AECOM Delivering a better world

CHAPTER 06
Water

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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6.1 Introduction

This chapter of the EIAR has been prepared by AECOM with input from the project team to assess potentially significant impacts upon the water environment and hydrogeology as a result of constructing and operating the Proposed Development.

Essentially, the assessment aims to satisfy the requirements of the EIA Directive and considers the potential for non-conformance with the EU Water Framework Directive (EU, 2000) (WFD) objectives. The assessment aims to ensure that:

- The need for the avoidance and reduction of impacts on the water environment is taken fully into account in the environmental evaluation; and
- The selection of appropriate means of preventing any significant predicted impact is made through modification of the drainage design, choice of discharge location(s) and/ or adoption of runoff treatment methods, with the objective of designing-out potential adverse environmental impacts.

This chapter describes water, hydrology and flooding risk issues associated with the Proposed Development and shall be read in conjunction with Chapter 07 – Biodiversity and Chapter 05 – Land and Soils, which pay particular attention to the potential for impacts upon the aquatic/ riparian and geological environments, respectively.

In order to describe the baseline conditions, AECOM utilised the geotechnical and environmental investigations data acquired during 2006/ 2007 for a previous planning application on the site, and supplemented this with additional groundwater and surface water measurement and samples collected on the Proposed Development site in February 2020.

In assessing potential significant effects associated with construction and operational phases of the Proposed Development on surface waters and hydrogeology, AECOM has considered both the importance of the attributes and the predicted scale and duration of likely impacts.

6.2 Competent Expert

This assessment has been undertaken by Kevin Forde, Associate Hydrogeologist in the AECOM Ground, Energy and Transaction Services team, who has more than 28 years' post-graduate experience. He graduated with an honour's degree in Geology (1991) and has since earned a post graduate diploma in Computing (UCC, 1992) and a Masters in Hydrogeology (UCL, 1993). He has extensive experience of ground contamination assessment and remediation for both public and private sector clients involving environmental due diligence, pre-construction site investigation, EIAR, contaminated land remediation and construction phase soil waste management

6.3 Methodology

This assessment presented in this chapter has been undertaken to satisfy the requirements for an EIAR as outlined in the relevant National (Government of Ireland, 2018) and EU legislation (EU, 2014). This chapter has been prepared in accordance with:

- 'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports', 2017 (EPA, 2017),
- 'Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report', 2017 (European Commission 2017),
- 'Guidelines on the Information to be Contained in Environmental Impact Statements, 2002 (EPA 2002),
- 'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, 2003 (EPA 2003), and
- 'Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland (IGI), 2013).

6.3.1 Sources of Information

The assessment presented in this chapter has been based on both a desktop review of existing information and as well as site specific investigation data acquired from the site of the Proposed Development, as follows:.

- Ordnance Survey of Ireland (OSI) website[1] for historical maps of 1:2,500 scale and 1:10,560 scale (1829 to 1913) and aerial photographs (1995, 2000 and 2005);
- OSI Discovery Series, 2010 of 1:50,000 scale;
- Geological Survey of Ireland (GSI) website[2] for Public Viewer and Groundwater Maps;
- EPA Maps website[3] for Groundwater and Surface Water information;
- AECOM 2020 Groundwater and Surface Water Monitoring Report, Shannon LNG site, Tarbert, Co. Kerry, Ireland, report Ref PR-452891_xxx Draft issue dated xx April 2021;
- Shannon LNG Terminal On shore Ground Investigation Interpretive report C1676.30 Issue 2 Arup dated January 2010 (reports 2006 ground investigation data);
- Office of Public Works' (OPW) national flood hazard mapping and management information (www.floodinfo.ie);
- 2007 Shannon LNG Environmental Impact Statement plus appendices, Arup Consulting Engineers for Shannon LNG Limited, dated September 2007 (particularly Appendix 15.1 'Hydrological and Hydrogeological Impact Assessment of the Proposed Shannon LNG (Liquid Natural Gas) Terminal Development at Ballylongford, Co. Kerry', Minerex Environmental Limited (MEL), 2007); and
- 2012 Shannon LNG CHP Plant Environmental Impact Statement plus appendices, Arup Consulting Engineers for Shannon LNG Limited, dated December 2012.

The hydrological and hydrogeological impact assessment study (Minerex Environmental Limited (MEL), 2007) included a detailed hydrological and hydrogeological study of the then-proposed Shannon LNG development site, encompassing the site of the current Proposed Development, the subsequently-permitted CHP plant site and an area west of the Ralappane Stream (EPA nomenclature, was termed the D1 Stream in previous EIA studies).

There has been no significant development of or disturbance on the Proposed Development site since 2007, therefore the findings of the 2007 MEL study are relevant to the current Proposed Development. The findings have been supplemented by additional groundwater and surface water data collected by AECOM Ireland Limited in February 2020 from monitoring locations within the Proposed Development site, see further details below.

Significant soil and bedrock investigations were undertaken by Arup and MEL across the wider site in 2006 and 2007, respectively (see Chapter 05 and Vol. 4, Appendices A5-1 and A5.2 and Appendix A6-1), including:

6.3.1.1 Arup 2006 – Onshore Ground Investigation study

- 33 trial pits for soil description purposes (TP## series locations – where ## represents the sequential location number);
- 26 rotary core boreholes installed into bedrock and subsoils (the RC## series locations), 10 of which were installed as monitoring wells, also utilised but referred to as BH## series wells in the 2007 MEL study); and
- 1 trial pumping well (location PW01)

6.3.1.2 MEL 2007 Hydrological and Hydrogeological Study

- 4 shallow 'gouge core' soil sampling bores (the GC## series monitoring locations);
- 1 percussive window sampling (the PWS3-series monitoring location);
- 36 piezometers installed in clusters at varying depths into bedrock and subsoils (the BR-## series installations);

[1] http://www.osi.ie
[2] http://www.gsi.ie
[3] https://gis.epa.ie/EPAMaps//

- 24 'phreatic' installations with screened sections at the water table (the BR-## series installations);
- 13 staff gauges to monitor drainage, standing water and lagoon water levels across the wider site (the xx-SG# monitoring locations – where xx represents drainage feature numbers (D1-D5);
- 35 surface water physical chemistry monitoring locations (the xx-SW## monitoring locations);
- 9 flow gauge locations (the xx-FG## monitoring locations); and
- 1 weather station to measure climatic conditions.

AECOM acquired measurements and/ or samples at the pre-existing groundwater wells and surface water monitoring locations within the Proposed Development site in February 2020 to confirm and supplement the earlier datasets, map piezometric contours and hydraulic gradients and assess hydrochemistry.

Not all monitoring locations were found in February 2020 - no trace remains of well RC/ BH10, no staff gauges remain at MEL surface water locations D3-FG-SW2 or D1-SW-FG-SG1 and several wells show damage to the well headworks and/ or standpipes, likely due to livestock presence (notably BH14, BH19, BR-01 and BR-11 – see Vol. 4, Appendix A6-2), however the new data acquired in 2020 support the findings of the previous MEL study.

Hydrodynamic modelling of temperature, salinity, suspended sediment and wastewater dispersion in the estuary referred to in this chapter was completed by Hydro Environmental and AquaFact and is described in Appendix A6-4, Vol. 4.

6.3.2 Determination of Sensitive Receptors

The sensitivity of the receiving environment identifies the ability of the receptor to respond to potential effects. Receptors have been identified during the baseline study and a qualitative assessment has been used to assign a sensitivity rating from low to extremely high based on the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009). Assigning a sensitivity rating (Table 6-1) considers an attribute's likely adaptability, tolerance and recoverability, as well as their designation.

With regards to natural resource use, the materials themselves have been identified as the sensitive receptors. Consuming materials impacts upon their immediate and (in the case of primary materials) long-term availability; this results in the depletion of natural resources and adversely impacts the environment.

Table 6-1 Estimation of Importance of Hydrological and Hydrogeological Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	**Hydrogeology:** Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. Special Area of Conservation (SAC) or Special Protected Area (SPA) status **Hydrology:** River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality or value on a regional or national scale	**Hydrogeology:** Regionally Important Aquifer with multiple wellfields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2,500 homes Inner source protection area for regionally important water source **Hydrology:** River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	**Hydrogeology:** Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1,000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source **Hydrology:** Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	**Hydrogeology:** Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source **Hydrology:** Coarse fishery Local potable water source supplying >50 homes

Importance	Criteria	Typical Examples
		Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	**Hydrogeology:** Poor Bedrock Aquifer Potable water source supplying <50 homes **Hydrology:** Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Source: Based on criteria outlined within the TII's Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009)

6.3.3 Describing Potential Effects

The methodology used for describing the potential effects considers the 'quality' of the effects (i.e. whether it is adverse or beneficial), the 'probability' of the event occurring and the 'duration' of the effects (i.e. whether it is short or long term) as per Section 3.7.3 and Table 3.3 of the EPA's draft Guidelines on the information to be contained in environmental impact assessment reports (EPA, 2017).

Specific assessment criteria and typical examples (based on information within the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)) are outlined in Table 6-2.

Table 6-2 Criteria and Examples for Describing Potential Effects on Waters Environment

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
Large Adverse	Results in loss of attribute	**Hydrogeology:** Removal of large proportion of aquifer Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >2% annually

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
		Hydrology: Loss or extensive change to a waterbody or water dependent habitat Increase in predicted peak flood level >100mm Extensive loss of fishery Calculated risk of serious pollution incident >2% annually Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	**Hydrogeology:** Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >1% annually **Hydrology:** Increase in predicted peak flood level >50 mm Partial loss of fishery Calculated risk of serious pollution incident >1% annually Partial reduction in amenity value
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	**Hydrogeology:** Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems Potential low risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >0.5% annually **Hydrology:** Increase in predicted peak flood level >10 mm Minor loss of fishery

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
		Calculated risk of serious pollution incident >0.5% annually Slight reduction in amenity value
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	**Hydrogeology:** Calculated risk of serious pollution incident <0.5% annually **Hydrology:** Negligible change in predicted peak flood level Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >10 mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >50 mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >100 mm

Source: Based on 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)

6.3.4 Appraisal and Significance of Effects

The appraisal methodology considered the 'quality' of the effect (i.e. whether it is adverse or beneficial), the 'significance' of the effects (i.e. the magnitude of the effect in terms of the environment), the 'probability' of the event occurring, and the 'duration' of the effect (i.e. whether it is short or long term). Terminology for describing the quality, significance, extent, probability and duration of effects is set out in Section 3.7.3 of the EPA guidance (EPA, 2017).

A qualitative approach was used to determine the significance of effects as per the EPA's draft guidance determination figure (Figure 3.5; page 53). Due account was taken of both the sensitivity of the attributes (Table 6-1) and the description of the potential effect (Table 6-2).

It shall be noted the control measures such as sealed drainage systems, hydrocarbon interceptors, packaged sanitary wastewater treatment system and process effluent treatment as outlined in Chapter 2 Project Description, have been considered as embedded mitigation in the project design and their application has been assumed in determining the significance of the effect. Mitigation measures have then been devised for each potential complete pollutant linkage (comprising a source, pathway and receptor).

Table 6-3 Significance Ratings

		Magnitude of Effect			
		Negligible	**Small**	**Moderate**	**Large**
Importance of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Severe/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

6.4 Limitations and Assumptions

AECOM has as part of this assessment reviewed and appended a number of relevant site investigation reports to this EIAR (Appendices A5-1 and A5-2). These investigation reports were undertaken by third parties and AECOM takes no responsibility for the conclusions presented in those reports which were used to provide hydrological, hydrogeological and geotechnical recommendations for a previously proposed development on the site.

6.5 Baseline Environment

6.5.1 Site Area Description

The Proposed Development site covers an area of approximately 41 ha; however, development (i.e. buildings and associated process infrastructure) will principally take place in the north-eastern portion of the Proposed Development site, covering an area of approximately 14 ha. There will be an access road leading south from this area to join the L1010 road.

The entire Proposed Development site is currently in agricultural use, predominantly as pastureland though there is tillage (barley) reported to the south and west of the Proposed Development. There are no currently occupied buildings onsite (see Figure F2-1, Vol. 3 for site location and Figure 6-1 for site layout).

The Proposed Development site is surrounded by a mixture of open water, agricultural land, rural housing, public highway and forestry:

- There is an adjacent area of forestry to the east, beyond which is agricultural land. Tarbert town and Tarbert Generating Station are situated approximately 3.8 to 4.0 km east of the Proposed Development site.
- To the north, the Proposed Development site is bounded by the Shannon Estuary.
- To the south, there is agricultural land used for grazing and the Coast Road (L1010) with dispersed residential properties and agricultural lands beyond.
- To the west, the Proposed Development site is bound by coastal marshes, agricultural land and a derelict residential property in the area of the Masterplan Data Centre Campus, with coastline and agricultural land with individual residential dwellings located beyond. The village of Ballylongford is 3.5 km west of the Proposed Development site.

6.5.2 Topography

The Proposed Development site (excluding the access road) will consist of a constructed platform between Knockfinglas Point and Ardmore Point at elevation of 18 m above Ordnance Datum (m OD) (mean sea level at Malin Head, Co. Donegal).

The topography on the north-eastern side of Knockfinglas Point consists of a number of fields sloping towards the northeast from 14 m to <5 m towards the coast, where there is a low cliff, typically 2 to 5 m in height composed of glacial till subsoils and exposed bedrock, above a tidal rock or shingle coastline. No construction on the foreshore is envisaged in this area other than the outfall and jetty structures.

The preconstruction topography in the north-eastern area, where it is proposed that the LNG Terminal and Power Plant will be constructed, consists of a undulating hillside, sloping downward to the north towards the coastline and varying in elevation from 30 to 35 m OD along its southern boundary to 5 to 11 m OD at the northern edge, where there is a low cliff, typically 2 to 5 m in height and composed of glacial till subsoils and exposed bedrock, above a tidal rock or shingle coastline. This is in line with the topography of the surrounding area, which slopes gently towards the coast.

Ground level contours indicate localised surface gradients at a maximum of approximately 1 in 20, towards the north, in the northeast area of the Proposed Development site.

The access road in the southern part of the Proposed Development will join the L1010 road.

6.5.3 Marine Environment

The Proposed Development is located on the southern side of the Shannon Estuary and comprises both onshore (LNG Terminal and Power Plant) and offshore (FSRU, jetty and outfall pipe) elements.

The River Shannon is the longest river in Ireland at 360.5 km and it drains an area of 16,865 km^2 or one fifth of the island's landmass. This large catchment area includes upland areas and flatter, low land areas used primarily for agriculture, silviculture and turf cutting. These activities give rise to high levels of suspended solids (SS) (80 mg/l) in the estuarine section of the river below Limerick City (McMahon, 1988; McMahon and Quirke, 1992). Light attenuation levels in the estuary are therefore high (McMahon et al., 1992).

Apart from being Ireland's longest river, the Shannon is also, by far, Ireland's largest river by flow having a long term average flow rate of 208.1 m^3/s at Limerick. This is double the flow rate of Ireland's second largest river, the River Corrib. If the flows from all of the rivers and streams into the Shannon Estuary are added to this, the total discharge of the River Shannon at Loop Head increases to 300 m^3/s.

West of the confluence of the River Shannon with the River Fergus, water depths are in excess of 20 m and increase in depth in a westerly direction (British Admiralty Charts nos. 1547 – 1549). Tidal flow velocities are high reaching speeds of approximately 2 m/s and these give rise to high levels of turbulence throughout the estuary; overspills are marked for some areas of the estuary (British Admiralty Charts nos. 1547 – 1549). The maximum tidal range in the Shannon is approximately 5.5 m.

Salinity values range from 0.10 – 26.80 psu (CRFB, 2008) and increase in a westerly direction (McMahon and Quirke, 1992). Because fresh water is lighter than salt water, surface salinities will be lower than deeper values.

Monthly average water temperatures in the Shannon Estuary at Shannon reportedly range from 9.4 to 15.7 ^{o}C (source https://www.seatemperature.org/europe/ireland/shannon).

There are a number of designated marine conservation areas located in the vicinity of the Proposed Development. These include:

- Lower Shannon candidate Special Area of Conservation (cSAC), Site Code 002165.
- Ballylongford Bay proposed Natural Heritage Area (pNHA), Site Code 1332.
- Shannon-Fergus Estuary Special Protection Area (SPA), Site Code 004077.

The Lower Shannon cSAC site includes the Shannon Estuary and river from a line drawn across the mouth between Loop Head and Kerry Head to Killaloe in Co. Clare. The cSAC covers the entire area of estuary and river enclosed by these two boundaries. The site is noted for the presence of a number of habitats listed in Annex I of the EU Habitats Directive (Council Directive 92/43/EEC), including lagoons that are listed as a priority habitat.

The FSRU operations, the jetty and the outfall pipe will be located within the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. These designated areas are also discussed in Chapter 07A – Marine Biodiversity.

6.5.4 Drainage

The Proposed Development site is currently drained by a number of shallow drainage channels.

In the north-eastern area, these drainage features are short (100-200 m or less) and drain directly northward towards the coast (see drainage nomenclature on Figure 6-1).

Several longer drainage features cross the southern portion of the Proposed Development site, generally flowing in a west or northwest direction. The drainage features along the access road all ultimately drain to a single surface water course, the Ralappane Stream (River Waterbody Code IE_SH_24R300270 EPA code 24R30, WFD status reported by EPA as 'Unassigned' (EPA, 2021, see also Section 6.5.9), which was termed the D1 Stream in the 2007 MEL study.

The Ralappane (D1) Stream flows in a northwest direction towards the coast close to, but beyond, the western boundary of the Proposed Development site and through a key coastal wetland area, which is part of both the Lower River Shannon cSAC and the Ballylongford pNHA, before discharging to the Shannon Estuary on the southwest side of Knockfinglas Point via a modified channel (see Photograph 1 in Vol. 4, Appendix A6-1).

Figure 6-1 Local Surface Water Network showing Site Boundary and Proposed Development Layout

The north-eastern and north-western areas of the Proposed Development site are composed of poorly-drained soils and showed development of waterlogged areas and reed growth at several locations under winter 2020 conditions, (see Figure 6-1 and Photographs 2 and 18 in Vol. 4, Appendix A6-2).

Along the access road in the south of the Proposed Development, soils appear better drained (Photograph 1 in Vol. 4, Appendix A6-2), except where the proposed road crosses existing drainage features (near sampling locations D1-SW, D3-SW1 and D2-SW1, see Figure 6-2 and Photograph 2 in Vol. 4, Appendix A6-2).

6.5.5 Quaternary Deposits

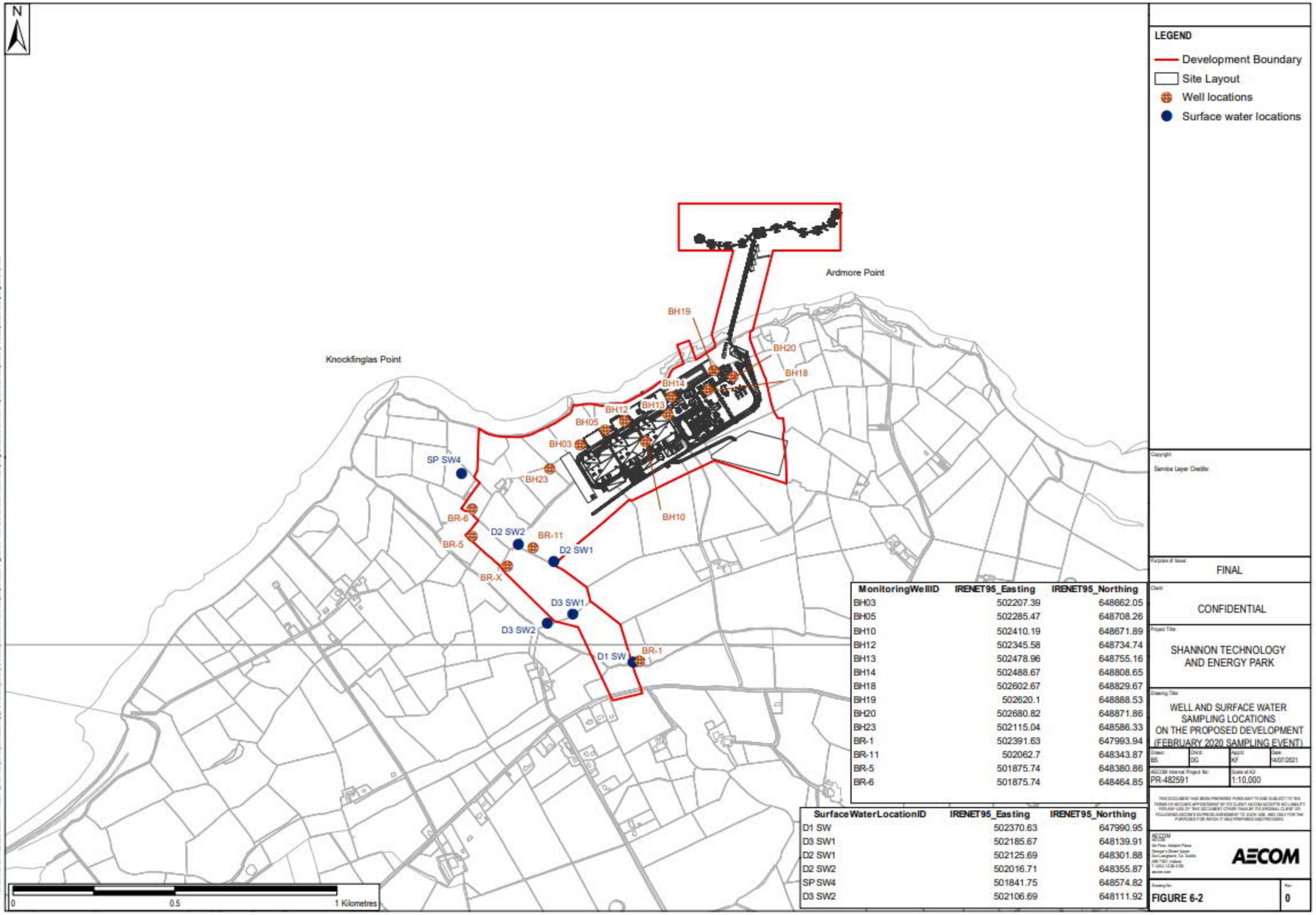
The Teagasc Soil map (provided on GSI mapping website) indicates that the local quaternary deposits are largely glacially-derived and generally comprise predominantly 'TNSSs - tills derived from Namurian sandstones and shales'.

Small amounts of subsoils classified as 'A – alluvium' are also depicted at the Proposed Development site predominantly associated with the principal surface water feature, the Ralappane Stream (stream ref: D1), and associated with inferred periglacial water features (see Chapter 05 - Soils and Geology). No evidence of excavation, filling or waste disposal at the Proposed Development site was observed by AECOM during the December 2020 site walkover or the site assessment works completed during the groundwater and surface water sampling in February 2020.

The previous site investigations identified two distinct Quaternary age glacial till subsoils across the majority of the Proposed Development site, comprising:

- Lower Till - a medium to dark grey coloured stiff stony till encountered directly above bedrock and interpreted as a lodgement till deposited beneath and consolidated by glacial ice; and
- Upper Till – a morainic till deposit over lying the Lower Till, and which is generally lighter brown in colour and less consolidated than the Lower Till. The Upper Till was not encountered at all drilling locations by MEL (2007), due to either lack of deposition or subsequent erosion but, where present, it directly overlies the Lower Till and is from 2 to 3.5 m thick.

In the north-eastern area subsoil thickness in the RC/ BH series bores (Arup, 2007) varied from 0.5 m at RC/ BH20 to 6.7 m at RC/ BH23 (see February 2020 well and surface water sampling locations on Figure 6-2).



MonitoringWellID	IRENET95_Easting	IRENET95_Northing
BH03	502207.39	648662.05
BH05	502285.47	648708.26
BH10	502410.19	648671.89
BH12	502345.58	648734.74
BH13	502478.96	648755.16
BH14	502488.67	648808.65
BH18	502602.67	648829.67
BH19	502620.1	648888.53
BH20	502680.82	648871.86
BH23	502115.04	648586.33
BR-1	502391.63	647993.94
BR-11	502062.7	648343.87
BR-5	501875.74	648380.86
BR-6	501875.74	648464.85

SurfaceWaterLocationID	IRENET95_Easting	IRENET95_Northing
D1 SW	502370.63	647990.95
D3 SW1	502185.67	648139.91
D2 SW1	502125.69	648301.88
D2 SW2	502016.71	648355.87
SP SW4	501841.75	648574.82
D3 SW2	502106.69	648111.92

Figure 6-2 Well and Surface Water Sampling Locations on the Proposed Development Site

The majority of the MEL (2007) site investigation locations were in the west of, or to the west of, the Proposed Development site and found subsoil thickness close to the valley of the Ralappane Stream (the D1 valley) varied from <1 m to 10 m (MEL, 2007), with the thickest subsoils being in the more elevated areas of the Proposed Development site and the thinnest subsoils being in the eroded, fault-controlled valley features or along the coastline.

The glacial till subsoils are discussed in more detail in the Chapter 05 - Land and Soils however MEL (2007) interpreted both till horizons to be clay-dominated (40-70% clay) and concluded that this subsoil type is characterised by poor drainage, low infiltration properties and low permeability, consistent with AECOM field observations of poorly drained areas in February 2020. The glacial till as a whole therefore acts as a hydraulically-confining horizon above the more-permeable weathered bedrock horizon.

Water strikes during drilling in 2006 and 2007 were generally encountered at the base of the tills/ top of rock and standing water levels in the boreholes frequently rose above the level of the water strikes, indicating locally confined (occasionally artesian) conditions in the weathered bedrock.

6.5.6 Bedrock

According to the GSI database, the bedrock underlying the entire Proposed Development site is described as undifferentiated mudstone, siltstone & sandstone of the Lower Carboniferous (Namurian) age Shannon Group (GSI stratigraphic code SHG).

The Shannon Group is reported by the GSI to consist of grey to dark grey bedded sandstones and siltstones, with subordinate blackish grey mudstone or shale. The sandstones frequently show fining upward cycles and are interpreted as forming via turbidite deposition in a marine environment.

The Shannon Group bedrock at the Proposed Development site, and in North Kerry generally, is poorly exposed at the surface inland but there is a good bedrock exposure along the northern coastal boundary of the Proposed Development, showing the bedrock strata typically dipping towards the north-north-west at an angle of 15 to 20º, but with some gentle folding of the strata evident in shoreline exposures on the west side of Ardmore Point.

The cored bores drilled in 2006 (Arup, 2010) in the north-eastern area logged the Shannon Group bedrock as fine grained sandstones interbedded with argillaceous (siltstone and mudstone) bands, with unweathered bedrock showing variable fracture spacing depending on borehole location and with the rock being interpreted as strong and as medium to occasionally thickly bedded (0.1 to 0.3 m thick sandstone/ siltstone beds).

Depth to bedrock at the Proposed Development site varies from 0.5 m below ground level (bgl) (BH20) to 8.0 m bgl (BR-6). Bedrock underlying the main construction area in the northwest of the Proposed Development is generally between 1 and 5 m bgl.

Bedrock at the Proposed Development site is generally unweathered below approximately 10-14 m bgl (MEL, 2007). Below this depth, the bedrock is generally dark grey, very dense and with few, tight fractures. Borehole BR-1 is an exception to this and is reported to show deeper weathering and more extensive fracturing. The drilling logs for boreholes RC/ BR03, RC04, RC/ BR05, RC07, RC08, RC/ BR12, RC/ BR13, RC/ BR14, RC16, RC/ BR19 and RC/ BR20 show iron-staining on bedrock fracture surfaces, suggesting some groundwater movement within this unit.

The upper few metres of bedrock are noted to be more weathered, typically 2-3 m thick, where present (Arup, 2007), having a brownish grey colour and being more extensively fractured along bedding planes and joints. Groundwater strikes were generally encountered within this more open and permeable weathered rock horizon and were artesian in places, particularly in the lower-lying, poorly-drained area between the proposed LNG Terminal and CCGT facilities and Knockfinglas Point, due to the overlying low permeability tills acting as a confining layer.

Borehole BR-1, adjacent to Ralappane Stream and a low lying waterlogged area in the very south of the Proposed Development, showed a high degree of weathered bedrock and both this weathering and the high water table may indicate faulting and groundwater discharge along the east-west alignment of the Ralappane Stream (D1 stream) in this area, which is not in the same orientation as both the main northwest to southeast Ralappane Stream (D1 stream) alignment downstream and the coincident mapped F1 bedrock Fault (MEL, 2007).

The 2006-2007 studies showed that the areas of higher topographic relief between Knockfinglas Point to the west and Ardmore Point in the east are composed of a greater proportion of sandstone and siltstone, which are more resistant to erosion and underly the higher ground in this area, whereas further to the west, outside the area of the Proposed Development site, the relative lack of shoreline and inland bedrock exposures and more subdued topography suggest a greater proportion of softer, less resistant mudstone bands in the near-surface bedrock succession.

The bedrock is discussed in more detail in Chapter 5 - Land and Soils.

6.5.7 Hydrogeology

According to the GSI database, the Shannon Group underlying the Proposed Development site is classified as a 'LI - locally important aquifer, which is moderately productive in local zones'.

The National Draft Gravel Aquifer Map does not indicate a gravel aquifer under the Proposed Development site or in the study area. No extensive clean sands or gravels with resource potential were encountered during the 2006-2007 intrusive site investigation.

The GSI database classifies groundwater vulnerability beneath the Proposed Development site as High to Extreme, due to the relatively thin soil cover across much of the site.

The inferred groundwater flow direction within both the overburden/ subsoil and the bedrock unit beneath the Proposed LNG Development site is to the north or north west in line with the regional gradient, while that beneath the access road is towards the west or southwest towards the wetland areas and the Ralappane Stream (D1 stream).

The Shannon Group bedrock aquifer is not expected to have any significant permeability or transmit large volumes of groundwater other than in the 2-3 m thick weathered bedrock zone.

A search of the GSI well database found no springs or recorded groundwater abstraction wells potentially within a 1 km radius of the Proposed Development site.

The following four private wells are recorded between 1 and 2 km outside of the redline boundary of the Proposed Development site in the GSI well database. All have 'Poor' reported well yields (<100 m^3/day) and are used for agricultural or domestic supply purposes (where use is reported).

- 0813NEW010 - townland Carhoonakilla, depth 33.5 m, depth to rock 9.8 m, yield 26 m^3/day.
- 0813NEW019 - townland Kilcolgan, depth 33.5 m, depth to rock 1.5 m, yield 26 m^3/day, use Agri & domestic.
- 0813NEW029 - townland Kilcolgan, depth 8.2 m, depth to rock 8.2 m, yield 8.7 m^3/day, use Agri & domestic.
- 0813NEW031 - townland Kilcolgan, depth 31.7 m, depth to rock 6.1 m, yield 15 m^3/day, use Agri & domestic.

It shall be noted that there is no requirement to register abstraction wells with the GSI and there may be other, unregistered wells in the vicinity of the Proposed Development site.

The MEL (2007) study identified two groundwater springs within the redline boundary of the Proposed Development. Springs SP-SW4 and SP-SW5 are both located just west of the proposed construction phase car parking/ laydown area and both flow westward towards the D2 Stream, a minor stream/ field drain on the Proposed Development site which flows northwest and then turns southwest and joins the larger Ralappane Stream (D1 stream) outside the site boundary (see Figure 6-1). These minor springs are not recorded on the GSI Wells and Springs database[2].

A larger 150 mm diameter 10 m deep bedrock well, PW01, installed in 2006, was located in an inferred bedrock fracture zone as a potential groundwater supply well for the then-proposed development, however a 28.6 hour pumping test from the 5.4 m bedrock section of the bore indicated a low bedrock permeability (reported as 1.05×10^{-5} m/s) and the well was estimated to have a long term yield of <1 L/s (litre per second), which was insufficient for the requirements of the proposed 2007 development (Arup, 2007). A 3 m drawdown was noted in well RC/ BH23, approximately 75 m to the northeast of PW01, during the PW01 pumping test, indicating good connectivity but poor storativity within the bedrock fracture network at the Proposed Development site.

Packer testing of site investigation boreholes at a site just west of the Proposed Development also reported low bedrock permeabilities (1 to 2.1 x10^{-6} m/s) (Arup, 2012).

6.5.8 Hydrology

6.5.8.1 Regional Hydrology

Regionally, the Proposed Development site lies at the western end of the Shannon Estuary South hydrometric area and Water Framework Directive catchment (hydrometric area 24 and WFD catchment 24). The major rivers in this catchment are the Deel (IE_SH_24D021400) and the Maigue (IE_SH_24M010980), 30 to 45 km east of the site. The overall Shannon Estuary South catchment encompasses an area of approximately 2,033 km^2.

The Proposed Development site lies within the Astee_West sub catchment of the Shannon Estuary South (WFD sub catchment name Astee_West_SC_010).

Approximately 1km west of the Proposed Development site, the short (<1km) Reenturk stream rises at a spring and flows generally west to enter the Shannon Estuary. The Ballyline River (IE_SH_24B030700, EPA name Ballylongford_020) is the principal surface water body to the west of the site; its closest tributary, the Glancullure North (IE_SH_24B030860), is approximately 2 km southwest of the Proposed Development site. The Ballyline River rises on higher ground approximately 6 km south of Ballylongford and flows in a northerly direction, joined by tributaries from east and west, and enters the Shannon Estuary north of Ballylongford, where it is termed Ballylongford Creek (IE_SH_24B030860).

To the east of the Proposed Development site, the Doonard Lower watercourse (IE_SH_24T010100) flows towards the northeast and enters the sea at Tarbert. At its closest point it is approximately 1.8 km from the south of the site and 380 m south of the source of the Ralappane River to the south east of the Proposed Development site.

Between Ardmore Point and Tarbert the short (<1km) Farranwana stream (IE_SH_24R300270) flows north to the Shannon Estuary

6.5.8.2 Local Hydrology

There is one minor watercourse on the Proposed Development site, the Ralappane Stream (IE_SH_24R300270) or D1 stream (MEL 2007 nomenclature), classified by EPA as a 3,498 m long Order 1 watercourse. The Ralappane Stream is not assigned a River Waterbody Status by EPA under the 2013-2018 River Basin Management Plan.

MEL carried out detailed mapping of site drainage during the 2007 survey (MEL, 2007 Section 4.5). Catchments, drainage patterns, drain dimensions, flow rates and surface water hydrochemistry were examined in detail in the field (see Figure 6-1).

The Proposed Development site is within two surface water catchments:

- **Catchment D1 -** The western part of the Proposed Development site where the access road and the western part of the parking/ lay down area are proposed to be located is within Catchment D1, which is drained by the Ralappane Stream (D1 Stream).
- **Shannon Estuary Sub-Catchment** - The north eastern portion of the Proposed Development site where the jetty and CCGT Power Plant is to be built are within the Shannon Estuary Sub-Catchment, which drains directly north to the Shannon Estuary coastline.

Catchment D1

Three significant drains were identified by MEL (2007) in the D1 Catchment in the immediate vicinity of the Proposed Development site. These are shown on Figure 6-1 and are named as follows:

- **D1** (named the Ralappane Stream on EPA maps) the main stream in the area – it passes through the southern end of the Proposed Development site, but is largely outside the Proposed Development site and flows parallel to the western edge of the site in a northwest direction via a tidal creek bordered by dense reed beds (forming part of the Lower River Shannon cSAC) to discharge to the Shannon Estuary;

- **D2** (secondary stream/ field drain north of D1) - enters the Proposed Development site from the east and flows towards the northwest through the Proposed Development site before turning southwest and flowing offsite to join the D1 stream to the west of the site; and
- **D3** (tertiary stream/ field drain north of D1) - enters the Proposed Development from the east and flows across the access road area and then offsite to the southwest to join the D1 stream to the west of the site.

Inflows in April/ May 2007 from the D2 stream (0.16 L/s) and D3 stream (0.04 L/s) to the D1 (Ralappane) Stream (average flow 14.87 L/s along stream) suggests that the D2 and D3 inflows are minor inputs to the D1 flow; however the April/ May 2007 monitoring is noted in MEL (2007) as having followed a period of sustained dry weather conditions in early April 2007.

Short streams D4 and D5 flow towards the southwest from springs SP-SW4 and SP-SW5 before joining the D2 stream in the west of the site.

Shannon Estuary Sub-Catchment

The Shannon Estuary Sub-Basin drains directly northward to the coast via overland and groundwater flow, with a number of short unnamed drainage channels crossing the Proposed Development in a generally northerly direction.

6.5.8.3 Flood Risk

According to the Office of Public Works (OPW) flood risk website[4], there is no history of flooding in the immediate vicinity of the Proposed Development site, although there are a number of records relating to recurring flooding associated with both coastal/ estuarine and runoff sources at Ballylongford, approximately 3.8 km west of the Proposed Development site, and recurring coastal/ estuarine flooding on the Ferry Road at Tarbert Island, approximately 4 km east of the Proposed Development site.

A Flood Risk Assessment (FRA) of the Proposed Development site, which is included in Vol. 4, Appendix 6-4, was carried out using a three-step approach:

- Stage 1 – Flood Risk Identification;
- Stage 2 – Initial Flood Risk Assessment; and
- Stage 3 – Detailed Flood Risk Assessment.

The information collated during Stage 1 – Flood Risk Identification and the subsequent Stage 2 – Initial Flood Risk Assessment was insufficient to assess the potential flood risk to the Proposed Development site. The proposals have been classified as 'Highly Vulnerable Development' and therefore their construction within either Flood Zone 'A' or Flood Zone 'B' requires the justification test to be passed.

The Stage 3 – Detailed Flood Risk Assessment involved the construction of a linked 1D-2D hydraulic model using 'Infoworks ICM' modelling software based on hydrographic and topographic survey information. Fluvial flow estimation was undertaken for the 50%, 1% and 0.1% Annual Exceedance Probability (AEP) events along with tidal level estimation for the 50%, 0.5% and 0.1% AEP events. Climate Change flows and levels were also derived for the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS) in line with current OPW guidance. These flows and levels were subsequently applied to the model to obtain flood extents and levels. Both a baseline and proposed model were developed.

The model results showed that approximately 400 m at the downstream end of the model (Ralappane (D1) stream discharge to the Shannon Estuary) is tidally influenced with a sizeable area liable to tidal flooding, but this area is outside the Proposed Development area. A limited degree of fluvial flooding is present and limited to an area near and beyond the upstream site boundary. The extents of Flood Zone 'A' and Flood Zone 'B' have been determined based on the baseline model outputs.

With the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone 'A' or Flood Zone 'B' and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. Given no development within either flood zone, the proposals are therefore seen to pass the justification test.

The proposed crossings of the watercourses within the Proposed Development have been adequately sized to have a minimal impact on the current hydraulic regime in the area (600 mm culvert (D3 stream

[4] www.floodinfo.ie

crossing), 1200 mm diameter culvert (D2 stream crossing) and 2.4 m x 3.0 m box culvert for the Ralappane (D1) stream crossing)). They also provide an adequate freeboard in accordance with current OPW guidelines for the 1% MRFS AEP fluvial event, which will be seen as an acceptable design flow event for culverts.

The access road levels will be profiled to drain road runoff to an engineered swale adjacent to the road, which will in turn drain northward to the engineered storm drainage system at the LNG Terminal and Power Plant site. There will be no discharge of road runoff to the Ralappane Stream or associated minor watercourses from the access road of from the developed area in the northeast of the Proposed development.

6.5.9 Regional Surface Water Quality

The EPA Quality Rating (Q-value) System has been used to indicate the ecological quality of streams and rivers based on biotic index in Ireland since 1971. River water quality has been provided by the EPA for the Ballyline River west of the Proposed Development site and unnamed river (IE_SH_24T010100) to the east.

The EPA[5] has classified the overall river water quality for the Ballyline River as Q4 – Good. Q-value results of monitoring at two hydrometric stations on the river located at Gortanacooka Br (Station Code RS24B030700, Q-value 3-4) and at Br SW of Shrone (Station Code RS24B030400, Q-value 3-4) both indicate Moderate WFD status, based on data for 2020. Both monitoring stations are located over 3 km west of the Proposed Development site.

River quality for an unnamed river (IE_SH_24T010100) has also been classified as Q4 -Good status based on data for 2017 at a hydrometric station upstream of Tarbert (Station Code RS24T010100), located over 3 km west of the Proposed Development site.

There is no EPA surface water quality data available for the Ralappane Stream (D1 stream) (IE_SH_24R300270) adjacent to the Proposed Development site. A monitoring location named RS24R300270 is shown on EPA mapping on the Ralappane Stream approximately 1.2km upstream of the Proposed Development, however both the EPA and Kerry County Council have indicated that they have no data on record for this location. The EPA has indicated (email dated 27th April 2021) that the Ralappane Stream, like many small streams, is likely to remain unmonitored and unclassified, as long as there is no discharge to it licensed by the Local Authority or EPA.

Transitional Water Quality data for the Lower Shannon Estuary (IE_SH_060_0300) for the period 2010-2012 indicated the estuary to be classified as Unpolluted.

6.5.10 Environmental Site Assessment 2020

6.5.10.1 Groundwater Flow Direction

Groundwater was sampled from 8 of the pre-existing wells on the Proposed Development site by AECOM on 5th and 7th February 2020.

Groundwater levels were measured in 25 wells or piezometer installed by previous site investigations. Groundwater was present in all overburden and bedrock monitoring wells, with depth to groundwater varying between 0.062 m below casing top (m bct) (BH23) and 5.608 m bct (BR-X), with depth to groundwater typically being less than 1 m bct.

Groundwater elevations ranged from 6.098 m OD (BR-6 P2) to 18.143 m OD (BH18).

An assessment of groundwater flow in 2007 by MEL (see Vol. 4, Appendix 6-1) indicated that groundwater flow within the bedrock unit in the north-eastern part of the Proposed Development site was to the north/ northwest towards the Shannon Estuary, in line with the local topographic gradient. Groundwater flow in the western and southern part of the Proposed Development site was generally westward towards the Ralappane Stream (D1 stream).

[5] https://gis.epa.ie/EPAMaps/

The groundwater elevation data calculated from depth to water measurements collected in February 2020 and inferred groundwater contours for the bedrock wells are presented in Figure 6-3 below and supports this groundwater flow interpretation.

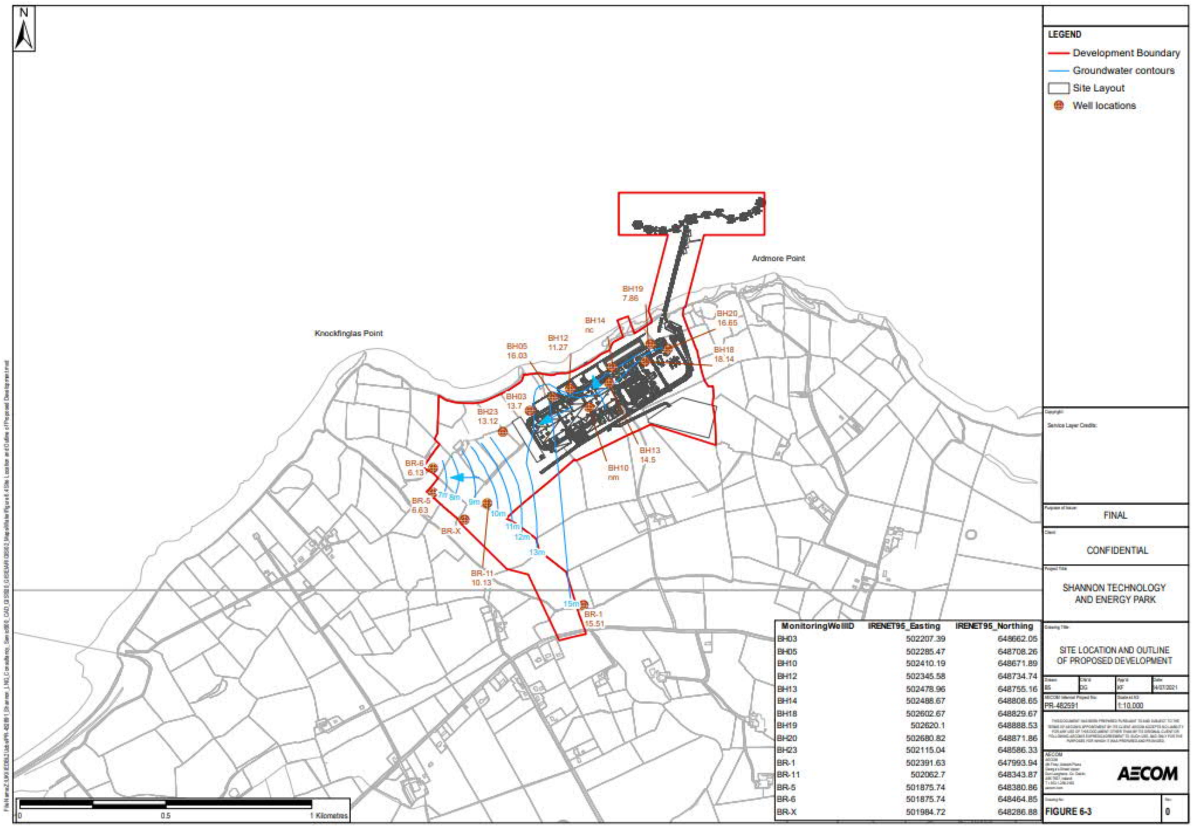


Figure 6-3 Groundwater Elevations and Contours – February 2020 Sampling Event

Bedrock well groundwater elevations in the northern areas of the Proposed Development site indicate generally northward groundwater flows inferred to discharge at the coast to the Shannon Estuary.

In the southern and western areas of the Proposed Development site, groundwater flows towards the main surface water features and generally westward or south-westward towards the Ralappane Stream (D1 stream).

In locations where there are nested piezometer installations in a single borehole, with monitoring zones in both the subsoils and the bedrock (locations BR-1, BR-5, BR-6, BR-11 and BR-X), the water levels in the different monitoring zones show varying vertical head gradients, with vertical upward groundwater head gradients from the deepest to shallowest zones at BR-5 and BR-11 (0.12 and 0.013, respectively) and vertically downward groundwater head gradients at BR-1, BR-6 and BR-X (ranging 0.03 to 0.044) under February 2020 (winter) groundwater conditions.

6.5.10.2 Groundwater Analytical Results

AECOM completed a supplementary Environmental Site Assessment (ESA) in February 2020, which involved the collection and laboratory analysis of groundwater samples and surface water samples within the Proposed Development site to supplement data for the wider area (MEL, 2007).

The supplementary ESA was completed in order to identify potential groundwater or surface water contamination issues which may have been associated with the Proposed Development site resulting from current or past uses of the site and surrounding land.

Sample locations are presented in Figure 6-1 and Volume 4, Appendix 6-2. Samples were delivered to an independent laboratory (EuroFins ELS in Cork) for analysis.

Groundwater Criteria

Appropriate generic assessment criteria were selected based on the Proposed Development site's environmental setting, which is summarised below:

- The bedrock aquifer beneath the Proposed Development site is classified by the GSI as a 'locally important aquifer which is moderately productive in local zones'.

Accordingly, groundwater analytical data were assessed using criteria from the following Irish legislative hierarchy:

- European Union Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016;
- European Communities Environmental Objectives (Groundwater) Regulations, 2010. S.I. No. 9 of 2010 (Groundwater Threshold Values, GTVs);
- European Union (Drinking Water) Regulations 2014. Statutory Instrument (S.I.) No. 122 of 2014 (Drinking Water Standards (DWS);
- European Communities Environmental Objectives (Drinking Water) Regulations, 2010. S.I. No. 106 of 2007 (Drinking Water Standards (DWS); and
- Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003.

It is assumed that groundwater beneath the Proposed Development site will not be abstracted for potable or production uses.

Tables comparing analytical results with relevant standards and guidance including Environmental Quality Standards (EQSs), IGV, GTV or DWS are provided in Volume 4, Appendix 6-2.

Groundwater Results Summary

Groundwater field readings of the unstable parameters pH, electrical conductivity (EC), temperature and redox potential were taken during the February 2020 sampling event. These parameters were all within the applicable statutory GTV ranges for groundwaters and are consistent with groundwater in a non-carbonate, non-saline aquifer (pH ranged from 6.27 to 8.75 pH units, EC ranged 201 to 553 microSiemens per centimetre, temperature 10.2 to 11.31 ^{o}C and redox ranged 142 to 369 milliVolts).

Groundwater analytical data was screened against generic assessment criteria (GAC) for a future commercial end use of the Proposed Development site and within the context of the site environmental setting. Constituent concentrations were deemed 'potentially significant' if they exceeded the 'generic' values, which is an approach consistent with the principles of human health protection in Irish EPA, UK DEFRA and UK Environment Agency guidance.

None of the groundwater parameters analysed exceeded surface water EQSs (European Union Environmental Objectives Regulations 2015, S.I. No. 386 of 2015), however there were exceedances of the other applicable environmental standards or guidance for certain parameters.

The analytical results indicated that background groundwater conditions at the Proposed Development site are locally impacted by some minor water quality issues:

- Petroleum-range hydrocarbons are detected in excess of IGV and/ or GTV guidance in wells BH05, BH19 and BH20 in the north of the Proposed Development site and in well BR-11 in the west of the Proposed Development site. No evidence of fuel hydrocarbon use or storage was observed on the Proposed Development site, therefore hydrocarbons in groundwater may either originate offsite (potentially related to fuel storage, road runoff or machinery maintenance) and migrate onto site via groundwater flow or be derived from breakdown and decay of organic material in vegetated, waterlogged areas of the Proposed Development site and surroundings.
- Dissolved iron and manganese exceed the DWS and IGV at numerous locations in groundwater; however, water at these locations is not used for potable purposes and the IGV is non-statutory guidance in relation to groundwaters. The most elevated dissolved iron and manganese results are associated with wells BH20 and BR-11, which also show the most elevated hydrocarbon results, suggesting that these most elevated dissolved iron and manganese results in groundwater are related to dissolution of iron and manganese from aquifer materials under anaerobic groundwater conditions resulting from biodegradation of the hydrocarbons in the environment.

- Sodium concentrations in groundwater and surface water are all less than 60 mg/l and generally less than 30 mg/l, so do not indicate that salinity is a significant impact on groundwater quality at the Proposed Development site, despite the site's proximity to the estuary.
- Other inorganic parameters (nitrate, phosphate, chloride, sulphate, alkalinity and total organic carbon) in groundwater were generally typical of surface waters in rural, coastal settings. Groundwater samples generally showed elevated phosphate concentrations (which exceeded the GTV by a factor of up to 4) and chloride concentrations (which exceeded either the GTV or IGV by a factor of up to 7 and reflect the site's marine coastal setting), but none of these inorganic parameters analysed in groundwater exceeded the DWS.

6.5.10.3 Surface Water Analytical Result

Surface Water Criteria

Appropriate generic assessment criteria were selected based on the Proposed Development site's environmental setting, which is summarised below:

- Three key watercourses, the Ralappane Stream (D1 stream), D2 Stream and D3 Stream, are identified on the Proposed Development site and numerous smaller field drains are present within the site boundary. The D2 and D3 streams join the D1 Stream and discharge to the Shannon Estuary 50 m west of the north-western site boundary.

As surface water streams are present at the Proposed Development site, analytical data from these was also assessed using criteria from the following Irish hierarchy:

- European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. S.I. No. 386 of 2015. Ireland - AA-EQS Inland/ MAC-EQS Inland;
- Ireland Freshwater EQS (AA/MAC) - European Communities Environmental Objectives (Surface Waters) Regs, 2009. S. I. No. 272 of 2009; European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2010. S. I. No. 327 of 2012; and
- Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003 (EQS only).

Surface Water Analytical Results

Surface water data was screened against GAC for a future commercial end use of the Proposed Development site and within the context of the site environmental setting. Constituent concentrations were deemed 'potentially significant' if they exceeded the 'generic' values, which is an approach consistent with the principles of human health protection in Irish EPA, UK DEFRA and UK Environment Agency guidance.

None of the parameters analysed exceeded surface water EQSs (European Union Environmental Objectives Regulations 2015, S.I. No. 386 of 2015), however there were exceedances of the other applicable environmental standards or guidance for certain parameters.

The analytical results indicated that surface waters at the Proposed Development site are locally impacted by some minor water quality issues:

- Petroleum hydrocarbons were detected at surface water sample D1 SW in the south of the Proposed Development site, where the D1 stream enters the site, suggesting that the hydrocarbons at this location originate upstream of the site.
- Dissolved iron and manganese exceed the DWS at numerous locations in surface water, being highest at spring SP-SW4, which is located in a water-logged, heavily vegetated area, and the significantly elevated iron concentration here is likely related to anaerobic conditions caused by the pooled water and decaying vegetation, however water at these surface water locations is not used for potable purposes.
- Sodium concentrations in surface water are all less than 60 mg/l and generally less than 30 mg/l, so do not indicate that salinity is a significant impact on surface water quality at the Proposed Development site, despite the site's proximity to the estuary.
- Surface water samples show elevated dissolved organic carbon concentrations, generally less than 10 mg/l but are higher at spring SP-SW4 (60.28 mg/l), where it is likely related to slow moving water and decaying vegetation in the hollow where the spring is located.

- Other inorganic parameters (nitrate, phosphate, chloride, sulphate, alkalinity and total organic carbon) were generally typical of surface waters in rural, coastal settings. Surface water samples generally showed elevated phosphate concentrations (which exceeded the EQS by a factor of up to 2) and chloride concentrations (which do not exceed any surface water quality guidance, but reflect the site's proximity to the coast), but none of these inorganic parameters analysed exceeded the DWS.

6.5.11 Groundwater Conceptual Site Model

Rainfall onto the area of the Proposed Development site and the surrounding agricultural land infiltrates into the predominantly clayey soils on the site, providing recharge to the groundwater, or runoff into the streams crossing the site.

The clay till subsoils are frequently poorly drained and the Proposed Development site shows numerous poorly-drained or marshy areas, indicated by extensive growth of reeds, particularly in the western parts of the site. These low permeability tills restrict rainfall infiltration and act as a confining layer to the water-bearing bedrock unit beneath.

The sandstone/ siltstone bedrock is generally encountered at depths between 1 and 5 m bgl at the Proposed Development site. The upper few metres of bedrock of the bedrock are noted to be more weathered (typically the upper 2-3 m), showed groundwater strikes during drilling and the weathered bedrock horizon is considered to be principal lateral groundwater flow pathway, with short groundwater pathways either to the surface watercourses on and near the Proposed Development site or directly to the Shannon Estuary.

Bedrock at the Proposed Development site is generally unweathered below approximately 10-14 m bgl, with few, tight fractures and little groundwater movement reported, other than the deeper fracturing noted at location BR-1 in the south of the Proposed Development site.

Groundwater monitoring in February 2020 indicated that vertical groundwater head gradients at the Proposed Development site are variable and water level measurements in the bedrock wells indicate that groundwater flow in the north of the site is generally northward, discharging to the Shannon Estuary, and is generally westerly in the south and west of the site, discharging towards the surface water courses which ultimately enter the Ralappane Stream (D1 stream) adjacent to the western boundary of the Proposed Development site, which discharges to the Shannon Estuary via the protected wetland area.

Flood risk assessment indicates that the Proposed Development will have negligible impact on the existing flood regime in the area.

The only background water quality issues identified by the 2020 sampling event relate to:

- Localised detections of low concentrations of hydrocarbons in several monitoring wells in the north of the Proposed Development site and in a surface water sample from the south of the Proposed Development site. These hydrocarbon detections are potentially related to degradation of naturally-occurring organic material (decaying vegetation), to upgradient activity involving the use of fuel hydrocarbons (transport, domestic, agricultural or commercial fuel use) or to road runoff to the Ralappane Stream from the L1010 road);
- Elevated dissolved iron and manganese (likely due to anaerobic conditions in the subsoil and bedrock aquifers related to degradation of organic material);
- Elevated chloride (related to the site's coastal setting) and elevated phosphate; and
- Elevated total organic carbon at spring SP-SW4, which is likely to reflect the presence of slow-moving water and decaying vegetation in the hollow where the spring is located.

6.5.12 Summary of Baseline Conditions

A summary of the existing environment baseline conditions at the Proposed Development site is presented in Table 6-4 below.

Table 6-4 Summary of Baseline Conditions

Item	Description
Context	The Proposed Development site is agricultural land, which covers an area of approximately 41 hectares (excluding offshore elements). Historically efforts have been made to improve the agricultural standing of the land with a number of drainage channels constructed and deepened to improve drainage of the land. The land does not appear to have been intensively managed and is currently in use as pastureland. The adjacent marine environment is a designated marine conservation area and is an important marine mammal habitat and is classified as Unpolluted.
Character	The land is unpolluted agricultural land in an agricultural setting. Soil, groundwater and surface water was found to be unpolluted and the environment in the vicinity of the Proposed Development site is generally unpolluted other than pressures associated with its agricultural setting, i.e. some eutrophication (anaerobic conditions) in groundwater and surface water. The adjacent marine environment is classified as Unpolluted The Proposed Development site is surrounded by a mixture of agricultural land, rural housing, public highway and the Shannon Estuary. The Proposed Development site has shown no change in use or significant development since a previous extensive surface water assessment in 2007. There are no EPA Integrated Pollution Control or Industrial Emission licensed facilities within 1 km of the Proposed Development site.
Significance	The Proposed Development site consists of managed agricultural land in an agricultural setting which has shown no increased development since at least 2007. Land use of this nature is abundant within the local area, with agricultural land of a similar nature bounding the Proposed Development site to the south, east and west. The closest designated sites to the Proposed Development site are: • Special Areas of Conservation (cSAC) - Lower River Shannon cSAC - Site code 002165 – borders the entire site to the north and includes the wetland area along the Ralappane Stream (D1 stream) to the west of the site, the salt marsh further west of the site and fields immediately east of the site at Ardmore Point. • Proposed Natural Heritage Area (pNHA) – Ballylongford Bay pNHA – Site Code 001332 – west of Knockfinglas Point and includes the wetland area along the Ralappane Stream to the west of the site, the adjacent heathland and the salt marsh further west of the site. • Special Protection Area (SPA) – River Shannon and River Fergus Estuaries SPA – Site Code 004077 – borders the entire site to the north and includes a portion of the wetland area along the Ralappane Stream to the west of the site and the salt marsh further west of the site. According to the National Parks and Wildlife Service website, the onshore Proposed Development site has not been designated as either a pNHA or SAC. The offshore elements of the Proposed Development are within the Lower Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.
Sensitivity	Ground conditions beneath the Proposed Development site generally consist of topsoil overlaying glacial till over mudstone, siltstone & sandstone bedrock of the Shannon Group, which is classified as a 'LI - locally important aquifer, which is moderately productive in local zones'. Glacial till was encountered beneath the Proposed Development site to depths of between 0.5 m bgl and 8.0 m bgl and the groundwater vulnerability beneath the Proposed Development site is classified as 'High to Extreme' due to the limited subsoil thickness in areas of the site. The Proposed Development site is not located within a groundwater drinking water protection area. A search of the GSI well database found no springs and a relatively small number of low-yielding groundwater abstraction wells between 1 and 2 km from the proposed Development site, though historical site investigation and AECOM's

Item	Description
	2020 sampling identified two springs on the site and there are numerous monitoring wells installed on the Proposed Development site. The monitoring wells on the Proposed Development site were assessed as generally having a poor yield during purging and sampling and a pumping test on bedrock trial abstraction well PW1 in 2006 had insufficient yield (<1 L/s) to meet the needs of the development. The Proposed Development site is drained by a number of short drainage channels which discharge either to the Ralappane Stream (D1 stream) or directly to the Shannon Estuary. The Ralappane Stream drains directly to the Shannon Estuary via a tidal wetland area and river water quality for the Ralappane Stream is not assessed by the EPA.

6.6 Characteristics of the Proposed Development Relating to Hydrology and Hydrogeology

6.6.1 Project Description

The Proposed Development is outlined in Chapter 02 – Project Description and comprises the following 5no. key elements:

- Floating Storage Regasification Unit (FSRU) including LNG Vaporisation Process Equipment, with visiting LNG Carrier moored on seaward side of FSRU;
- Jetty, access trestle with capacity to accommodate up to four tugs;
- Onshore support facilities, including a nitrogen generation facility, control room, guard house, workshop and maintenance buildings, instrument air generator, backup power generators and fire water system;
- Above Ground Installation (AGI) including odorization, metering and pressure control equipment; connecting to the already consented 26 km Shannon Pipeline; and
- Power Plant and Battery Energy Storage System (BESS) facility.

The onshore elements of the Proposed Development are to be constructed mainly at a platform level of 18 m OD in the north of the Proposed Development site.

6.6.2 Construction Activities

The overall construction duration of the Proposed Development will be approximately 32 months. The civil works of relevance to surface water and hydrogeology include the following activities:

- Preliminary enabling works, including clearance, levelling, site roads/ pedestrian access, establishment of lay-down and fabrication area and storm water attenuation ponds;
- Laying of foundations for plant and buildings; and
- Landscaping and reinstatement.

Based on the geotechnical site investigation, excavation to 18 m OD will be required to create the level platform for the LNG Terminal shore facilities and the Power Plant facility. A lower jetty access platform will be constructed at 9m OD and will be accessed via a roadway from the main platform level.

Approximately 480,000 m^3 of overburden soils and rock will be excavated and placed as fill across both the LNG facility and the Power Plant facility in the following construction scenario (each step of which will have an overall net zero cut/ fill balance) (note - the BESS may be built in conjunction with any of the CCGT units):

1. Initial Build (LNG Terminal) 280,000 m^3

2. CCGT Units 1 + 2 130,000 m^3

3. CCGT Unit 3 (+ BESS) 70,000 m^3

All excavated material will be used onsite and no import of soil is expected. Excess material is anticipated to be used in the laydown area, as engineering fill, as landscaping and for other uses throughout the Proposed Development site. It is expected that blasting will be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators.

Based on previous geotechnical investigations, the jetties, mooring/ breasting dolphins and outlet structure will be constructed with approximately 203 steel piles inserted into the estuary bed.

The onshore buildings are generally proposed to comprise pre-engineered/ manufactured structural steel structures which may be founded directly on rock; through rock-socketed piles; or directly on shallow soils/ fill, dependent on the findings of geotechnical testing.

All drainage from the construction phase of the Proposed Development will be controlled and monitored as part of the discharge licence for construction surface water drainage for the Proposed Development from Kerry County Council (KCC) and associated planning conditions. Surface water runoff from the access road and construction areas and all storage of materials potentially hazardous to the aquatic environment will be managed to prevent discharges to the Ralappane Stream (D1 stream) or any uncontrolled discharges to the Shannon Estuary.

6.6.3 Operational Activities

During operation of the Proposed Development, ships carrying LNG will berth alongside the FSRU and unload directly to the FSRU. The LNG vaporisation process equipment to re-gasify the LNG to natural gas will be onboard the FSRU. LNG stored onboard the FSRU will be vapourised or regasified onboard the FSRU at the jetty, via a heat exchanger using seawater from the estuary as the heat source at a rate of up to 22,000 m^3/hr (at seawater temperatures <12 ^oC supplementary heating via gas-fired boilers on the FSRU will be used). Seawater used for regasification will be returned from the FSRU to the estuary via horizontal water jets below the water surface.

Some of the seawater intake will pass through an onboard electro-chlorination unit which produces sodium hypochlorite to be injected back into the sea water circulation system. This acts as a biocide to reduce and control biofouling on the internal pipework and heat exchangers.

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant.

The storage or use of hazardous materials onshore during the operational phase of the Proposed Development will be limited to:

- Diesel – Firewater pumps, black start generator and emergency generators will be powered by diesel which will be stored in bunded facilities;
- Chemical odorant – Odorant NB, a liquid odorant consisting of a tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%) which is classified as Toxic to the aquatic environment (Category 2) (Hazard Code H411) will be stored onshore in two bunded bulk tanks (each 22.7 m^3 capacity) at the AGI Gas Metering/ Odorization Area and will be injected into the gas stream under controlled conditions; and
- Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc. A designated chemical cage is included within the design of the proposed warehouse/ workshop building;

LNG itself is not considered to be a potential source of contamination to groundwater or surface waters, because in view of its extremely low vaporisation temperature (approximately -160°C) it will never be present as a liquid or solid under ambient conditions.

Fuel used for fired heaters and general domestic heating will be met by either withdrawing a small natural gas stream from the high pressure send-out or by using the compressed boil-off gas.

Ancillary construction will include access roads, internal roads, car parking, drainage, workshop, entrance security guardhouse, and landscaping. The internal road network will service access and egress for all site buildings.

6.6.4 Effluent

The Power Plant will generate several different process water effluent streams. Some of the Power Plant effluent streams (see Chapter 02 – Project Description) will either be collected and removed Offsite or be pumped or fall by gravity to the effluent sump, as follows:

- Water treatment process effluent – discharged via effluent sump;
- Steam cycle blowdown/ drains and condenser filter backwash– quenched, pH dosed and discharged via effluent sump;
- Auxiliary boiler blowdown/ drains and drain down of feed water, HRSG or auxiliary boiler systems - discharged via effluent sump;
- Turbine building drains – collected and removed offsite for disposal to an appropriate waste licensed facility; and
- Other process liquid wastes - gas turbine wash water effluent, closed cycle cooling water drain down, sludges from petroleum interceptors - collected and removed offsite for disposal to an appropriate waste licensed facility.

The effluent sump will be equipped with a continuous pH monitor and pH dosing equipment prior to discharge to the estuary. Process effluent discharge volumes are anticipated to be up to 47 m^3/hour.

6.6.5 Foul Sewage

Sanitary wastewater will be generated at three locations on the LNG Terminal site (the workshop/ warehouse building, the nitrogen package control room and the main control room) and at four locations in the Power Plant (the administration building, the central control/ operations building, the stores/ workshop/ canteen building and each turbine building).

The LNG Terminal and Power Plant areas will be served by a common waste water treatment plant (WWTP) and all sanitary effluent will be pumped or fall by gravity to the WWTP.

The WWTP will be a pre-engineered/ package biological treatment system that will treat effluent to required discharge standards required by the site's IE licence and will be designed to cater for 67 people. An average flow of 0.4 L/s (34.5 m^3/day) is expected to be discharged from the WWTP.

All treated effluent from the WWTP will be discharged to the Shannon Estuary via the same discharge point as the stormwater.

All sanitary effluent from the FSRU and tugs will be retained onboard and discharged ashore via vacuum lorry and taken offsite for treatment at a licensed facility. LNG carrier ships will not be permitted to unload sanitary effluent at the Proposed Development.

6.6.6 Storm Water Drainage

The proposed Shannon Technology and Energy Park development will have a total impermeable area of approximately 14 hectares including:

- Heater Building, electrical substations, heat exchangers, administration and security guardhouse buildings;
- Laydown and car parking area;
- Access road, Jetty road and footpaths;
- Lined outfall; and
- A percentage of the side slope and landscaping areas.

As part of the Proposed Development, a surface water drainage network consisting of piped drainage and swales/ catch basins will be constructed to collect, convey, and attenuate the surface water runoff generated.

It is proposed that all stormwater from paved and impermeable areas will be collected and discharged, directly to the Shannon Estuary via a discharge pipe that will extend across the foreshore to below the low water mark. All stormwater from paved and impermeable areas will pass through seven Class 1 hydrocarbon interceptors on the site, each serving particular drainage areas of potential concern on the site before joining the combined drainage system leading to the final discharge monitoring station and the surface water outfall to the estuary.

Stormwater collected from roof drains and permeable areas will discharge directly to the estuary via the final discharge monitoring station. All bunded areas within the Proposed Development site will have valved discharge points as part of their connection to the drainage network.

During the operations phase, all drainage from the Proposed Development site will be controlled and monitored in compliance with the terms of the IE licence.

The Proposed Development has an area of 41 ha (excluding the offshore elements), with the balance of the lands being retained as open grassland to the south and west other than the access road.

The area of the existing site that currently discharges to the Ralappane Stream is approximately 34 ha, while the area of the existing site currently discharging northward directly to the estuary is approximately 14 ha.

The stormwater discharge rate calculated is 162 L/s/ha, which equates to a total discharge rate of approximately 3,125 L/s peak flow from the Proposed Development site for a 100 year, 24 hour rainfall event using an SCS curve number approach. Greenfield runoff rates are not applicable to the Proposed Development, as the stormwater discharge is directly to the estuary and not to a watercourse that may cause flooding of the downstream catchment[6].

Groundwater seepages from springs or at the toe of cut slopes will be collected via a groundwater drainage network which will then discharge directly to the Shannon Estuary via the same discharge outfall pipe as the surface water.

Silt traps will also be incorporated into all groundwater drainage system prior to discharge.

6.6.7 Water Supply

The construction phase for the Proposed Development will require a water supply typically in the range 40 to 55 m^3/day (see Chapter 02 – Project Description) however hydrotesting of tanks and pipework will require a short term (up to 5 days) water supply in excess of 110 m^3/day.

A fresh water/ potable water supply will be required during the operational phase of the Proposed Development, as follows:

- Site-based Staff and visitors – 3.6 m^3/day ; and
- Process Water – ranging between 10 m^3/hr and 32.25 m^3/hr (240 m^3/day to 774 m^3/day); and
- Fire water supply – non-continuous - to fill or top up onsite firewater storage tanks periodically.

Potable and service water for the operational phase of the Proposed Development will be purchased from Irish Water, supplied from a connection to an upgraded 200mm mains water supply to be constructed by KCC along the L1010 (Coast Road from Ballylongford).

Irish Water have confirmed (email dated 9th June 2021) that the source supply for the area does have the capacity to supply the demand for the Proposed Development.

6.6.8 Flood Risk

The Stage 3 – Detailed Flood Risk Assessment concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone ‘A’ or

[6] http://geoservergisweb2.hrwallingford.co.uk/uksd/irish_suds/guidance_criteria.htm#Estuary

Flood Zone 'B' and therefore the Proposed Development, including the excavations required for the terminal and power station platform, has a negligible impact on the existing flood regime in the area.

The proposed crossings of the watercourses within the Proposed Development site have been adequately sized to have a minimal impact on the existing hydraulic regime in the area to the Ralappane Stream.

6.7 Embedded Mitigation Measures

The assessment of impacts assumes the implementation of embedded mitigation measures, as set out in Chapter 2 - Project Description. These will include:

- Separation of drainage from paved and other impermeable areas from other stormwater drainage;
- The provision of an attenuation system for stormwater runoff from paved/ impermeable areas, including silt traps and a Class 1 interceptor fitted with control valves;
- A firewater retention basin and associated stormwater diversion infrastructure;
- Dedicated process effluent and sanitary drainage and treatment systems; and
- Provision of designated bunded storage facilities for potentially-contaminating chemicals and fuels.

6.8 Assessment of Impact and Effect

The Proposed Development can give rise to potential impacts on the drainage regime and hydrology of the Proposed Development site both during the construction and operational phases as outlined below.

Due to the inter-relationship between land, soils and water (hydrology), the following impacts are considered applicable to Chapter 5 - Soils and Geology. Chapter 16 - Waste Management is also considered to comprise an interaction.

6.8.1 Construction Phase

Excavation and infilling of soil and subsoil will be required for levelling of the Proposed Development site to render it suitable for building the LNG Terminal platform and to construct the access roadway and associated swale draining road runoff to the platform area.

Beneath the proposed Terminal platform, a process of 'cut and fill' will be employed in order to level the footprint of the proposed process infrastructure and buildings and achieve the desired platform level of 18 m OD from which to commence construction works. Outside of the Terminal footprint 'cut and fill' will also be undertaken in order to construct roadways, facilitate firewater retention pond construction and achieve desired ground levels across the Proposed Development.

The civil works which may impinge upon the water environment will comprise the following activities:

- Preliminary works, including clearance, levelling, site roads/ pedestrian access, establishment of lay-down and fabrication area and firewater retention pond;
- Laying of foundations for plant and buildings; and
- Landscaping and reinstatement.

The risk of potential significant impacts occurring during the construction phase (in the absence of adequate management and mitigation measures) can arise from a range of activities , principally:

- Discharge of vehicle wash-down water;
- Discharge of construction materials, e.g. uncured concrete;
- Uncontained spillage of wastewater effluent;
- Uncontrolled sediment erosion and contaminated silty runoff;
- Construction vehicle refuelling areas and chemical and waste storage or handling areas;

- Polluted drainage and discharges from site;
- Changes to the existing drainage network including interception and redirection of natural and artificial watercourses (e.g. drainage channels);
- Discharge of groundwater to surface water at platform level due to natural springs or man-made spring lines due to topographical changes (cuttings);
- Increased runoff from cleared areas;
- Watercourse crossings;
- Construction works within water; and
- Outfall points.

Groundwater vulnerability beneath the Proposed Development site is classified as 'Low'. However, removal of the relatively thin soil cover will slightly increase the vulnerability to underlying bedrock aquifer.

During construction, pollution from elevated alkalinity (relating to use of concrete/ cement) and mobilised suspended solids from excavation and piling will generally be the prime concerns, but spillage of fuels, lubricants, hydraulic fluids and cement from construction plant may lead to incidents, especially where there are inadequate pollution mitigation measures.

6.8.1.1 Dewatering Due to Cuttings

The construction of cut faces into bedrock due to excavation for the 18 m platform will lead to seepage of groundwater into the excavation/ platform area from upgradient areas. The rate of seepage is anticipated to be low, due to the presence of clay-dominated soils and the relatively low permeability sandstone bedrock, as indicated by the unproductive pumping test at well PW1. Localised dewatering of the bedrock within 10-50 m of the cut faces of the excavation is anticipated; however, as all groundwater in the bedrock aquifer in this area is flowing towards the Shannon Estuary under baseline conditions, the interception and discharge of groundwater discharging to the platform area of the Proposed Development will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site.

Localised dewatering due to cuttings will result in a **permanent direct** effect on water levels and runoff volumes of **neutral** quality which will have an **imperceptible** effect on the character of the environment but is certain to occur and **irreversible**. This is considered to be a **moderate** effect on a groundwater environment of **low** sensitivity and the significance of the effect is considered **slight.**

6.8.1.2 Sedimentation (Suspended Solids)

Pollution of surface waters by mobilised suspended solids can have significant adverse ecological effects. Various construction activities have the potential to release sediment and cause unacceptable SS levels in the catchment area. Site stripping and bulk earthworks as part of landscaping and building and infrastructure construction will leave substrates exposed to erosion by wind or rain and this can potentially lead to increases in sediment loading of the drainage network or direct runoff to the estuary or to the Ralappane Stream and its tributaries. Contamination from suspended sediments may also be caused by runoff from material stockpiles.

Runoff containing large amounts of suspended solids can adversely impact on surface water. The impact of runoff is considered a temporary effect, as it is only associated with certain phases of the 32 month construction programme.

Control of runoff and release of suspended sediment from construction activities will be managed under the Outline Construction Environmental Management Plan (OCEMP); therefore, uncontrolled runoff containing large amounts of suspended solids is considered unlikely to occur and, should it occur, is likely to be infrequent and short-term. Therefore, it is considered to be a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (estuary) and the significance of the impact is considered **significant**.

Piling and construction operations in the near-offshore area for the jetty and outfall pipe have the potential to generate suspended sediment, which can travel with marine currents, be deposited elsewhere and can adversely impact aquatic habitat quality. Hydrodynamic modelling of marine sediment transport due to offshore piling has been conducted using Telemache software, assuming

10% loss of material (2,225 tonnes) from the installation of bored piles into the bedrock using a reverse circulation drilling technique over a 90 day continuous piling programme. This modelling is reported in Chapter 7A and Appendix A7A-5, Vol. 4 and indicates that suspended sediments will be dispersed laterally along the coastline by tidal currents, extending to the east of Tarbert at high tide and extending over 10 km downstream in the estuary under low water conditions. The model predicts sediment deposition rates in this area would be low, less than 0.01 mm per square metre across the majority of the suspended sediment deposition area, other than a localised area up to 0.2 mm per square metre on the east side of Ballylongford Bay, which is regarded as insignificant in relation to OSPAR guidance on sediment deposition (see Chapter 07A – Section 7.5.4.2). Piling operations are therefore considered to be a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (estuary) and the significance of the impact is considered **significant**.

6.8.1.3 Accidental Spillage and Leaks

Any construction activities carried out close to surface waters involve a risk of pollution due to accidental spillage and leaks. While liquids such as oils, lubricants, paints, bituminous coatings, preservatives and weed killers present the greatest risk, fuel spillages from machinery operating close to watercourses or the estuary also present a risk. The refuelling of general construction plant also poses a significant risk of pollution, depending on how and where it is carried out. Pollution as a result of accidental spillage can potentially affect fish, aquatic flora and can also have an effect on invertebrate communities.

As main site works are generally located within the area of moderate to high vulnerability due to its proximity to the estuary, fuels or chemicals, if inappropriately handled or stored, during construction can potentially impact on surface water quality in the estuary adjacent to the Proposed Development site.

Accidental spillage may result in the indirect impact to surface water at the Proposed Development site shall contaminants enter surface waters directly or migrate through the subsoils/ bedrock and underlying groundwater to surface waters. The impact is considered a direct effect of a negative nature and temporary duration, given it is only associated with one-off events during the construction programme.

Measures to prevent accidental spillages and leaks will be implemented in accordance with the OCEMP and are considered unlikely to occur and, shall they occur, are likely to be a temporary direct small adverse effect.

Therefore, accidental spillage and leaks during the construction phase is considered to be a **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.1.4 Use of Concrete and Lime

Lime and concrete (specifically, the cement component) are highly alkaline and any spillage can enter surface water directly or migrates though subsoils and groundwater impacting surface water quality. The activities most likely to result in contamination include piling and pouring of concrete foundations during building construction, roadway construction and construction of concrete culverts and watercourse crossings.

The impact is considered a direct effect of a negative nature and of a temporary duration given it is only associated with the construction programme. Impacts associated with the use of concrete and lime are considered unlikely to occur and, should they occur, are likely to be rare events of short duration. Therefore, the construction phase use of lime and concrete is considered to result in a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.1.5 Piling activities for Jetty and Outfall Construction

Due to the presence of shallow bedrock, the piles for the jetty and surface water outfall structures' foundations will be drilled and socketed into the rock. This operation will require a jack-up platform supporting a large crane-mounted drill and a large barge-mounted support crane. Spoils from the drilling operation will be conveyed to the surface via reverse-circulation through the drill stem and contained within designated scows or other vessels. Transport and deposition of suspended sediment caused by piling operations is discussed in Section 6.8.1.2. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work will be staged in a manner to prevent concrete from entering the water.

Piling activities are therefore considered to result in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) and the significance of effects is **significant.**

6.8.2 Operational Phase

Potential adverse impacts which can occur due to unplanned events during the operational phase, in the absence of adequate management and mitigation measures, are as follows:

- Uncontained spillage of wastewater effluent;
- Uncontained spillage of polluting materials stored onsite, e.g. diesel fuel, glycol heat transfer fluid or oil, cleaning chemicals and lubricants for maintenance;
- Excessive demand on the water main/ water network resulting in reduced supply or loss of pressure in the surrounding area;
- Potential flooding of the Proposed Development site resulting in contaminated floodwaters;
- Siltation of storm water drainage system and attenuation ponds; and
- Emergency overflow discharge from the foul sewage networks.

Direct discharges to the water environment during the operational phase will consist of the following:

- Surface water runoff from paved/ impermeable areas of the Shannon Technology and Energy Park and access road will be collected via a dedicated, sealed storm drainage network, which will pass through a silt trap and Class 1 hydrocarbon interceptor, and discharge to the shared constructed outfall to the Shannon Estuary. The resulting discharge will be similar in composition and will have similar flow rates to existing drainage, which discharges directly from the agricultural lands to the Ralappane Stream and the Shannon Estuary. On this basis it is not envisaged that the surface water discharge will have an adverse impact on receiving water bodies;
- Groundwater discharging to the excavated area of the Proposed Development will be intercepted at the toe of the cut faces by drains and will be discharged to the Shannon Estuary via the storm water outfall, but will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site;
- A minor portion of surface water from the immediate vicinity of the streams will enter directly through overland flow;
- Surface water from undeveloped areas in the west and south of the Proposed Development site will continue to discharge to the existing drainage ditch network, other than the access road runoff, which will be routed to the storm water drains serving the paved/ impermeable area of the developed area;
- Drainage from unpaved/ permeable areas of the developed area will be collected via a separate storm drainage network consisting of swales and catch basins and discharge directly to the shared constructed outfall to the Shannon Estuary;
- All foul water generated at the onshore part of the Proposed Development will be pumped or fall by gravity to a single WWTP onsite. The WWTP will be a package treatment system which will treat the effluent to required discharge standards. The WWTP will be sized to cater for a population of approximately 67 people. The treated effluent will be discharged to the estuary via the same discharge outfall pipe as the surface water. All sanitary effluent from the FSRU will be retained onboard and discharged ashore via vacuum lorry to a licensed waste facility;
- Process effluent streams principally comprising process water treatment effluent, steam cycle blowdown/ drains and auxiliary boiler blowdown/ drains will be collected separately, monitored and, if necessary, treated before being discharged to the effluent sump prior to discharge to the shared constructed outfall to the Shannon Estuary; and
- Other process effluent streams comprising Turbine Building Floor Drains and other liquid wastes not suitable for discharge to surface water will be collected and removed from site to an appropriate licenced waste facility.

6.8.2.1 Hazardous Materials Storage

The storage or use of materials hazardous to the aquatic environment during the operational phase of the Proposed Development will be limited to:

- Diesel – The firewater pumps, black start generator and emergency generators will be fuelled by diesel which will be stored in bunded facilities;
- Chemical odorant – Odorant NB, a liquid odorant consisting of a tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%) which is classified as Toxic to the aquatic environment (Category 2) (Hazard Code H411) will be stored onshore in two bunded bulk tanks (each 22.7 m^3 capacity) at the AGI Gas Metering/ Odorization Area and will be injected into the gas stream under controlled conditions; and
- Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc. A designated chemical cage is included within the design of the proposed warehouse/ workshop building.

LNG itself is not considered to be a potential source of contamination to groundwater or surface waters, because in view of its extremely low vaporisation temperature (approximately -160°C) it will never be present as a liquid or solid under ambient conditions.

The storage of materials hazardous to the aquatic environment during the operational phase will be in secondary contained areas, such as fixed or mobile bunds, and will be controlled in accordance with any IE licence conditions; therefore the risk of accidental discharge during storage or use of materials hazardous to the aquatic environment during the operational phase will be considered to result in a **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.2.2 Accidental Spillage and Leaks

Accidental spills and leaks are considered to be direct impacts of a negative nature and of a temporary duration given that they will be confined to one-off releases. Measures incorporated by design into the building will minimise the risk of spills entering surface waters and the potential for spills impacting on surface water is considered unlikely arising from rare events. Accidental spills and leaks are therefore considered to result in **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) therefore the significance of potential effects is **significant.**

6.8.2.3 Flooding and Drainage

The Stage 3 – Detailed Flood Risk Assessment (see Vol. 4, Appendix 6-3) concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone 'A' or Flood Zone 'B' and therefore the Proposed Development has a negligible impact on the existing flood regime in the area.

The proposed crossings of the watercourses within the Proposed Development will be adequately sized at detailed design stage to have a minimal impact on the existing hydraulic regime in the area draining to the Ralappane Stream.

The LNG Terminal and Power Plant site will have a constructed stormwater drainage system capable of handling anticipated stormwater volumes (up to be 162 L/s/ha (3,125 L/s) for a 100 year, 24 hour rain event) and which will incorporate monitoring equipment and firewater retention facilities.

Impacts from flooding and drainage are considered to be unlikely arising from rare events resulting in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) therefore the significance of potential effects is **significant**.

6.8.2.4 Combined Operational Stormwater, Sanitary and Process Effluent Discharges to Surface Water

The combined stormwater flows and treated sanitary effluent and process effluent from the Proposed Development will be discharged via a common outfall to the estuary below low tide level. The potential impact of this discharge on the marine environment is discussed under Chapter 7 - Biodiversity. The Surface Water Outfall pipeline outflow will be monitored prior to the discharge point for a range of parameters at frequencies specified under the site's IE licence and will allow for retention of the combined effluent stream in the Fire Water Retention Pond in the event of exceedances of the allowed Emission Limit Values under the IE licence. An average flow of 0.4 L/s (34.5 m^3/day) is expected to be discharged from the WWTP via the outfall pipe.

3-D hydrodynamic modelling of the wastewater discharge plume in the estuary using Telemache software has indicated negligible impact on the estuary, because of significant dilution and dispersion will occur due to the high water volume and tidal flux in the estuary. Modelling of water flow and direction for a flooding tide and mid-ebb tide indicates predominantly east-west water flow beyond a distance of approximately 250 m offshore.

Suspended sediment (see piling discussion in Section 6.8.1.2) and treated effluent (modelled as E. Coli bacteria) are predicted by the hydrodynamic modelling to undergo extremely high levels of dilution and dispersion within a short distance (approximately 1 km) of the site. Also, the predicted current directions on the ebb tide indicate little or no interaction of the outfall or FRSU discharges from the site with intertidal or subtidal habitats or species in the estuary, including the SCA, SPA, pNHA and the oyster production sites in inner Ballylongford Bay (see Chapter 07A – Marine Biodiversity). Maximum predicted E. coli concentrations from the site wastewater discharge are predicted to decline to below 1 per 100 ml before reaching either Tarbert Island or inner Ballylongford Bay.

Operational discharges to the estuary will be controlled under the site's IE licence and the operational phase Environmental Management Plan. Impacts from site drainage are considered to be unlikely, arising from rare events, resulting in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) and the significance of potential impacts is **significant**.

6.8.2.5 Discharges from FSRU Operations

Seawater used for regasification will be returned from the FSRU to the estuary at up to 8 ºC colder than the receiving ambient seawater. The cold water discharge from the FSRU to the estuary has been modelled using Telemache software and indicated negligible impact on the estuary, because of significant dilution and dispersion due to the high water volume and tidal flux in the estuary.

Cold water discharges from the FSRU were modelled as 8 ^{o}C below ambient seawater temperature at a rate of up to 22,000 m^3/hr) and indicated that the cold water plume parallels the coastline and dissipates quickly (< 0.5 ^{o}C below ambient seawater temperature within 200m of the discharge point and <0.1 ^{o}C within 3 km of the discharge point). A plume at between 0.01 and 0.05 ^{o}C below ambient seawater temperature was modelled throughout the water column (from the surface to the bottom layer) and extending west from the discharge point at the FSRU at mid-ebb and low water on a spring tide to the north of Carrick Island (>4km from the discharge point). The maximum reduction in temperature within the Ballylongford Bay area is between 0.05 and 0.1 ^{o}C, which is insignificant and is not predicted by the model to impact the oyster production sites in the bay (see Chapter 07A – Marine Biodiversity).

Similarly, a plume at between 0.01 and 0.05 ^{o}C below ambient seawater temperature extends >3km east of the discharge point at mid-flood and high water on a spring tide.

Seawater returned to the estuary from the seawater circulation system will contain residual chlorine from sodium hypochlorite used as a biocide. The concentration of residual chlorine at the FSRU seawater discharge will be monitored and will not exceed 0.5 mg/L. Modelling indicates it will undergo significant and rapid dilution and dispersion in the estuary. Maximum residual chlorine concentration above 0.1mg/l are shown to occur only within 20m of the FRSU discharge point and for a short period of time. Within 1.5km both east and west of the discharge point the predicted maximum residual chlorine concentration is predicted to decline to less than 0.01mg/l and is assessed as being negligible/undetectable (see Chapter 07A – Marine Biodiversity).

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant. The reject stream from these freshwater generators will have elevated salt content and will be discharged to the estuary from the FSRU and will undergo significant and rapid dilution and dispersion, similar to the other FSRU discharges to the estuary.

Discharges from FSRU operations are therefore considered to result in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC); therefore, the significance of potential effects is **significant.**

6.9 Cumulative Impacts and Effects

The cumulative impacts of the Proposed Development and nearby consented projects in the vicinity of the Proposed Development are discussed below. A planning search of granted and pending planning applications made within the vicinity of the Proposed Development site is presented in Chapter 4 - Planning and Development.

6.9.1 Summary of Schemes Considered in Cumulative Impact Assessment

6.9.1.1 LNG Pipeline

Permission was granted in 2009 for a pipeline to connect the Proposed Development site to the existing national gas network near Foynes, Co. Limerick. The application was accompanied by an EIAR.

No significant residual effects were identified to hydrogeology and surface water in the EIAR for the LNG pipeline.

6.9.1.2 Data Centre Campus

As part of the Masterplan, a Data Centre Campus is to be constructed to the west of the Proposed Development. This will be subject to its own EIAR and planning application.

6.9.1.3 220 kV and Medium Voltage (10/ 20 kV) Power Transmission Networks

An application to connect to the national electrical transmission network via a 220 kV high voltage connection was submitted to EirGrid in September 2020. An offer has yet to be received. It is expected that the high voltage connection will run 5 km east under the L1010 road to the ESBN/ EirGrid Kilpaddoge 220 kV substation.

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational (Chapter 02 – Project Description). Therefore, the LNG Terminal design will also require an onsite substation and a separate medium voltage (10/ 20 kV) connection, from the existing Electricity Supply Board Networks (ESBN)/ EirGrid Kilpaddoge substation. This will be used as a back-up electricity system when the Power Plant is undergoing maintenance.

The medium voltage (10/ 20 kV) and 220 kV power connections will be constructed in parallel with the Proposed Development but will be subject to separate planning design and planning applications.

6.9.1.4 Construction Impact

If works associated with these three schemes (described above) in close proximity to the Proposed Development are concurrent with works at the Proposed Development, there is potential for cumulative impacts and effects on surface water and groundwater features, notably the Ralappane Stream and associated protected habitats. Should this situation arise, construction activities will be planned and phased, in consultation with the construction management team for the Shannon Technology and Energy Park.. As outlined in Section 6.10 , mitigation measures proposed to manage and control potential impacts during the Proposed Development will reduce the magnitude and significance of effects to a minimum.

Taking account of mitigation measures proposed, the cumulative effect of all schemes proceeding simultaneously is considered to be a **negligible** impact to an **extremely high** sensitivity environment and the significance of the effect has been assessed as **imperceptible**.

6.9.1.5 Operational Impacts

Potential impacts from consented development elsewhere, combined with the potential impacts of the Proposed Development, can result in a temporary minor adverse impact to water supply.

Irish Water have confirmed that there is sufficient capacity to supply drinking water and process water to the Proposed Development. There is no requirement for sanitary and process effluent discharge to a local sewerage network (due to the onsite wastewater treatment proposed and the onsite containment of selected effluent streams for Offsite disposal).

Potential effects to surface water and groundwater from the Proposed Development range from **small to moderate** and mitigation measures proposed to manage and control potential impacts during operation will further reduce the magnitude and significance of effects. Potential impacts primarily relate to accidental releases, which on independent sites cannot be considered to be cumulative. Therefore, the cumulative operational effect of the Proposed Development and other consented or potential developments in the vicinity surface water and groundwater is considered to be **imperceptible**.

6.10 Mitigation and Monitoring Measures

6.10.1 Construction Phase

6.10.1.1 Construction Environmental Management Plan

An Outline Construction Environmental Management Plan (OCEMP) has been prepared as part of this application. The contractor will prepare and implement a Construction Environmental Management Plan (CEMP) for the Proposed Development during the construction phase. This will incorporate relevant environmental avoidance or mitigation measures to minimise potential environmental impact of the construction works. It will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the Proposed Development site will be trained in the implementation of the procedures. The CEMP will be reviewed and updated on a regular basis and modified and extended by any relevant construction related requirements imposed as conditions of any planning permission granted.

The CEMP will include a Waste Management Plan (WMP) (see Appendix A16-1, Vol.4 for the OCEMP), to be prepared in accordance with Department of Environment, Community & Local Government guidelines (DoEHLG, 2006) and an Oil and Hazardous and Noxious Substances Plan (Appendix A2-5, Vol. 4). It will also include details of environmental monitoring to be implemented for the duration of the construction works.

6.10.1.2 Soil Removal and Compaction

Temporary storage of soil and stone will be carefully managed in such a way as to prevent potential negative impact on the receiving environment. Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from the shoreline, drainage systems and retained drainage channels and away from areas subject to flooding, so as not to cause potential silt runoff to surface waters. Stockpiles will be managed to prevent dust generation during dry weather. The CEMP will outline proposals for the excavation and management of excavated material. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. Further detail on mitigation measures in relation to soil management is given in Chapter 5 - Land and Soils.

6.10.1.3 Bedrock Excavation

Where bedrock is to be removed as part of the cut/ fill exercise onsite, it is anticipated that rock breaking and blasting may be required to achieve the 18 m OD formation level. Mitigation measures relating to the associated noise impacts are set out in Chapter 9 - Noise & Vibration. Excavation of bedrock to 18 m OD will be below the pre-construction groundwater level in some areas of the Proposed Development site and will result in discharges of groundwater from the cut faces. This will be routed via the stormwater drainage system at platform level, as described below.

6.10.1.4 Surface Water/ Storm Water

During the construction phase the mitigation measures will ensure that no sediment contamination, contaminated runoff or untreated wastewater will enter watercourses on or near the Proposed Development site. Drainage channels and water streams will be clearly identified onsite and shown on method statements and site plans.

Groundwater from the upgradient area to the south discharging onto the main construction site at the cut faces to the south, east and west of the 18 m platform will be intercepted by drainage at the toe of the slopes and diverted away from the active construction areas, to the extent possible. In case of impact by construction activity and machinery, this groundwater will pass through a sediment trap and oil: water separator prior to discharge under licence to the estuary via the outfall.

Temporary surface water drainage and silt ponds will be constructed to control runoff from the earthwork stages. Drains carrying high sediment load will be diverted through silt ponds, located between the construction area and the surface water outfall. Surface water runoff from working areas will not be allowed to discharge directly to the local watercourses or to the estuary. To achieve this, the drainage system and silt ponds will be constructed prior to the commencement of major site works. All design and construction will be carried out in accordance with the Construction Industry Research and Information Association (CIRIA) C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors (CIRIA, 2001). During the construction activities there will be a requirement for diverting rainwater runoff away from the construction areas, into the nearby estuary. Rainwater runoff will be treated to prevent sediment from entering the estuary. Discharge water quality targets will be agreed with KCC and included in the CEMP. Regular water inspection and sampling regimes will be put in place via the CEMP on the foreshore during construction activity onsite to monitoring compliance with the discharge conditions.

Where possible, excavations will only remain open for limited time periods to reduce groundwater ingress and water containing silt will be passed through a settlement tank/ silt pond or adequate filtration system prior to discharge. Discharge consent under the CEMP will be obtained for disposal of ground water arising from pumping or such water may be disposed of as construction site runoff, having first passed through a settlement tank or filtration system, where appropriate. A discharge licence will be required for temporary construction phase storm water discharges to the estuary; operational phase discharges will be regulated under the site's IE licence.

To minimise impact from material spillages, all oils, chemicals and waste materials will be stored within temporary bunded areas with a volume of 110% of the capacity of the largest tank/ container within it. Fuel, oil and chemical filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and disposal.

Vehicle/ equipment refuelling and maintenance with hydraulic oil or lubricants will take place in bunded areas where possible. If it is not possible to bring the machine to the refuelling point, fuel will be delivered in a double-skinned mobile fuel bowser. Drip trays will be used to contain spillages with spill kits and hydrocarbon absorbent packs stored in vehicle cabs with operators fully trained in their use. Vehicles and equipment will not be left unattended during refuelling operations. Regular inspection and maintenance measures for site machinery will be included in the CEMP to minimise the likelihood of losses of hydraulic fluids or fuels to ground during the construction works.

Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from drainage systems and retained drainage channels, away from areas subject to flooding. Runoff from spoil heaps will be prevented from entering watercourses by diverting it through onsite settlement ponds and removing material as soon as possible to designated storage areas.

Culverts beneath the access road will be located at or close to the locations of existing natural flow paths to allow existing flows to continue. Lateral drainage will be within shallow geotextile and rock lined drainage channels to avoid the drainage of surrounding soils. The outer perimeter fence line will be set back from the L1010 to avoid crossing watercourses as far as possible. The outer perimeter fencing is not expected to impact surface water flow where two minor watercourses are crossed, as there will not be a requirement for this fencing to be extended below the water's surface. The inner security fence surrounding the Power Plant and LNG Terminal will not cross any existing watercourse.

All watercourse crossings will be planned in accordance with applicable guidelines. No permanent watercourse diversions are proposed as part of the Proposed Development.

The access road will be designed to conduct road runoff to an engineered swale adjacent to the west side of the road. This swale will be profiled to grade continuously northward and to transfer the runoff from the access road to the sealed stormwater drainage system at the LNG Terminal and Power Plant area in the north of the Proposed Development.

Silt traps will be placed at crossing points to avoid siltation of watercourses. These will be maintained and cleaned regularly throughout the construction phase. Attention will also be paid to preventing the build-up of dirt on road surfaces, caused by lorries and other plant entering and exiting the Proposed Development site, via wheel washes and road sweepers as required.

6.10.1.5 Fuel and Chemical Handling

Construction phase mitigation will be implemented to prevent spillages to ground of fuels, and to prevent any consequent soil, groundwater or surface water quality impacts. These include but are not limited to the following:

- Designating a bunded storage area at the contractor's compound for all oils, solvents and paints used during construction. Oil and fuel storage tanks will be bunded to a volume of 110% of the capacity of the largest tank/ container within the bunded area. Drainage from the bunded area will be diverted for collection and safe disposal. All containers within the storage area will be clearly labelled, so that appropriate remedial action can be taken in the event of a spillage. When moving drums from the bunded storage area to locations within the Proposed Development, a suitably-sized spill pallet will be used for containing any potential spillages during transit;

- Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area, which will be away from surface water gullies or drains. Spill kit facilities will be provided at the fuelling area in order to provide for accidental releases or spillages in and around the area. Any used spill kit materials will be appropriately disposed of using a hazardous waste contractor; and
- Where mobile fuel bowsers are used on the Proposed Development in the event of a machine requiring refuelling outside of the designated area, fuel will be transported in a mobile double skinned tank. Any flexible pipe, tap or valve will be fitted with a lock where it leaves the tank and locked shut when not in use. The pump or valve will also have a lock and be locked shut when not in use. Each bowser will carry a spill kit and each bowser operator will have spill response training.

6.10.1.6 Control of Concrete and Lime

Measures for protection of watercourses from wet concrete will be implemented and the following measures will be implemented to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil/ groundwater or nearby surface water, as follows:

- Ready-mixed concrete will be either produced onsite in a batching plant or brought to the Proposed Development by truck.
- A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment.
- The pouring of concrete will take place within designated areas as required, using a geosynthetic material to prevent concrete runoff into the soil.
- Washout of concrete-transporting vehicles will take place at an appropriate facility, offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.
- Rainwater will be diverted away from the construction areas into the estuary or nearby ditches and streams. Water from construction areas will be filtered and treated to prevent sediment from entering surface waters. A regular water sampling regime will be put in place for the D1, D2 and D3 streams and the Surface Water Outfall on the Proposed Development site and other potentially-impacted runoff points to the shoreline during construction activity onsite. Water samples will be taken at specified locations to be agreed with the local authority.
- Works requiring discharge of water from excavations or areas of water which may have come in contact with concrete or cementitious material will require a site Permit to Pump under procedures outlined in the OCEMP. All such water will be tested for pH by contractors, and discharging water must go through a series of filtration systems before final discharge.

6.10.1.7 Piling Operations for Jetty and Outfall Construction

Piling operation and follow on construction in the estuary have the potential to impact on the marine environment. However, 3-D hydrodynamic modelling of sediment generated during piling has been completed using Telemache software and indicated negligible impact on the estuary, because of significant dispersion due to the high water volume and tidal flux in the estuary leading to low sediment loadings. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work below the high water mark will be staged in a manner to prevent concrete from entering the water.

6.10.1.8 Sources of Aggregates and Clean Fill for the Project

While it is anticipated the Proposed Development will have a net zero cut/ fill balance, there is potential for small quantities of clean fill materials to be required to facilitate construction works, for example where site-won soils or crushed rock are not of sufficient geotechnical or chemical quality for re-use. The source of this fill material will be vetted in order to ensure that it is of a reputable origin and that it is 'clean' (i.e. will not introduce contamination to the groundwater or surface water environment). All potential suppliers will be vetted for the following criteria:

- Environmental management status; and
- Regulatory and legal compliance status of the company.

Clean fill material will be sourced from local suppliers which comply with the above requirements. If recycled aggregate is used as imported fill, rigorous chemical testing will be undertaken to confirm that it is 'clean' (i.e. will not introduce contamination to the environment).

6.10.1.9 Water Supply

The details of the water supply for the construction phase of the Proposed Development will be agreed with the water services section of Kerry County Council/ Irish Water prior to commencement. It is anticipated that a water supply of up to 98 m^3/day will be required during construction of the LNG Terminal and up to 55 m^3/day during construction of the Power Plant, which will be supplied from the upgraded water main along the L1010 road south of the Proposed Development site.

6.10.1.10 Foul Sewer

Foul sewage arising from kitchen facilities and temporary toilets and sanitary facilities during the Construction Phase on the Proposed Development site will initially be discharged to an onsite receptacle which will be appropriately managed by the service contractor with relevant licences and emptied by tanker on a regular basis for disposal at a licensed waste facility.

It is anticipated that, due to the scale of the Proposed Development, a canteen will be provided onsite during construction. Provisions will be made for a grease trap at the canteen drain outlet and this drain will connect to the onsite receptacle and later to the WWTP. Drumming of waste cooking oil within the canteen will also be provided.

6.10.2 Operational Phase

6.10.2.1 Surface Water

All hazardous or water polluting materials will be handled or stored in a manner to prevent/ minimise potential impact to surface water.

With regard to the emergency back-up generators associated with the Proposed Development, the diesel will be stored in fuel tanks located in bunded areas. If a leak from one of the tanks were to occur this will be identified by the leak detection system that will be present on each tank. The generator will be disabled in this event and the fuel will be allowed to collect within the second skin of the tank, which will have a 110% capacity. All bunded areas will have valved discharge points.

Emissions from chemical spills/ leaks or runoff from rainwater that has passed over impermeable surfaces will be prevented from polluting local surface water, as all surface water runoff from the Terminal, Power Plant and parking areas will be directed to hydrocarbon interceptors prior to discharge to the Shannon Estuary. The use of hydrocarbon interceptors will significantly reduce the likelihood of water contamination from vehicle fuel or chemical spills.

Spill kits will be located at strategic points around the Proposed Development in order to ensure a quick response to any spillages should they occur. Any used spill kits will be disposed of using a hazardous waste disposal contractor and in accordance with all relevant EU and Irish waste management legislation (i.e. the Waste Management Acts 1996 – 2011 and any regulations made thereunder, and the Waste Framework Directive). The EPA Guidance Note 'Storage and Transfer of Materials for Scheduled Activities' (EPA 2004) shall be taken into account when designing material storage and containment at the Proposed Development.

The transformers will be installed in bunds designed to retain a minimum of 110% of the total quantity of oil present in the transformer, below the fire trap. These bunds will be tested after construction and during maintenance to ensure the water depth loss is no more than 1 mm/hour over a continuous 6 hour period. Automatic emptying of rainwater from the bund will be achieved with a BundGuard© system or similar.

In the event of a fire, the fire water will drain through the storm sewerage system and hydrocarbon interceptors (where present) and be diverted to the firewater impoundment basin, sized and designed in accordance with the Irish EPA Guidance on Retention of Firewater, prior to inspection and discharge to the estuary. The retention pond will be rendered impermeable by use of an appropriate liner, and periodically integrity-tested in line with the requirements of the site's IE licence. All process area site storm drainage will pass through the retention pond. An automatic shut-off valve linked to the site's fire detection system would be installed on the drainage outlet point.

6.10.2.2 Foul Sewer

All foul water from the Proposed Development will be pumped or fall by gravity to a WWTP. The WWTP will be an pre-engineered biological treatment system which will treat the effluent to required discharge standards set out by the IE licence.

Table 6-5 Anticipated Characteristic of WWTP Discharge

Parameter	Emission Limit Value	Proposed Monitoring Frequency
Volume	35 m^3/day	Continuous
pH	6-10	Continuous
Biochemical Oxygen Demand	25 mg/L	Bi-annual
Suspended Solids	35 mg/L	Bi-annual
Ammonia	5 mg/L as N	Bi-annual
Total Phosphorous	2 Mg/L as P	Bi-annual

The WWTP will be sized to cater for a population of approximately 67 people. The treated effluent will be monitored in accordance with the site's IE licence requirements prior to discharge to the estuary via the same discharge outfall pipe as the surface water.

Effluent leaving the WWTP will be continuously monitored for flow rate and pH before discharging to the estuary. The automatic control system associated with the WWTP will sound an alarm if pH falls outside of the expected range. This will alert the operator to take corrective action to remedy the problem. If the problem continues to go outside the pre-set range, this will automatically close the discharge valve.

6.10.2.3 Water Supply

The water supply system will be metered to determine water consumption and facilitate leakage detection and will be in accordance with Irish Water requirements.

6.10.2.4 Storm Water Drainage

To minimise sediment build up within the storm water drainage network, trapped inlets will be used at all points of entry and key manholes will have sumps to collect material. A regular maintenance regime, including monitoring, will be put in place to remove any excess build-up of material.

6.10.2.5 Flood Risk

Flood Risk Assessment (Vol. 4, Appendix 6-3) concluded that the Proposed Development has a negligible impact on the existing flood regime in the area, with the exception of crossings of the watercourses for the access road. These will be culverted at an adequate size to have a minimal impact on the existing hydraulic regime in the area to the Ralappane Stream.

The LNG Terminal site will have a constructed stormwater drainage system capable of handling anticipated peak stormwater volumes for a 100 year, 24 hour rainfall event (162 L/s/ha, which equates to a total discharge rate of approximately 3125 L/s peak flow) and which will incorporate a firewater retention pond and discharge monitoring and flow control devices.

6.10.2.6 Discharges from FSRU Operations

Seawater used for regasification will be returned from the FSRU to the estuary at up to 8 ºC colder than the receiving ambient seawater. The cold water discharge from the FSRU to the estuary has been modelled using Telemache software and indicated negligible impact on the estuary, because of significant dilution and dispersion due to the high water volume and tidal flux in the estuary.

Seawater returned to the estuary from the seawater circulation system will contain residual chlorine from sodium hypochlorite used as a biocide. The concentration of residual chlorine at the seawater discharge from the FSRU will be monitored and will not exceed 0.5 mg/L.

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant. The reject stream from these freshwater generators will have elevated salt content and will be discharged to the estuary from the FSRU.

6.10.2.7 Environmental Management Plan

An environmental management plan for the Proposed Development will be implemented during the operational phase incorporating all mitigation measures and emergency response measures, as described in this chapter.

6.11 Do Nothing Scenario

Under a 'Do Nothing' scenario it is expected that the Proposed Development site will continue to be utilised for agricultural purposes. As is, the Proposed Development site potentially represents a source of contamination to the water environment, as diffuse agricultural sources continue to be the main threat to the quality of water in Ireland.

6.12 Residual Impacts

6.12.1.1 Construction Phase

The implementation of mitigation measures highlighted above will significantly reduce the likelihood and magnitude of the potential impacts on the groundwater and surface water environment occurring during the construction phase.

Residual impacts may be negative but are unlikely to occur if mitigation measures are properly implemented. Residual impacts will be of localised effect, in that they will only impact locally and impacts will be of temporary duration.

The magnitude of the potential residual effects during construction phase is therefore considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential impact of the Proposed Development on water is considered to be **imperceptible**.

6.12.1.2 Operational Phase

The implementation of measures inherent to the Proposed Development design and mitigation measures highlighted above will significantly reduce the likelihood and magnitude of effects on the groundwater and surface water environment occurring during the operational phase.

In relation to the operational phase, the magnitude of the potential residual effects is considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential effect of the Proposed Development on water is considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential effect of the Proposed Development on water is considered to be **imperceptible**.

6.13 Decommissioning

As outlined in Chapter 2 - Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that will be implemented are outlined in Section 2.9, Chapter 02 – Project Description and will include removal of subsurface utilities such as the site drainage and surface water management systems. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

A monitoring programme of all potential emissions including surface water and dust would be conducted after the decommissioning process in order to ensure that emissions from the facility have ceased.

6.14 Summary

The Proposed Development consists of an onshore Liquified Natural Gas (LNG) Terminal and Power Plant and an offshore jetty, together with associated infrastructure, on an approximately 14 ha area in the north east of the overall 41 ha Proposed Development site, which comprises grassland on the southern shore of the Shannon Estuary and is surrounded by a mixture of agricultural land, rural housing, public highway and the Shannon Estuary.

The onshore portion of the Proposed Development site itself is not a designated site but is bordered to the west, north and east by designated sites (Lower River Shannon cSAC, Ballylongford Bay pNHA and River Shannon and River Fergus Estuaries SPA). The jetty and surface water outfall elements of the

Proposed Development are located within the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.

Onshore and Offshore site investigations were undertaken in 2006 and 2007. The Proposed Development site and its surroundings have shown no change in use or significant development since a previous extensive surface water assessment in 2007.

Soil deposits are ‘till derived from Namurian sandstones and shales’, from 0.5 to 8.0 m depth, with small amounts of alluvium in localised areas. Groundwater was encountered in place within the till, with low rates of inflow. The upper till is moderately permeable (hydraulic conductivity of 3 to 4 x 10^{-6} m/s (metres per second)). The lower till layer overlying bedrock is stiff, of low permeability and no water strikes were recorded in this material.

The bedrock underlying the Proposed Development site is a mix of mudstone, siltstone and sandstone of the Shannon Group, which outcrops at the coast along the majority of the site’s northern boundary. Groundwater in the bedrock is classified as a ‘Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones’. The Proposed Development site is not located within a groundwater drinking water source protection area and public records indicate no springs and a relatively small number of low-yielding groundwater abstraction wells between 1 and 2 km from the Proposed Development site.

Depth to rock varies from 0.75 m (in the east of the site where the LNG Terminal and Power Plant will be situated to up to 9.8 m near the western boundary. Groundwater vulnerability is classified as ’High to Extreme’ due to the limited subsoil thicknesses. Monitoring wells in bedrock on the Proposed Development site generally have moderate permeability and a poor yield.

The Proposed Development site is drained by several short streams or drainage channels which discharge to the Ralappane Stream (also termed the D1 Stream) or directly to the Shannon Estuary. The Ralappane Stream drains directly to the Shannon Estuary via a tidal wetland area to the west of the Proposed Development site; it has not been sampled by the EPA and its Water Framework Directive status is Unassigned.

Groundwater wells and surface water courses on the Proposed Development site were sampled in February 2020 and were found to be relatively unpolluted, other than pressures associated with the coastal, agricultural setting, including anaerobic conditions, slightly elevated salinity and some localised hydrocarbon detections.

Construction stage spill and leaks, including concrete and lime products and fuels, may give rise to a small adverse effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) with the significance of the effect being significant, but such activities will be set back from the coast, and managed in accordance with the OCEMP resulting in a negligible impact after mitigation.

Other construction phase risks arise from excavation, localised dewatering near rock cuttings and silt runoff to surface waters from material stockpiles on the Proposed Development site. Dewatering of bedrock will be a permanent but localised direct impact and will not lead to a net volume change in groundwater discharge to the estuary, resulting in an imperceptible effect. Excavated materials storage areas and stormwater runoff will be carefully managed in accordance with the OCEMP to prevent potential negative effect on the receiving environment. Stormwater discharge from the Proposed Development to the estuary will be carried out in compliance with a discharge licence. Sediment impact on the marine environment due to piling for jetty and outfall construction will have imperceptible impact and offshore construction will be managed to minimise use of wet concrete in contact with marine waters.

Operational Phase risks to groundwater and surface water will arise principally from discharges of stormwater, process effluent and sanitary water via a Surface Water Outfall to the estuary. These effluent streams will be collected via separate constructed drainage networks and will be treated and monitored prior to discharge as required by the site’s IE licence from the EPA, resulting in a negligible adverse effect on an extremely high sensitivity environment and the significance of any residual effect is imperceptible.

FSRU operations may impact the marine environment via discharges of cold water from the regassification process with low residual chlorine concentrations from the electro-chlorination unit and of water with elevated salinity from the freshwater generators. The impact of these operational discharges from the FSRU on the estuary has been assessed as imperceptible. The FSRU will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.

Other Operational Phase risks to groundwater and surface water will arise from losses of diesel fuel, transformer oils, odorant chemical and other chemicals used onsite. These risks will be managed by siting sensitive chemical storage and equipment within bunded areas, resulting in a low adverse effect to an extremely high sensitivity environment and the residual significance will be imperceptible.

Mitigation measures associated with both the construction and operational phases of the Proposed Development have been proposed, which may also interact with waste management and land and soils aspects of the development.

A CEMP will be prepared for the Construction Phase of the Proposed Development which will incorporate relevant environmental avoidance or mitigation measures to reduce potential environmental impact of temporary storage of soil or rock fill, road runoff, runoff of contaminated waters from constructions areas, storage and use of oils, chemicals, fuels and waste material onsite, concreting operations and vehicles onsite. Site waste management, including control of sewage and other key effluents, will be managed under the CEMP.

Operational Phase mitigations include:

- Handling all hazardous or water-polluting materials in a manner to prevent/ minimise potential impact on groundwater and surface water.
- Secondary containment (bunding) and spill kits will be provided for other hazardous materials to be stored onsite, such as fuels, maintenance oils, odorant and cleaning chemicals.
- An Environmental Management Plan will be prepared for the operational phase.
- The environmental aspects of the operational phase will be licensed and controlled by the EPA via an Industrial Emissions Licence.

Hydrodynamic modelling of constructions stage sediment deposition from offshore piling operations and from operational stage outfall or FRSU discharges from the site indicated no significant impacts to the intertidal or subtidal habitats or species in the estuary, which includes the cSAC, SPA, pNHA and the commercial oyster production sites in inner Ballylongford Bay (see Chapter 07A – Marine Biodiversity).

Cumulative impacts arising from the related LNG Pipeline, Power Transmission Systems and Data Centre Campus developments envisaged under the Master Plan were considered, no significant residual impacts were identified to groundwater and surface water and the cumulative operational impact is considered to be imperceptible. The Power Transmission and Data Centre Campus developments will be subject to separate EIAR.

Should the Proposed Development not take place, the groundwater and surface water will remain in their current state and there will be no change.

The residual effect of the Proposed Development on the surrounding groundwater and surface water environments is considered to be imperceptible at both the construction and operational phases.

Table 6-6 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	Dewatering due to cuttings	Low	Cut faces into bedrock will lead to seepage of groundwater into platform localised dewatering of the bedrock within 10-50 m of the cut faces. Permanent, direct, irreversible moderate effect	Neutral	Localised dewatering of the bedrock within 10-50 m of the cut faces of the excavation is anticipated, however, as all groundwater in the bedrock aquifer in this area is flowing towards the Shannon Estuary under baseline conditions, the interception and discharge of groundwater discharging to the excavated platform area of the Proposed Development will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site. Groundwater seepage from cut faces will be managed via the Proposed Development site drainage systems in such a way as to prevent potential negative impact on the receiving environment The CEMP will outline proposals for the control and monitoring of groundwater seepages from the cut faces of the platform area.	Imperceptible
Construction	Sedimentation (Suspended Solids)	Extremely high	Runoff containing large amounts of suspended solids from site stripping, earthworks and material stockpiles can potentially adversely impact on surface water and marine environments. Installation of bored piles in the offshore area may generate low suspended sediment loads which will be transported by tidal currents. Temporary small adverse effect to an medium extremely high	Significant	Surface water runoff from working areas will not be allowed to discharge directly to the local watercourses. To achieve this, the drainage system, settlement ponds and surface water outfall will be constructed prior to the commencement of major site works. Spoil and temporary stockpiles will be positioned in locations which are distant from drainage systems and retained drainage channels, away from areas subject to flooding. Runoff from spoil heaps will be prevented from entering watercourses by diverting it through onsite settlement ponds and removing material as soon as possible to designated storage areas. Pile installation will use reverse circulation drilling to minimise loss of drilling spoil and generation of suspended sediment in the marine environment. Control of runoff from construction activities will be managed under the CEMP therefore runoff containing large amounts of suspended solids is considered unlikely to occur and, shall it occur, is likely to be rare and short-term.	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
			sensitivity surface water environment.			
Construction	Accidental Spills and Leaks • Use and Storage of liquid chemicals; • Spillage or leakage of oils and fuels from construction machinery or site vehicles; and • Spillage of oil or fuel from refuelling machinery onsite.	Extremely high	Adverse effect on fish, aquatic flora and invertebrate communities. the Proposed Development. Direct negative small effect of temporary duration.	Significant	In order to prevent spillages to ground of fuels or other chemicals, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include: • Designating a bunded storage areas and handling procedures for all oils, solvents and paints used during construction; • Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area with appropriate facilities; and • Refuelling outside of the designated area will be via a mobile double skinned tank with lockable fittings and an onboard spill kit. Accidental spillages and leaks will be managed under the CEMP and are considered unlikely to occur and, shall they occur, are likely to be a temporary	Imperceptible
Construction	Use of Concrete and Lime	Extremely high	Lime and concrete (specifically, the cement component) is highly alkaline and can impact surface water quality during construction. Direct negative small effect of temporary duration	Significant	Hazardous materials will be controlled via the CEMP and stored in bunded areas. A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment. Use of pre-cast concrete structures for the jetty and outfall in the marine environment will be maximised to limit the use of wet concrete. Washout of concrete-transporting vehicles will take place at an appropriate facility offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	Piling for offshore construction (Suspended Solids, Concrete use)	Extremely high	Mobilisation of sediment due to installation of steel piles into bedrock to support offshore structures. pH effect due to the use of concrete in the marine environment. Small adverse effect on an extremely high sensitivity environment.	Significant	Pile installation will use reverse circulation drilling to minimise loss of drilling spoil and generation of suspended sediment in the marine environment. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work would be staged in a manner to prevent concrete from entering the water.	Imperceptible
Operational	Hazardous Materials Storage • Diesel • Chemical odorant • Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc.	Extremely high	Storage of materials that are potentially hazardous to the aquatic environment. Temporary small adverse effect to an extremely high sensitivity surface water environment.	Significant	The storage of materials hazardous to the aquatic environment during the operational phase will be in secondary contained area and will be controlled in accordance with any IE licence conditions,. All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite. Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.	Imperceptible
Operational	Accidental Spills and Leaks	Extremely high	Spills during handling of fuels and other liquid chemicals can result in discharge to groundwater or the surface water environment. Direct negative small adverse effect of temporary duration.	Significant	All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite, such as maintenance oils and cleaning chemicals. Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas. Fuel will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					off valve from the generator yard to the external surface water drainage network. Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.	
Operational	Flooding and Drainage	Extremely high	Direct discharges to the water environment during the operational phase will consist of • Stormwater water runoff from the developed and undeveloped areas of the Proposed Development site; • Groundwater discharges from cut faces; • Foul water from welfare facilities on the Proposed Development site; and • Process effluent streams. Small adverse impact effect on an extremely high sensitivity environment	Significant	The proposed crossings of the watercourses within the Proposed Development along the access road have been adequately sized to have a minimal impact on the existing hydraulic regime in the area draining to the Ralappane Stream, and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. The LNG Terminal and Power Plant site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention facility, package waste water treatment plant and pH adjustment). Outfall discharges to the estuary were modelled and indicated that the treated effluent will be rapidly diluted and dispersed within a short distance of the outfall and does not compromise the water quality at the aquaculture sites in Ballylongford Bay. The site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Imperceptible
Operational	Combined Operational Stormwater, Sanitary and Process Effluent Discharges to Surface Water	Extremely high	Direct discharges to the marine environment during the operational combined Surface Water Outfall Small adverse impact effect on a medium	Significant	The LNG Terminal and Power Plant site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
			extremely high sensitivity environment.		facility, package waste water treatment plant and pH adjustment). The Proposed Development site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	
Operational	FSRU Operational Discharges to Surface Water	Extremely high	Discharges of cooled water from regassification process, electro-chlorination and freshwater generators.	Significant	FSRU operations may impact the marine environment via discharges of cold water from the regassification process, with low residual chlorine concentrations from the electro-chlorination unit, and of water with elevated salinity from the freshwater generators. Temperature and residual chlorine modelling indicates that discharges from the FSRU are rapidly diluted and dispersed within a short distance of the FSRU discharge. The impact of these operational discharges from the FSRU on the estuary has been assessed as imperceptible. The FSRU will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Imperceptible

6.15 References

AECOM (2021) Shannon LNG Environmental Impact Assessment Report - Flood Risk Assessment, New Fortress Energy Revision 0 dated 19th March 2021

ARUP, (2010). Shannon LNG Terminal – On Shore Ground Investigation Interpretive Report – Issue 2 dated January 2010.

ARUP, (2012). Environmental Impact Assessment, Shannon LNG CHP Plant, Kilcolgan Lower, Co. Kerry. December 2012.

Central and Regional Fisheries Board, 2008. Shannon Estuary. 9 pps.

CIRIA, (2001). C532 Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors. Construction Industry Research and Information Association.

DoEHLG, (2006). Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects. Department of the Environment, Heritage and Local Government.

Environmental Protection Agency (EPA), (2021). EPA Maps. Available from: https://gis.epa.ie/EPAMaps/

European Commission, (2017). Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report. European Union.

EU, (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy. European Union.

EU, (2003). Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003.

EU, (2010). European Communities Environmental Objectives (Groundwater) Regulations, 2010. S.I. No. 9 of 2010 (Groundwater Threshold Values, GTVs).

EU, (2010). European Communities Environmental Objectives (Drinking Water) Regulations, 2010. S.I. No. 106 of 2007 (drinking Water Standards (DWS).

EU, (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. European Union.

EU, (2014). European Union (Drinking Water) Regulations 2014. Statutory Instrument (S.I.) No. 122 of 2014 (Drinking Water Standards (DWS);

EU, (2015). European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. S.I. No. 386 of 2015. Ireland - AA-EQS Inland/ MAC-EQS Inland.

EU, (2016). European Union Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016.

EPA, (2002). EPA Guidelines on the information to be contained in Environmental Impact Statements; (March 2002); Environmental Protection Agency, Co. Wexford, Ireland

EPA, (2003). EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements; Environmental Protection Agency, Co. Wexford, Ireland.

EPA, (2003). Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003 (EQS only).

EPA, (2004). Guidance to Storage and Transfer of Materials for Scheduled Activities. Environmental Protection Agency, Co. Wexford, Ireland

EPA, (2017). EPA Guidelines on the information to be contained in Environmental Assessment Reports, Draft, August 2017; Environmental Protection Agency, Co. Wexford, Ireland.

Government of Ireland, (2009). European Communities Environmental Objectives (Surface Waters) Regs, 2009. Stat. Inst. No. 272 of 2009.

Government of Ireland, (2012). European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2010. Stat. Inst. No. 327 of 2012.

Government of Ireland, (2018). S.I. No. 296/2018 - European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018.

IGI, (2013). Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.

MEL, (2007). Hydrological and Hydrogeological Impact Assessment, Minerex Environmental Limited - Appendix 15.1 to 2012 EIS for a proposed Shannon LNG Terminal Development – ARUP Environmental Impact Assessment, Shannon LNG CHP Plant, Kilcolgan Lower, Co. Kerry. December 2012.

McMahon, T. 1988. Hydrographic and chemical observations in the Shannon Estuary during 1987. Proceedings of the 4th Lough Beltra Workshop, Dublin.

McMahon, T. and Quirke, J. 1992. Chemical observations in the water column and sediments of Galway Bay and the Shannon Estuary. Proceedings of the 5th Lough Beltra Workshop, Galway.

McMahon, T., Raine, R., Fast, T., Kies, L. and Patching, J. 1992. Phytoplankton biomass, light attenuation and mixing in the Shannon Estuary, Ireland. Journal of the Marine Biology Association of the United Kingdom, U.K. 72: 709 – 720.

TII, (2009). 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes', Transport Infrastructure Ireland.

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