each tower is completed and the concrete sufficiently cured, it is ready to receive the tower body.
- A hardstand area for the crane will be created by laying geogrid material on the ground surface and overlaying this geogrid with a suitable grade of aggregate.
- A physical barrier (Heras Fence Site Boundary) will be put in place to restrict plant from coming too close to the OHL.
- The tower will be constructed lying flat on the ground beside the recently installed tower base.
- The conductor will be moved off centre using a stay wire and weights to anchor the stay wire to ground.
- The tower section will be lifted into place using the crane and guide ropes.
- The body sections will be bolted into position.
- The conductor will be centred over the towers and held in place. Once the conductor is secured at both ends it is then cut and attached onto each tower. The section of conductor in between the two towers will be removed and utilised as connector wire for the new towers.
- Down dropper conductors (For Electrical Connections, Insulators, Surge arrestors), shackles and all associated accessories required for transition from line to cable will be installed on the interface towers.
- The circuit will be tested in both directions before the line is re-energised.

Plates 2.2, 2.3 and **2.4** show examples of an interface mast construction in progress.

Plate 2.2: A 110 kV interface mast foundation complete

Plate 2.3: Base of an interface mast structure backfilled

Plate 2.4: A completed line/cable interface mast

2.6.16 Rock Breaking

It is unlikely that rock breaking will be required due to the nature of the sites, however if it is required the following will apply. Weaker rock will be extracted using a hydraulic excavator and a ripper. Upon the completion of further detailed site investigation, where stronger rock is encountered and cannot be extracted using an excavator, then rock breaking equipment will be employed. This will involve the use of a 40-60 tonne 360-degree hydraulic excavator with a rock breaker. The rock breaker is supported by a smaller 30-40 tonne rock breaker which breaks the rock down further for feeding into the rock crusher machine. The larger rock breaker breaks out the rock in a progressive manner and the smaller rock breaker breaks it down further.

The broken-down rock is loaded into mobile crusher using a wheeled loading shovel machine and crushed down into the correct grade for use in the construction of Wind Farm Site access roads and Turbine Hardstands or Hydrogen Plant Site access roads.

2.6.17 Rock Blasting

It is very unlikely that rock blasting will be required due to the nature of the sites, however if it is required then this is carried out using a mobile drilling rig which is used to drill vertical holes into the rock area that requires blasting. This is where the explosives are used. It will take the drilling rig three to four days to drill the number of holes required for a single blast. A specialist engineer will be employed to determine the locations and depths of blasting required. The specialist blasting engineer will arrange for the correct amount of explosives to be delivered to the sites for each blast. The management of explosives delivery and storage on-site will be agreed with An Garda Síochána in advance. The blast engineer will set the explosives and manage the blast. The rock generated from the blast will usually be the correct size to be loaded directly into the mobile crusher. The effects of blasting on noise are assessed in **Chapter 11: Noise and Vibration**.

2.6.18 Wind Farm Drainage

The Wind Farm Site surface water runoff contained within natural and artificial drainage channels includes stream and river waterbodies, drainage ditches, and other minor natural and artificial manmade drainage features. Drainage measures will be provided to attenuate runoff, guard against soil erosion, soil compaction, and safeguard local water quality. Details of the drainage system are shown on **Figure 2.11** and outlined in detail in the Surface Water Management Plan, part of the CEMP (**Appendix 2.1**). Full details are provided in **Chapter 9: Hydrology and Hydrogeology.**

The Wind Farm Site is characterised by historic and continuing peat cutting activities on a single plot scale for individual turbary right holders personal use and as such possesses an extensive drainage network. There are five (order one streams) sections of streams in total on the Wind Farm Site, made up of three waterbodies.

A buffer zone of at least 50 m will be in place for natural streams, with a 20 m buffer to significant drains. Mitigation measures have been set out in the **Appendix 2.1 CEMP** where this is not possible. Sustainable Drainage System (SuDS) principles will be employed as follows:

Source controls for surface water:

- Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sandbags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.

- Small working areas, covering stockpiles with geotextiles layering to protect against water erosion and runoff in rainy weather, and/or cessation of works in certain areas such as working on a high gradient during wet and windy weather.

In-line controls for surface water:

- In line controls are controls which are directly applied to the surface water body including interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds and/or temporary pumping chambers.

Treatment systems for surface water:

- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbusters. When heavy rainfall is predicted, works will be suspended or scaled back.

There are 72 No. stilling ponds on site with a combined area of 8,514 m^2 and a combined volume of 8,514 m^3. Further details on drainage management and mitigation can be found in **Chapter 9: Hydrology and Hydrogeology** and the **Surface Water Management Plan** attached as **Appendix 2.1.**

2.6.19 Hydrogen Plant Site Drainage

Drainage at the proposed Hydrogen Plant location is limited to approximately 3 no. field drains, an area of cutover boggy peat adjacent to the south of the Hydrogen Plant Site boundary and the Dooyeaghny_or_Cloonloughan_010 River which runs 70 m at the closest point along the south of the Hydrogen Plant Site.

Drainage measures will be provided to attenuate runoff, guard against soil erosion, soil compaction, and safeguard local water quality. Details of the drainage system are shown on Drawing No. 6129-PL-301 to 6129-PL-304 and outlined in detail in the Surface Water Management Plan, part of the CEMP (**Appendix 2.1**). Full details are provided in **Chapter 9: Hydrology and Hydrogeology.**

A buffer zone of at least 70 m will be in place for natural streams except the discharge point, with a 20 m buffer to significant drains. Mitigation measures have been set out in the **Appendix 2.1 CEMP** where this is not possible. Sustainable Drainage System (SuDS) principles which are outlined in the Wind Farm drainage section 2.6.18 will be employed.

Storm water will be collected through a combined network of drains & piped network of gully trap, catch basin and manholes from uncontaminated areas. This system will pass through the oil separator as it will be collected from hard surfaces/roof areas onsite and be fed into the underground storage tanks.

There are two constructed wetland areas in the northeast of the Hydrogen Plant Site. The sanitary sewage from the welfare facilities will transfer to a septic tank which will then feed the top/most northernly constructed wetland as it requires greater residence time. Wastewater from the water treatment building will be collected in a wastewater storage tank which will act as a method of attenuation. Water from here will then flow into the lower of the constructed wetlands. Then water will enter a ditch/channel on the east of the Hydrogen Plant Site which will flow south along the perimeter of the site and into the Dooyeaghny River.

With reference to **Appendix 9.3** Preliminary Discharge & Assimilative Capacity Assessment, the Hydrogen Plant will include sustainable use of several raw water sources (storm runoff, rainwater and groundwater) and will employ constructed wetlands to treat and discharge wastewater at the site. Furthermore, the Proposed Development promotes diffuse overland discharge to adjacent peatland areas, and to promote and maintain high bog water levels and healthy peatland conditions.

2.6.20 Key Proposed Development Infrastructure Metrics

Table 2.10: Wind Farm Key Proposed Development Infrastructure Metrics

Description	Length [m]	Width [m]	Depth [m]	No.	Area [m²]	Volume of Excavation [m³]
Upgraded Wind Farm Site access road	8,772	1.50 (to be extended by)	0.60		13,158	25,281
New Wind Farm Site Access Road	1,323	4.50	0.60		5,954	8,292
Cut and Fill Junctions			0.6		14,947	8,984
Wind Farm Internal Cabling (power & communications)	13,000	0.45	1.00	1	5,850	5,850

Description	Length [m]	Width [m]	Depth [m]	No.	Area [m²]	Volume of Excavation [m³]
Turbine Hardstands	-	-	0.60	13	46,800	75,960
Turbine Foundations (25.5 m diameter)	-	-	3.30	13	6,641	21,922
Wind Farm Substation and compound	-	-	0.60	1	13,892	8,335
Contractors Compound	60	30	0.60	1	1,800	1,080
Materials Storage Area	-	-	0.60	1	16,664	9,999
Grid Connection and Interconnector Cable Trench	14,659	0.6	1.315	-	12,780	16,806
Joint Bays, link boxes and comms box						538
Drainage	-	-	-	-	-	8,514
Blade Fingers	12	9	0.6	26	2,808	1,685
Total						**193,246**

Table 2.11 Hydrogen Plant Key Proposed Development Infrastructure Metrics

Description	Length [m]	Width [m]	Depth [m]	No.	Area [m²]	Volume of Excavation [m³]
Hydrogen Plant Electrolyser Building Pad Foundations	1.2	1.2	1	420	605	605
Tube Trailer Parking Area	16	106	0.5	1	1700	850
Water Storage tanks	45.65 (diameter)		5	2		16,374
Constructed Wetlands	10 35	8 17	0.5	1 1	80 400	40 290
Process Swale	131	4	0.5	1	524	262
Wastewater Storage	30	10	5		300	1500
Hydrogen Plant Temporary Construction	60	30	0.60	1	1,800	1,080

Description	Length [m]	Width [m]	Depth [m]	No.	Area [m^2]	Volume of Excavation [m^3]
Compound						
Hydrogen Plant site access track	785	7	0.6	1	5882.2	3529.32
Hydrogen Plant Substation			0.60	1	3520	1,552
Total						**26,080**

The combined excavation volume for the Wind Farm Site and Hydrogen Plant Site is 219,326 m^3. Management of excavated materials is covered in section 2.7.8.3 and 2.7.9.3 and in the Peat and Spoil Management Plan in the CEMP in **Appendix 2.1**.

2.6.21 Hydrogen Plant Staff

The plant will be operational 24 hours a day and will be always manned. Approximately 10 full time staff or equivalent will be employed at the facility. These staff will have appropriate training and qualifications in operation of the plant and all required health and safety training.

During the operation of the Hydrogen Plant, regular maintenance and inspection will be carried out on the electrolyser, dispensing station, compressors, cooling equipment, water treatment equipment, Hydrogen Plant Substation and site infrastructure. In addition, operation and monitoring activities will be carried out remotely with the aid of computers connected via a telephone broadband link.

2.6.22 Wind Farm Staff

During the operation of the Wind Farm, the turbine manufacturer, the wind farm operator, or a service company will carry out regular maintenance of the turbines, Wind Farm Substation and site infrastructure. Monthly routine inspection and preventative maintenance visits will be necessary to provide for the smooth and efficient running of the wind farm. This will occur over one day with one vehicle attending the Site. In addition, operation and monitoring activities will be carried out remotely with the aid of computers connected via a telephone broadband link. Staff will have appropriate training and qualifications in operation and maintenance of the Wind Farm and all required health and safety training.

2.7 CONSTRUCTION OF THE PROPOSED DEVELOPMENT

The first phase of the Proposed Development will comprise the construction phase. This phase will begin with site preparation works and will be complete when the Proposed Development is built and ready for commissioning and when all wastes have been removed from the sites. For this Proposed Development, it is envisaged that the construction phase will last approximately 21 months. An indicated construction programme is set out at **Table 2.12** and **Table 2.13.**

Table 2.12: Outline Wind Farm Construction Programme

Activity	Month																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Site Establishment/ Fencing	X	X	X																		
Internal Access Road Upgrade & Construction		X	X	X	X	X															
Substation & Compound Construction		X	X	X	X	X	X	X													
Substation Electrical Works									X	X	X	X	X	X	X	X	X				
Substation Commissioning																X	X				
Excavation & Construction of Turbine Foundations & Hardstands		X	X	X	X	X	X	X	X	X	X										
Internal Cabling Installation										X	X	X	X	X	X	X					
Turbine Delivery and Erection												X	X	X	X	X					
Grid Connection													X	X	X	X	X				
Energisation																		X			
Turbine Commissioning																			X	X	X
Site Restoration																		X	X	X	X

Table 2.13: Outline Hydrogen Plant Construction Programme

Activity	Month																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Site Establishment/ Fencing	x																				
Contractor Compound and Welfare Facilities	x																				
Hydrogen Plant Site Preparation including drainage		x	x	x																	
Site Access Road		x	x	x																	
Excavation and installation for underground storage tank					x	x	x	x													
Electrolyser building construction					x	x	x	x	x	x	x	x	x	x	x	x					
Ancillary buildings and Hydrogen Plant Substation construction							x	x	x	x	x	x	x	x	x	x					
Installation of outdoor plant and equipment															x	x	x	x			
Installation of the wind farm interconnector							x	x	x	x	x	x	x	x	x	x					
Delivery of equipment and installation															x	x	x	x			
Testing and Commissioning																		x	x	x	x
Site Restoration																			x	x	x

2.7.1 Construction and Environmental Management Plan (CEMP)

A CEMP is appended to the EIAR in **Appendix 2.1**. The CEMP includes an emergency response plan, peat and spoil management plan, surface water management plan, surface water quality and inspection management plan and a waste management plan. The CEMP includes all the mitigation measures proposed within the EIAR and the NIS. A Summary of the mitigation measures is included in **Appendix 17.1**. In the event planning is granted for the Proposed Development, the CEMP provides a commitment to mitigation and monitoring, and reduces the risk of pollution whilst improving the sustainable management of resources. The environmental commitments of the Proposed Development will be managed through the CEMP and will be secured in contract documentation and arrangements for construction and later phases, such that there will be a robust mechanism in place for their implementation. The CEMP addresses the construction phase, and will be continued through to the commissioning, operation and final decommissioning phases. An Environmental Manager / Ecological Clerk of Works (ECoW) with appropriate experience having completed a similar role will be appointed for the duration of the construction phase so that the CEMP is effectively implemented.

2.7.2 Refuelling

Vehicles will be refuelled off-Development where possible. For vehicles that require being refuelled on-Development, fuels will be stored in the temporary construction compound at both the Wind Farm Site and Hydrogen Plant Site and bunded to at least 110 % of the storage capacity of fuels to be stored. Refuelling will take place via a mobile double skinned fuel bowser. The bowser will be a double axle refuelling trailer which will be towed to the refuelling locations by a 4x4 vehicle. The 4x4 will carry, a drip tray, spill kit and absorbent mats in case of any accidental spillages. Only designated competent personnel will refuel plant and machinery.

2.7.3 Concrete

There will be no concrete batching on the construction sites. It will be transported to the Hydrogen Plant site or Wind Farm Site as it is required. A dedicated, bunded area will be created to cater for concrete wash-out and this will be within the temporary construction compounds. This will be for the wash-out of the chutes only after the pour. Concrete trucks will then exit either the Hydrogen Plant site or Wind Farm Site and return to the supply plant to wash out the mixer itself.

The main concrete pours at the turbine locations will be planned in advance and mitigation measures (detailed in **Chapter 9: Hydrology and Hydrogeology**) will be as follows:

- Avoiding large concrete pours, for Turbine Foundations for example, on days when temperatures are not optimal as per (BS 8110) (EN1992-1-2) or when heavy or prolonged rainfall is forecast i.e., during a period in which a Met Éireann Status Red weather event will/has occurred
- All concrete pour areas are dewatered prior to pouring concrete and while the concrete is curing
- Making covers available so that areas can be covered if heavy rain arrives during the curing process which will prevent runoff of concrete

2.7.4 Dust Suppression

During periods of dry and windy weather, there is potential for dust to become friable and cause nuisance to nearby residences and users of the local road network. Damping down may be required to see that dust does not become friable. This requires wetting the material and ensuring water is supplied at the correct levels for the duration of the work activity. To reduce mud and debris from getting onto the local road network, a wheel wash facility will be employed at The Wind Farm Site and at the Hydrogen Plant Site which will wash mud and debris from vehicles before exiting. Where rock is sourced from off-site, HGVs entering the sites carrying rock will be covered to prevent dust generation. A road sweeper will be available in case of any mud or debris making it onto the public road network.

2.7.5 Construction Hours

The Proposed Development will have 100-150 construction workers during the peak of the construction phase. Working hours for construction will be from 07:00 to 19:00 on weekdays, with reduced working hours at weekends, from 08:00 to 13:00 on a Saturday. It should be noted that during the turbine erection phase, operations will need to take place outside those hours with concrete pours commencing at 06:00, to facilitate turbine foundation construction and so that lifting operations are completed safely. Hours of working for turbine foundation construction will be agreed with Mayo County Council prior to the commencement of turbine foundation construction. **Chapter 15: Traffic and Transportation** refers to this in further detail. A detailed Traffic Management Plan ("TMP") will be implemented for the construction phase, which shall be agreed during the planning compliance stage with the Planning Authority so that strict controls are in place with all suppliers coming to the Proposed Development.

2.7.6 Construction Employment

It is estimated that at peak construction, 100-150 construction workers in total will be employed at the Proposed Development, these would be based on the Wind Farm Site, Hydrogen Plant Site, Grid Connection Route and Interconnector Route.

2.7.7 Construction Supervision and Monitoring

The construction activities will be monitored by a Geotechnical Engineer, a qualified archaeologist and an Ecological Clerk of Works (ECoW). The Geotechnical Engineer will be contracted for the detailed design phase and their services retained throughout the construction and reinstatement phases. The Geotechnical Engineer will oversee all earthworks and excavation activities and monitor for issues such as ground stability, water ingress into excavations etc. Roles and responsibilities are further detailed in **Appendix 2.1.**

The ECoW will be employed prior to the commencement of the construction phase to monitor and review the pollution control measures and working practices during construction and have input into the Proposed Development remediation. The ECoW will have stop work authority if, for example, a sensitive habitat feature is encroached upon or there is the possibility of silt/pollution runoff to natural watercourses.

The potential exists for the presence of unrecorded, sub-surface archaeological features within green field locations in construction areas within the Proposed Development. A series of pre-construction and construction phase archaeological investigations under licence by the National Monuments Service will be carried out by a suitably qualified archaeologist, details can be found in **Chapter 14: Cultural Heritage**, section 14.6. The archaeologist will have responsibility for providing that potential archaeological features are protected should any be discovered during excavations. The Proposed Development will be accessible to the appointed archaeologist at all times during working hours and the nominated archaeologist will monitor all invasive works.

In the event that any sub-surface archaeological remains are identified during site investigations, they will be cleaned, recorded and left to remain in situ within cordoned off areas while the National Monuments Service are notified and consulted in relation to appropriate future mitigation strategies, which may entail preservation in situ by avoidance or preservation by record by archaeological excavations.

A Water Quality Monitoring and Watercourse Crossing Plan has been prepared as part of the **CEMP** in **Appendix 2.1** and will be implemented prior to commencement of construction. Regular inspections of the installed drainage system will be undertaken, especially after heavy rainfall events, to check blockages and see that there is no build-up of standing water in any part of the system where is it not designed to be.

Excess build-up of silt will be removed at check dams, attenuation/settlement ponds or any other drainage feature by scraper or excavator and under the supervision of the ECoW.

During the construction phase, field testing and laboratory analysis of a range of parameters with relevant regulatory limits and Environmental Quality Standards will be undertaken for each watercourse close to the Proposed Development, and specifically following heavy rainfall events (i.e., weekly, monthly and event based).

The CEMP for the Proposed Development sets out the development organisation, sequencing of works, methodologies, mitigation measures and monitoring measures.

Daily monitoring of excavations by the Geotechnical Engineer will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken. Further details of what this will involve are detailed in **Chapter 8: Soils and Geology and Chapter 9: Hydrology and Hydrogeology.**

The local road network near the Proposed Development used to transport construction materials will be monitored during construction, so that any damage caused by construction traffic associated with the Proposed Development can be identified and repaired. This monitoring will be undertaken on the junction with the N59 to the Hydrogen Plant Site and on the local road (L-5137-9) near to Wind Farm Site entrance. Readymix concrete will be sourced from local quarries when required and monitoring, such as visual inspections, will also be undertaken on the route as required. This is assessed in **Chapter 15: Traffic and Transportation.**

2.7.8 Wind Farm Construction

2.7.8.1 Construction Compound and Temporary Works Area

The Wind Farm Temporary Construction Compound will be set up upon commencement of the construction phase. The compound will be split in to two areas, one containing offices and welfare facilities and the other as a set down/storage area for materials. These are along the proposed new access road into the Wind Farm Site as shown in **Figure 2.1**.

The compound will be 60 m by 30 m. The compound will contain cabins for offices space, meeting rooms, canteen area, a drying room, parking facilities, and personnel facilities. It will also be used as a secure storage area for construction materials. An area within the compound will be used for the storage of fuel and oils and this will be suitably bunded and the bund will be lined with an impermeable membrane to prevent any contamination of the surrounding soils, vegetation and water table. Double protection containers / equipment will be used along with drip trays and details are included in the CEMP, included as **Appendix 2.1.**

During the construction phase, water will be supplied by water bowser. The maximum wastewater production is estimated to be the same as the maximum water consumption (2,000 litres per day). The Wind Farm Site will include an enclosed wastewater management system at the Wind Farm Temporary Construction Compound, capable of handling the demand during the construction phase with 100 construction workers expected on the Wind Farm Site at the peak (100-150 on the overall Proposed Development). There will be a holding tank for wastewater management at the Wind Farm Site. Wastewater will be removed off- the Wind Farm Site weekly, by a licensed wastewater disposal company and disposed at an appropriate licenced facility, likely to be Ballina waste water treatment facility.

2.7.8.2 Construction of Crane Hardstands and Foundations

The construction methodology for the wind Turbine Foundations will depend on the strength and depth of the substrata (layers of rock or soil beneath the surface) specific to each location. Foundations will be taken down to competent bearing strata by excavating through the soil, subsoil, and rock if necessary.

The method of construction for turbine foundation is also described below:

- Install temporary drainage around perimeter of excavation
- Excavate soil and rock
- Form a level working area to build foundation
- Install formwork and reinforcement
- Pour concrete
- Cure concrete

- Once the concrete has set and the earthing system is in place, backfill the foundation with rock
- Use soil to build up the area around the turbine base

2.7.8.3 Management of Excavated Material

Subsoil and bedrock which are excavated as part of the construction phase of the Proposed Development will be reused onsite where possible. Peat material excavated will be reused as backfill in areas previously excavated as much as possible, and/or for reinstatement works elsewhere on the Wind Farm Site. To facilitate this the acrotelm (living layer) and the catotelm (lower layer) will be treated as two separate materials. Catotelm peat will be used to backfill, for example; around turbine foundation pads once established. Acrotelm peat will be used as a dressing on top of deposited catotelm peat in order to promote and re-establish flora. The excavated peat material will be stored in designated spoil deposition areas as shown on Drawing No. 6129-PL-100. There are 3 areas designated for peat storage on the Wind Farm Site. The locations chosen for temporary storage are based on gradient, geotechnical data and ground stability assessment, habitat type, and the adequacy of the ground to support the surcharge material. Further information can be found in **Chapter 8: Soils and Geology** and in the Peat and Spoil Management Plan in the CEMP in **Appendix 2.1.**

2.7.8.4 Construction Wind Turbine Assembly

Once on the Wind Farm Site, the wind turbine components will follow a detailed route and plan to minimise manoeuvring. Components will be placed on Turbine Hardstands prior to assembly. A 'just in time' delivery strategy will be in place for wind turbine blades to reduce the need for temporary set down areas. One large crane will be required for erecting the wind turbines, assisted by a smaller crane. A similar number of cranes will also be required for maintenance during the operational phase.

The towers will be delivered in sections, and work on assembly will not start until a suitable weather window is available, e.g., wind gust speed threshold of less than 6 ms^{-1}. The bottom tower section will be bolted onto the concrete foundations. The mid tower section will then be lifted into position and bolted to the bottom tower section. Finally, the top tower section will be lifted into position and bolted to the mid tower section. Three methods can be used to attach the blades:

1. The blades can be attached to the nacelle and hub on the ground. The hub and blades are then lifted as one.

2. The hub can be attached to the nacelle and the two blades attached to the hub while the nacelle is on the ground – the "bunny lift". The nacelle is then lifted into position and the third blade lifted into place separately. This requires manoeuvring of several components on the ground and usually the repositioning of cranes.
3. Lifting the nacelle and hub as one unit, as described above and then attaching the blades one at a time, rotating the hub between lifts. The blade lifting operations do not require repositioning of the crane.

The most appropriate method will be decided by the lifting contractor and the turbine manufacturer, prior to turbine erection.

2.7.8.5 Construction Traffic

It is estimated that during civil construction, approximately 6,718 loads will be delivered to the Wind Farm Site. This is estimated to result in a maximum of 868 trips each month with an average of 41 HGV trips per day in this period. Peak deliveries are expected to be during the period of concrete pours for Turbine Foundations when there will be approximately 140 loads per Turbine Foundation. If two Turbine Foundations are poured per month, then the balance of the loads in the busiest month would be 588 loads or 27 loads per day over the remaining days of the month.

This is assessed in **Chapter 15: Traffic and Transportation**.

2.7.8.6 Construction Sequencing

It is envisaged that the following will be the sequence of construction for the Wind Farm:

1. Contractor Compound and Welfare Facilities
2. Surface water management measures
3. Works along the construction routes
4. Wind Farm Preparation including felling and drainage
5. Site Roads
6. Crane hardstandings
7. Turbine foundations
8. Internal cable ducting
9. Installation of the Grid Connection
10. Erection of wind turbines
11. Commissioning and Energisation

The Wind Farm Substation will be constructed in parallel with Turbine Hardstands, Turbine Foundations and ducting. The first step will be to construct the Wind Farm Temporary Construction Compound and welfare facilities. The next step will be to prepare the areas of the Wind Farm Site where infrastructure is to be located by marking out the construction works corridor and the relevant environmental buffer zones as needed and the designed drainage and surface water management measures.

Following the Wind Farm Site preparation, the site access roads and associated drainage will be constructed according to the planning drawings which have taken into consideration the wind turbine manufacturer's specifications. The next step will involve construction of the crane hard-standing areas for the 13 no. wind turbines according to the site access roads and Turbine Hardstands specifications of the chosen wind turbine manufacturer. The 13 no. Turbine Foundations can then be excavated, and Turbine Foundations constructed. No concrete batching will take place on Wind Farm Site. Following the construction of the Turbine Foundations, internal cable ducting from the turbine locations to the Wind Farm Substation will be laid in trenches along the constructed site access roads.

The Grid Connection will consist of largely underground cabling (UGC), 6.65 km with the majority of this to be installed within road networks, with minor section of works required in the vicinity of the tie in towers to allow integration between the wind farm and transmission overhead line. The construction methodology can be found in section 2.6.12.

The last step will be to erect the 13 no. wind turbines on the Turbine Foundations using two cranes. Commissioning and testing of the wind turbines can then proceed.

2.7.8.7 Commissioning

Wind farm commissioning can take in the region of two months to complete from the erection of the final wind turbine to the commercial exportation of power to the national grid. It involves commissioning engineers working through an entire schedule of SCADA (Supervisory Control and Data Acquisition) and electrical and mechanical testing and control measures to check that the wind farm will perform and export power to the national grid, as designed.

2.7.9 Hydrogen Plant Construction

2.7.9.1 Construction Compound and Temporary Works Area

The Hydrogen Plant Site Temporary Construction Compound will be set up upon commencement of the construction phase. This will be 80 m by 40 m and be located in the tube trailer parking area shown in **Figure 2.2.**

The compound will contain cabins for offices space, meeting rooms, canteen area, a drying room, parking facilities, and personnel facilities. The compound will be used as a secure storage area for construction materials. An area within the compound will be used for the storage of fuel and oils and this will be suitably bunded and the bund will be lined with an impermeable membrane to prevent any contamination of the surrounding soils, vegetation and water table. Double protection containers / equipment will be used along with drip trays and details are included in the CEMP, included as **Appendix 2.1.**

During the construction phase, water will be supplied by water bowser. The maximum wastewater production is estimated to be the same as the maximum water consumption (2,000 litres per day). The Hydrogen Plant Site will include an enclosed wastewater management system at the Hydrogen Plant Temporary Construction Compound capable of handling the demand during the construction phase with 50 construction workers on the Hydrogen Plant Site at peak (100-150 overall for the Project). There will be a holding tank for wastewater management at the Hydrogen Plant Site. Wastewater will be removed off site weekly, by a licensed wastewater disposal company and disposed at an appropriate licenced facility, likely to be Ballina waste water treatment facility.

2.7.9.2 Construction of Hydrogen Plant

The method of construction for the Hydrogen Plant is described below:

- Upgrade existing access road and construct supports to proposed access roads.
- Initial site development works i.e. Earthworks (excavation and bund construction) and site grading.
- Hardcore area for temporary site offices and mobilise same. Construct bunded area for oil tanks (to absorb 110% of potential spill volume).
- Surface water management measures.
- Construct site roads, drainage ditches, culverts etc., integral to road construction operations.
- Where necessary, dewater excavations. Store soil locally for backfilling and re-use. Place blinding concrete to Hydrogen Plant Substation foundation. Fix reinforcing steel. Construct shuttering. Fix any ducts etc., to be cast in. Place concrete to

foundation by starting from the centre, working out to the edges and finishing with the rising section from the middle. Cure concrete. After 1-2 days, remove shutters.

- Excavate area for underground water storage tanks and install precast concrete sections.
- Erect the steel frame for the electrolyser building and Hydrogen Plant Substation.
- Fence off the compound area with suitable palisade fencing.
- Excavate trenches for site cables, lay cables and backfill. Provide ducts at road crossings.
- Installation of outdoor plant and equipment.
- Installation of the Wind Farm Interconnector.
- Complete electrical installation, SCADA system etc., at the electrolyser building
- Commission and test equipment
- Complete site works, tidy up site.
- Demobilise temporary offices
- Provide any gates, signs etc. which may be required.
- Landscaping measures to be undertaken

The construction of the water storage tanks will require excavation, placement of a layer of limestone hardcore, placement of concrete blinding, installation of steel reinforcement, insitu-concrete floor/base installation, precast concrete walls and column installation, precast concrete roof installation and backfill with suitable material.

The Hydrogen Plant production capacity will be scaled up to a maximum 80 MW, to meet demand for green hydrogen in the Irish market. The physical infrastructure of the entire Hydrogen Plant as per **Figure 2.2**, (i.e. buildings, roads, water treatment, cooling and fuelling, etc) will be built during a single construction phase with the modular electrolyser system installed in 5 MW batches. The smallest initial batch of electrolyser capacity will be 10 MW. Subsequent electrolyser capacity will be delivered via HGV with no abnormal loads required and no need for further construction works. The subsequent electrolyser capacity will be installed into existing physical infrastructure and integrated into existing electrolyser capacity and ancillary infrastructure such as cooling fans, water treatment.

The Interconnector will consist of underground cabling (UGC) of 6.7 km with the majority of this to be installed within road networks. The construction methodology can be found in **Section 2.6.12**.

Plant commissioning will follow completion of the plant construction phase and will involve setting up and testing the equipment to ensure that it is fully functional and that all technical, environmental and safety requirements have been met.

2.7.9.3 Management of excavated Material

Subsoil and bedrock which are excavated as part of the construction phase of the Hydrogen Plant will be reused onsite where possible as fill material and for landscaping. Bedrock material arising at the Hydrogen Plant site will be reused as fill material where applicable, e.g. access tracks. Using the local geology as fill will ensure that impacts to hydrochemistry are minimised.

2.7.9.4 Construction traffic

It is estimated that during civil construction, approximately 3661 loads will be delivered to the Hydrogen Plant Site. This breaks down to approximately 174 loads per month or an average of 8 to 10 loads per day. The peak number of deliveries per day will occur during the excavation for the underground storage tank, construction of the electrolyser building and the installation of the wind farm interconnector.

2.7.9.5 Construction Sequencing

It is envisaged that the following will be the sequence of construction for the Hydrogen Production Plant:

1. Site Establishment/ Fencing
2. Contractor Compound and Welfare Facilities
3. Surface water management measures
4. Hydrogen Plant Site Preparation including drainage
5. Site Access Road
6. Excavation and installation for underground storage tank
7. Electrolyser building construction
8. Ancillary buildings and Hydrogen Plant Substation construction
9. Installation of outdoor plant and equipment
10. Installation of the wind farm interconnector
11. Delivery of equipment and installation
12. Testing and Commissioning
13. Site Restoration

2.7.10 Reinstatement and Monitoring

Following completion of construction, all plant and machinery will be removed from the Wind Farm Site and Hydrogen Plant Site. The temporary works areas needed for the construction period such as blade laydown areas, will be reinstated using the original spoil material removed and stockpiled close to the location from where it was excavated as stated in **Chapter 5: Terrestrial Ecology** and **Chapter 8: Soils and Geology**. Stockpiles will be restricted to less than 2 m in height and located outside of the surface water buffer zones. All stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW). The Wind Farm Temporary Construction Compound will be left as a car parking facility. The Hydrogen Plant Site Temporary Construction Compound will be left as a Hydrogen Tube Trailer parking. The Grid Route and Interconnector Route will be reinstated to its original condition. Joint bays will be reinstated in accordance with the Guidelines for Managing Openings in Public Roads 2017, private third-party landowners, Mayo County Council and Sligo County Council specifications. Where required, grass will be reinstated by either seeding or by replacing with grass turves.

The on-site installed drainage network will be left in place. This will be monitored on a quarterly basis to see that it is operating to its stated design purpose. Water monitoring on nearby natural watercourses and wells will be undertaken during and post construction to determine if any pollution has migrated off-site, and if so, implement measures to rectify the impact. Monitoring will also assess any changes to groundwater levels in nearby wells that may be caused by water extraction for the Hydrogen Plant Site. Details of this can be found in **Chapter 9: Hydrology and Hydrogeology.**

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions. As part of the Proposed Development, an area of cutover bog, measuring approximately 15.23 ha, will be built upon. As the cutover bog is considered of Local Importance (higher value), compensation is being provided to off-set the habitat loss through the implementation of the Biodiversity Enhancement and Management Plan (BEMP). The BEMP is focused on the rehabilitation of an area of cutover lowland blanket bog habitat of 10.6 ha which adjoins the southwest corner of the Wind Farm Site. The BEMP has two objectives:

- To preserve and rehabilitate an area of lowland blanket bog which has been partly cutover and drained in the past (hereinafter known as the 'peatland restoration area') to compensate for the loss of cutover bog as a result of the Wind Farm.
- To provide enhanced habitat for peatland associated species such as red grouse, meadow pipit (both Red-listed), skylark, the common frog and the common lizard, which may be affected by the loss of some cutover bog habitat as a result of the Project.

The BEMP will be underwritten by a detailed monitoring programme, which will allow for modifications to ensure that the objectives are being achieved throughout the lifetime of the Wind Farm.

2.8 OPERATION AND MAINTENANCE

During the operation of the Wind Farm, the turbine manufacturer, the Transmission System Operator (TSO) (EirGrid), the wind farm operator and a service company will carry out regular maintenance of the wind turbines, Wind Farm Substation and site infrastructure on a weekly basis. In addition, operation and monitoring activities will be carried out remotely with the aid of computers connected via a telephone broadband link. Weekly routine inspection and preventative maintenance visits will be necessary to provide for the smooth and efficient running of the wind farm.

The Hydrogen Plant has been designed so that it can be in operation 24 hours a day, seven days a week and will be manned with a dedicated team providing maintenance, monitoring and servicing. Site specific management systems and operating procedures will be developed in accordance with industry procedures and policies.

A detailed Emergency Response Plan (ERP) for the operational phase of the Hydrogen Plant, to cover health and safety emergencies as well as environmental emergencies, as part of the H&S Plan will be developed. This ERP shall be activated in the event of an emergency such as an accident, fire, spillage etc. and will provide details on who is required to be notified, first aid facilities and closest hospitals.

While production of green hydrogen is expected to be a 24 hour a day process, the Developer intends to restrict tube trailers from entering and leaving the premises between the hours of 19:00 and 07:00 as part of a wider traffic management plan, full details are in **Chapter 15: Traffic and Transport**.

A lighting plan for the Hydrogen Plant will be designed in compliance with current lighting standards, in the detailed design phase. The Developer has begun engaging with Mayo Dark Skies and will look to incorporate suggested lighting proposals during the detailed design phase in order to reduce excess light pollution. For example, the use of down lighting, energy efficient lighting, movement sensors, selecting area sensitive tones, minimizing lux levels to required standards, unoccupied zones to be unlit to limit excess illumination of the surrounding area.

2.9 DECOMMISSIONING

The Developer is applying for a consent for an operational period of 40 years for the Wind Farm. Cranes of similar size to those used for construction will disassemble each wind turbine using the same crane hardstands. The towers, blades and all components will then be removed from the Wind Farm Site and reused, recycled, or disposed of in a suitably licenced facility. The wind turbine transformers will also be removed from the Wind Farm Site. There is potential to reuse wind turbine components, while others can be recycled.

Underground cables will be removed while the ducting will be left in-situ. The foundations will remain in-situ.

All Wind Farm site access roads, hardstanding areas and drainage will be left in situ for future use.

It is intended that all above ground components and underground cabling (ducting left in-situ) will be removed from the Wind Farm Site as part of the decommissioning of the Firlough Wind Farm. The following elements are included in the decommissioning phase:

- Wind turbines dismantling and removal off the Wind Farm Site
- Underground cabling removal (ducting left in-situ)
- Turbine Foundation backfilling following dismantling and removal of wind turbines (any excavated material, will be re-instated / foundations that protrude above ground level will be backfilled with soil -underground reinforced concrete remaining in-situ)
- Transport Route Accommodation Works

Any structural materials suitable for recycling will be disposed of in an appropriate manner. The financial costs of decommissioning, at current material values, will be more than met by the recycling value of the wind turbine components.

Prior to wind turbine removal, due consideration will be given to any potential impacts arising from these operations. Potential impacts are likely to be similar to that of the construction phase, to an equal or lesser extent. Some of the potential issues could include:

- Potential disturbance by the presence of cranes, HGVs, and personnel on-site
- Time of year and timescale (to be outside sensitive periods).

Prior to the decommissioning work, a comprehensive plan will be drawn up and submitted to An Bord Pleanála for written agreement. The plan will take account of the findings of this EIAR and the contemporary best practice at that time, to manage and control the component removal and ground reinstatement.

It is the intention that the Hydrogen Plant will continue operations indefinitely. The source of electricity for the Hydrogen Plant would change upon the decommissioning of the Wind Farm and be changed to one of the following options;

- Subject to planning consents, the repowering of Firlough Wind Farm.
- Reinforced electricity network with a corporate Power Purchase Agreement with a green electricity producer.
- Connection to an offshore wind power generator off the west coast.

If these alternatives are not viable then the process equipment would be decommissioned; all plant, machinery and equipment will be emptied and dismantled to be sold or recycled or, where these are not possible, disposed of through a licenced waste contractor. If required, all machinery will be cleaned prior to removal and all necessary measures implemented to prevent the release of contaminants. All waste will be removed from the facility and recycled wherever possible, disposal operations will be controlled by licenced waste contractors. The buildings and infrastructure would be retained and repurposed.

2.10 COMMUNITY BENEFIT

In addition to helping Ireland reduce environmentally damaging fossil fuel emissions and helping avoid significant fines from the EU, Firlough Wind Farm and Hydrogen Plant will also contribute positively to the national and regional economy.

A SEAI report indicated that in 2019 wind energy generated 32% of all electricity, avoided 3.9 million tonnes of CO_2 emissions; and avoided approximately €260 million in fossil fuel imports[4]. Additionally, a report published by Barringa in January 2019 states that:

"Our analysis indicates that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year."[5]

In the North Mayo/West Sligo region, the full renewable energy generation potential of the area cannot be realised due to physical shortcomings and restrictions in the electricity network. The Hydrogen Plant would provide a viable off-take and route to market for renewable energy that otherwise would have been lost due to these constraints. This maximises the contribution to targets for both:

- Renewable electricity; Ireland needs to increase from 42% in 2020 to 80% in 2030 of electricity produced by renewable sources; and
- Ireland's overall renewable energy; Ireland needs to increase from 13.5% in 2020 target of 32% by 2030

By producing green hydrogen, the Proposed Development could contribute towards the Climate Action Plan's target by 2030 of at least 2.1 TWh consumption of zero emission gas for industrial heating and up to 0.7 TWh of renewable gas to aid in the decarbonisation of residential heating.

If used to displace diesel HGVs, the green hydrogen produced by the Proposed Development could result in the avoidance of up to 49,883 tonnes of CO_2 annually. It will also assist in achieving the European Hydrogen Strategies target of achieve 6 GW of renewable hydrogen electrolysers by 2024, and 40 GW by 2030 with production of up to 10 million tonnes of renewable hydrogen. Over the 40-year operational life of the Wind Farm, the Hydrogen Plant and Wind Farm combined will displace between 1,621,183 and 2,468,000 tonnes of CO_2, assuming at least 10MW of hydrogen electrolyser capacity is installed. This is influenced by the size of the electrolyser (10 MW to 80 MW) and the selected turbine in the range (5 MW to 6 MW).

[4] https://www.seai.ie/publications/Energy-in-Ireland-2020.pdf [Accessed 08/02/2022]
[5] https://windenergyireland.com/images/files/baringa-wind-for-a-euro-report-january-2019.pdf [Accessed 08/02/2022]

The utilisation of hydrogen technology is likely to act as a catalyst to attract new business to the region, providing an opportunity for counties Sligo and Mayo to be established as a forerunner in this rapidly growing industry.

The Proposed Development has the potential to bring significant positive benefits to local communities. The Developer has produced a website for community interaction and is working with local communities to enable continued access to turf harvesting. The Proposed Development will support sustainable local employment, it will contribute annual rates to the Mayo County Council and Sligo County Council and will contribute to the local economy by procuring material and services locally were possible. The Developer is working with Dublin City University to help advance research/technological knowledge of hydrogen technology across a range of disciplines including engineering, data science and climate sustainability. There is a plan to establish apprentice programmes for electricians, logistics management, health and safety officers and other technical specialities.

The significant annual community benefit fund will be established in line with the Renewable Energy Support Scheme (RESS) €2 / MWh policy which will include funding for both wider community initiatives and a Near Neighbour scheme focused on houses in close proximity to The Proposed Development.

The Project has the potential to make more than €500,000 available per annum in the local area for community funding for the RESS period, consistent with Government Policy. However, the above figure is indicative only and is and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

- Number and type of wind turbines permitted
- Capacity and availability of energy production of the delivered turbines
- Quantity of wind and wind conditions in any given year
- Timing of the electrolyser module phasing to full capacity as the hydrogen market grows

2.10.1 Community Benefit Fund Usage and Administration

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, the first step will be to form a benefit fund development working group that clearly represents both the closest neighbours to the Proposed Development as well as nearby communities. This group will then work on designing the governance and structure of a community entity that will administer the Community Benefit Fund.

It is acknowledged that the people living closest to the Wind Farm and Hydrogen Plant are the most important stakeholders and a proportion of the Community Benefit Fund will be set aside as a dedicated "Near Neighbour Fund". The exact structure of this will be confirmed as part of the development of the overall Community Benefit Fund but would typically provide support of varying degrees for properties up to 2 km from wind turbines and the Hydrogen Plant. This is supported by the requirements set out in the RESS-2 and may be adjusted in future RESS schemes that may relate to this Proposed Development.

The Proposed Development website established by the Developer has information and communication points for the local community to share ideas around utilising the community fund to promote local business, develop tourism activities, support local charities and public interest groups. The local community is encouraged to reach out with ideas on how the fund could be used.