11.0 LAND – SOILS, GEOLOGY AND HYDROGEOLOGY

11.1 INTRODUCTION

This section describes the existing land, soils and water environment in terms of the baseline environment underlying the proposed extension to an existing abattoir and the surrounding area. Based on this information, the potential impacts of the proposed extension are identified, as are the measures required to mitigate any identified negative impacts on the land, soils and water environment.

11.2 METHODOLOGY

This chapter has been prepared in accordance with the following guidelines from the Environmental Protection Agency (EPA) and the Institute of Geologists of Ireland (IGI):

- Environmental Protection Agency (EPA). *Guidelines on Information to be contained in Environmental Impact Statements* (EPA, 2002).
- EPA (2017). *Guidelines on the Information to be contained in Environmental Impact Assessment Reports, Draft 2017*.
- IGI (2013). *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*. Institute of Geologists of Ireland.

The potential impact of the proposed extension to the existing abattoir on the land, soils and water has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any impact on these attributes.

This impact assessment methodology is in accordance with the guidance outlined in *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements* published by the Institute of Geologists of Ireland in 2013.

For the purpose of this assessment the impacts of the proposed extension to the existing abattoir on the surrounding environment, the wider study area includes up to a 2km radius from the site. The extent of the wider study area was based on the IGI (Institute of Geologists of Ireland) guideline which recommends a minimum distance of 2km. Where necessary, the study was extended beyond the 2 km limit, following the precautionary principle. The IGI's and EPA's recommended methodology for assessing impacts was used. Each potential impact was described in terms of its Type, Quality, Significance and Duration.

11.3 INFORMATION SOURCES

Data used in the baseline assessment was collected from the following available sources:

- Historical and recent mapping from Ordnance Survey Ireland (OSI).
- Aerial Imagery from Google Maps and Bing Maps.
- Teagasc Subsoil Mapping.

- Geological Survey of Ireland (GSI).
- Environmental Protection Agency (EPA).
- EPA Catchments Website.
- National Parks & Wildlife Service (NPWS).
- National Flood Hazard Mapping (Office of Public Works, OPW).
- Mét Eireann.

The following surveys/reports were commissioned in relation to the site and their findings fed into the preparation of this chapter:

- *Geophysical Survey. Boheradurrow, Banagher, Co. Offaly*. MGX Project No. 6415, MGX File Ref.: 6415d-005. Minerex Geophysics, 25th February 2019.
- *Site Specific Flood Risk Assessment. Banagher Chilling Ltd. Banagher, Co. Offaly*. IE Consulting, IE1796-3149. April 2019.
- *Effluent Process Description. Banagher Chilling Ltd. Banagher, Co. Offaly*. Panther Environmental Solutions Ltd, PES_ETP_19_9201, 15th March 2019.
- *Integrated Constructed Wetlands. Banagher Chilling Ltd*. Planning Report, Boheradurrow and Meenwaun, Banagher, Co. Offaly. VESI Environmental Ltd. April 2019.

11.4 DESCRIPTION OF EXISTING SITE

The existing facility at Meenwaun was originally developed as an abattoir by the Lynch family in the 1990s and was acquired by Banagher Chilling Limited in 2018. The abattoir facility is located in the town land of Meenwaun, while the proposed extension and associated development will be located within the town land of Boheradurrow, Co. Offaly, as shown in Figure 11.1.

Within the landholding, there is an established farmyard complex of buildings and an existing permitted abattoir extending to approximately 748 m^2.

The existing abattoir facility was managed by Ossory Meats, and has ceased operation circa November 2016. At the time of their operation, Ossory Meats were slaughtering 100 cattle per week, and for a period, the site was also slaughtering horses under their licence.

The existing abattoir development is comprised of the following:

- Main building housing the slaughter hall, boning hall, cold room, loading area and amenities (including offices, locker rooms, kitchen and toilets);
- Lairage and holding pen areas;
- Offal skip shed;
- Septic tank and percolation area servicing staff facilities;

- Surface water tank;
- Wastewater treatment system, comprising of inlet sump and storage sump;
- Lorry-wash.

The existing abattoir and proposed extension are detailed in *Attachment 2.3 / Drawing Ref. 1806-06-5*.

11.5 LAND & SOIL BASELINE ENVIRONMENT

This section describes the existing baseline land & soils environment in terms of the land and soils underlying proposed extension to the existing abattoir and the surrounding area.

11.5.1 SITE SETTING & TOPOGRAPHY

The site is located at Boheradurrow, approximately 3.5 km south east of Banagher, Co. Offaly. The site is located on the L3010, 0.25 km off the R438 from a junction known as the '*Five Cross Roads'*. The national secondary road, the N62 is located approximately 7 km to the east. The location and site are outlined on Drawing No. *IE1746-001-Site location & boundary*, in Attachment 11.1. A slaughter house, lairage, office and associated facilities are located onsite; along with a farm yard comprising several cattle sheds. Overall, the site is dominated by large, open green field areas.

The site is relatively flat, with Ordnance Survey Mapping indicating it slopes gently from east (60 mOD) to west (50 mOD), as shown in Figure 11.1. Mullaghakaruan Bog is located along the northern boundary of the site. This bog has been extensively worked and in parts is covered with dense gorse. The bog contains a narrow-gauge rail network which was constructed to transport harvested peat to the now decommissioned Lumcloon Power Station, 12 km North West of the site.

To the south, an area of managed forestry is present. Farm land bounds the site to the South East, while the R438 bounds the site to the West. The River Shannon flows in a South Westerly direction and is located approximately 4.5 km North West of the site. The River Brosna, a tributary of the Shannon flows North Westwards approximately 5 km South of Boheradurrow. The Meenwaun Wind Farm is located to the east of the site.

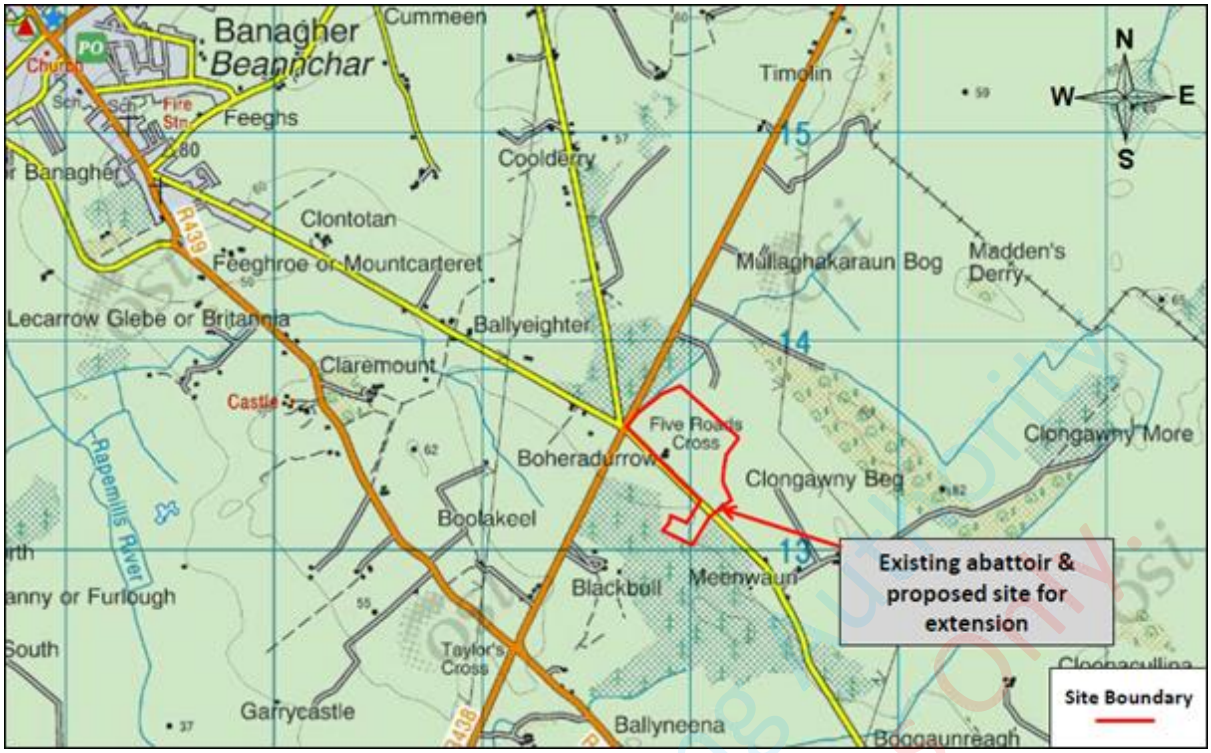

Figure 11.1: Site Location

11.5.2 HISTORIC LANDUSE

Historical mapping and aerial imagery from Ordnance Survey Geohive suggests the site has been in agricultural use throughout history, with a farm yard/buildings present onsite where the current farm yard/sheds are located, since 1837, as shown in Drawing No. *IE1746-003-Historic Map 6 inch Black & White (1837-1842*), in Attachment 11.1. OSI Aerial imagery from 1995 shows the current abattoir facility in the south east of the site.

11.5.3 REGIONAL SOILS & SUBSOILS

Soil is the top layer of the earth's crust which supports the growth of crops, plants and many microorganisms. The formation of soil is dependent upon geology, climate, vegetation, altitude, landform shape and finally management over time. Soil landscapes found in Ireland are a consequence of the changing climatic conditions over the last 100,000 years (with periods of glaciation, the last of which was c.12, 000 years ago) and the management of land by farmers.

Soils can be subdivided into topsoil and subsoil. Topsoil is the active layer at ground level where living organisms occur. In soil science this is referred to as the 'A' and 'B' horizons. Subsoil is the loose uncemented (unlithified) sediments present between the soil 'B' horizon and bedrock. In soils science this is termed the 'C' horizon.

Reference to GSI (Geological Survey Ireland) and Teagasc soil mapping indicates the soils throughout the region are dominated by **raised peat**, and **poorly drained basic mineral soils**. The Regional Soils are outlined in Drawing No. *IE1746-004-Regional Soil Mapping*, in Attachment 11.1.

Regional subsoils consist of **till derived from limestone** and **cut over raised peat**. Gravels derived from limestones are also mapped in the wider region. The regional sub-soils are outlined in Drawing No. IE1746-005-*Regional Subsoil Mapping*, in Attachment 11.1.

11.5.4 SITE SPECIFIC SOILS & SUBSOILS

The soils mapped across the site are dominated by **peat** along the North of the site with the remained of the site covered in a **'fine loamy' drift with limestone clasts** (a poorly drained basic soil).

The sub-soils underlying the soil are mapped as **till derived from limestones** with **peat** present in the North West and along the Northern boundary of the site.

A geophysical survey was completed across the site to investigate the ground conditions, identify areas of soft ground and determine the depth to rock. During the geophysics survey, the surveyors noted that the soils in the North West of the site were peat rich and very soft. The results of the geophysical survey suggest the soils and sub-soils throughout the site are loose to mildly stiff.

The topographic high points were found to contain sand and gravels. Overall, the depth of the soils/sub-soils does not vary greatly throughout the site (between 4 to 8.5 mbgl). The South West and West of the site were identified as having the shallowest bedrock. The subsoils overlay an upper bedrock zone which is highly weathered. Seismic refraction surveying suggests that these soils and sub-soils are extractable by digging. The geophysical report is contained in Attachment 11.3.

Further investigation of the soils/subsoils by intrusive investigation (trial pits/boreholes) will be undertaken to inform engineering design of the complex.

11.5.5 REGIONAL BEDROCK & STRUCTURAL GEOLOGY

The GSI Online bedrock mapping indicates the site, including the region around the site is underlain by the **Waulsortian Limestone Formation**. Waulsortian Limestone is described as dominantly pale-grey, crudely bedded or massively bedded limestone. Waulsortian Limestone is common throughout the central plain of Ireland.

The **Lucan Formation** is mapped in the South East of the site, in contact with the Waulsortian Limestone Formation. The Lucan Formation is also known as '*Calp*' and consists of dark-grey to black, fine-grained, occasionally cherty, micritic limestone that weathers to a pale grey colour. The Lucan Formation overlies the Waulsortian Formation.

There is evidence of limited karstification in the Lucan Formation, which may occur in the slightly more pure limestone zones. There is likely an epikarstic layer of 1-2 m at the top of the pure Waulsortian Limestone. The Ballysteen Formation is mapped 2 km to the west. This Formation consists of irregularly bedded and nodular bedded argillaceous bioclastic limestones (wackestones and packstones), interbedded with fossiliferous calcareous shale.

Regionally the structural geology consists of a series of major North East – South West striking normal faults, with a series of minor North West – South East striking, younger faults. The closest mapped, most probable location of a fault is 1.10 km south the proposed

extension to the existing abattoir, which strikes North West – South East. The Regional Bedrock and Structural geology is presented in Drawing No. IE1746-007-*Regional Bedrock & Structural Geology*, in Attachment 11.1.

The GSI Borehole Database indicates that there are no boreholes on site. The closest borehole is 2.5 km to the North East, located in the town land of Clongawny More (GSI ID: 1071). This borehole encountered bedrock at a depth of <1m; and no other information is available for this borehole.

11.5.6 SITE SPECIFIC BEDROCK & STRUCTURAL GEOLOGY

According to the GSI Bedrock Map, the Lucan Formation underlies the south east of the site, while the Waulsortian Limestone Formation underlies the remainder of the area. The Lucan Formation overlies the Waulsortian Formation. A geological contact between the Lucan and Waulsortian Formation is mapped in the South East of the site, as indicated on the GSI Bedrock Map. This is outlined in Drawing No. IE1746-007-*Regional Bedrock & Structural Geology*, in Attachment 11.1.

A geophysical survey was completed across the site to investigate for the ground conditions; determine the depth to rock; estimate the rock quality; establish the presence of fractures/faults; investigate the presence of karst; and identify potential locations for trial well drilling to develop a water supply on site.

The electrical resistivity data identified the presence of a geological contact or gradational zone whereby the bedrock changes composition from a strong clean limestone (Waulsortian Formation) to a muddier softer form of limestone (Lucan Formation) in the North West of the site.

This corridor where the bedrock transitions from the Waulsortian to the Lucan Formation is a zone of weakness, which is susceptible to karstification.

An extensive zone of karst was identified in the Northwest of the site, which correlates to the gradational boundary between the Lucan and Waulsortian Formations.

A linear karst feature has been identified running in a South West – North East direction, immediately south of the abandoned farm yard. Elsewhere, localised karst anomalies were identified in the south of the site, running parallel to the L3010 road.

Section 11.5.9.3 contains further details on the karst geology of the site.

Results of the geophysical survey indicate that the depth to bedrock across the site varies between 4m to 8.5 m below ground level. The South West and West of the site were identified as having the shallowest bedrock. The upper zone of bedrock across the site is either weathered or overlain by firm to stiff, dense overburden. Below the weathered zone, the geophysical survey suggests the limestone on site is fresh and strong. The geophysical report is contained in Attachment 11.3.

Further investigation of the bedrock by intrusive investigation (boreholes) will be undertaken as part of detailed design.

11.5.7 GEOLOGICAL HERITAGE

The GSI Heritage Database indicates that there are no geological heritage features on the site or within 2 km of the site. The closest geological heritage feature is located 2.7 km to the south of the proposed extension to the existing abattoir. Kilcormac Esker (Site Code: OY018) is mapped as a County Geological Heritage Site. It is classified under theme 7 – Quaternary. The feature is indicated as being recommended for a National Heritage Area (NHA) status.

The Kilcormac Esker and surrounding sands and gravels include an exceptionally large accumulation of sands and gravels deposited under the ice sheet and at its margin as the ice withdrew westwards across Offaly at the end of the last Ice Age. The esker forms part of the much larger Killimor-Birr-Fivealley-Kilcormac Esker System, which extends across the Midlands for over 70 km in linear extent.

The Crancreagh Mushroom Rock (Site Code: OY011), located approximately 4.5 km North East of the site is designated a County Geological Heritage Site. It is classified under theme 1 – Karst. The feature is essentially an isolated upstanding of rock in a grass field. The feature is indicated as being recommended for NHA status. The Regional Geological Heritage surrounding the site is outlined in Drawing No. *IE1746-008- Geological Heritage*, in Attachment 11.1.

11.5.8 ECONOMIC GEOLOGY

Economic geology is concerned with the Earth's material which can be used for economical/industrial purposes. Following a review of the GSI Online Mapping Viewer peat extraction was identified as an economic deposit within 2 km of the site. Mullaghakaruan Bog has an extensive Industrial Railway Network, which was used to transport harvested peat to the Lumcloon Power Station for electricity generation. Lumcloon Power Station is located approximately 12 km North West of the Proposed Site. Lumcloon Power Station has ceased operations.

11.5.9 GEOHAZARDS

A geohazard is a geological event, which can pose a risk to; or lead to an event which can cause harm or damage to human life and infrastructure. Regional and site specific geohazards are outlined in the Sections below.

11.5.9.1 Landslides

The GSI Landslide Database indicates that there are no recorded landslides on or within the proposed extension to the existing abattoir and surrounding area, or within 2 km of it. The closest landslides recorded are as follows:

- Clonoghil Lower – 10 km South East of the proposed development site, a landslide occurred in an area of cutover blanket bog. The resultant damage a blockage to a road, in 1920. Event ID: GSI_LS03-0054.
- At Derry Bridge (Derrycarney) – 15 km North East of the proposed development site, a landslide occurred along the Grand Canal in 1954, which did not result in any infrastructure damage. Event ID: GSI_LS03-0065.

These landslide locations in relation to the site are outlined in Drawing No. *IE1746-009-Landslides*, in Attachment 11.1.

11.5.9.2 Radon

Radon is a naturally occurring radioactive gas formed in the ground by the radioactive decay of uranium which is present in varying quantities in all rocks and soils. As a known carcinogen, in the same category as tobacco smoke and asbestos it is a cause of lung cancer. The EPA's online Radon Map was consulted. This map shows a prediction of the number of homes in a given grid square that exceed the national Reference Level (200 Bequerel per cubic metre (Bq/m^3)).

The EPA's Radon Map shows that the site is not in a High Radon area (where radon levels in >10% of homes are estimated to be above the reference level). Less than 1% of the homes in this 10km grid square of the proposed extension to the existing abattoir are estimated to be above the Reference Level of 200 Bq/m^3.

11.5.9.3 Karst

The GSI Online Karst Database indicates no karst features mapped on site. However, within the wider region of the proposed extension to the existing abattoir, there are several karst features mapped. These are outlined in Table 11.1. The location of these karst features relative to the proposed extension to the existing abattoir, are presented in Drawing No. IE1746-010-*Regional Karst Features*, in Attachment 11.1.

Table 11.1: Summary of the mapped karst features (GSI, 2019)

GSI ID	NAME	DISTANCE FROM SITE	STRATIGRAPHY	DESCRIPTION
2021SWK001	Milltown Swallow Hole	1.5 km SW	Lucan Fm	Located close to the boundary with the Waulsortian Formation
2021SWK003	All Saints Well	2.2 km SW		Spring discharge at surface
2021SWK003	All Saints Well	2.2 km SW		Spring discharge at surface
2021SWK004	Kilcannin Holy Wells	4.4 km NE	Waulsortian Fm	Spring
No ID available	Crancreagh Mushroom Rocks	4.5 km NE		Superficial solution features in clean limestone; located in the town land of Crancreagh
No ID available	Derrinlough Mushroom Rocks	4.7 km NE		Superficial solution features in clean limestone; located in the town land of Derrinlough
No ID available	Drinagh Mushroom Rocks	6.8 km E		Superficial solution features in clean limestone; located in the town land of Drinagh
2019NWK004	Tobernapoula Spring	6.42 km E		Located in townland of Ballynaguisha

The existence of karst could lead to subsidence under buildings and roads on site, especially if the drainage of the site is altered. The Geophysics Survey completed identified a substantial area of possible **karst along the North West portion of the site**. The electrical resistivity data suggests that this area of karst relates to the change in bedrock composition from a strong clean limestone (Waulsortian Formation) to a muddier, softer form of limestone (Lucan Formation) in the North West of the site.

Localised potential karst zones along the south of the site, parallel to the road at L3010 were identified during the geophysical survey. A linear karst feature has been identified running in a South West – North East direction, immediately south of the abandoned farm yard. Further investigation of these features by intrusive investigation is recommended.

A summary of the geophysical survey results are outlined in Drawing No. IE1746-006-*Summary of Geophysical Survey Results*, in Attachment 11.1. The geophysical report is contained in Attachment 11.3.

11.6 WATER BASELINE ENVIRONMENT

This section describes the existing water environment in terms of hydrology, flooding and hydrogeology in the area and surrounding environment of the proposed extension to the existing abattoir.

11.6.1 HYDROLOGY

11.6.1.1 River Basin & Surface Water Features

The site lies within the Shannon International River Basin District. The Shannon River Basin District is a transnational river basin, covering both the Republic of Ireland and Northern Ireland. Within the Shannon River Basin District, the site lies within the Lower Shannon Catchment (HA: 25B); and locally within the Little Brosna Sub Catchment.

The main surface water bodies within the vicinity of the site are the River Brosna; River Rapemills and Little Cloghan River, all tributaries of the River Shannon. The River Shannon flows southwards, into Lough Derg, which drains through the Shannon Estuary into the Atlantic Ocean at Kilrush, Co. Clare. The Grand Canal, the waterway linking the River Shannon and River Liffey in Dublin, is located north of the site at Shannon Harbour. The Feeghroe stream also referred to as the Mountcarteret in the literature/mapping forms the western boundary of the site.

Table 11.2 outlines the main surface water features within a 5 km radius of the proposed extension to the existing abattoir and they are shown in Drawing No. IE1746-011-*Regional Surface Water Features (Hydrology)*, in Attachment 11.1. The rivers/streams outlined in Table 11. 2, are not indicated as being salmonid according to the EPA GIS Portal. Figure 11.2 shows the streams within the immediate vicinity of the site.

Table 11.2: Surface water features in the region of the proposed extension

WATER BODY	PROXIMITY TO SITE	STREAM ORDER	COMMENTS
Feeghroe or Mountcarteret	<0.05 km W	2nd	Forms western boundary of site, flows SW. Rises in Mullaghakaraun Bog, tributary of Rapemills River
Timolin	<0.8 km N	1st	Within managed area of Mullaghakaraun Bog
Mullaghakaraun Bog	<0.5 km N	1st	Within managed area of Mullaghakaraun Bog; tributary of Rapemills River
Portavolla	2.3 km NW	1st	Tributary of Grants Island
Grants Island	2.7 km NW	1st	Tributary of River Shannon
Madden's Derry	3.3 km N	1st	Rises in Mullaghakaraun Bog
Little Cloghan	4.7 km NE	3rd	Tributary of River Shannon
Five Roads Cross	<0.7 km SW	1st	Tributary of Feeghroe Stream
Milltown	<1.1 km S	1st	Flows South, tributary of Rapemills River
Rapemills	2.5 km S	2nd	Tributary of River Shannon
Little Brosna	5 km S	5th	Tributary of River Shannon
Shannon	3.8 km W	7th	Flows southwards, through Banagher Town
Grand Canal	5.3 km N	n/a	Manmade waterway, joining the River Shannon north of Banagher town

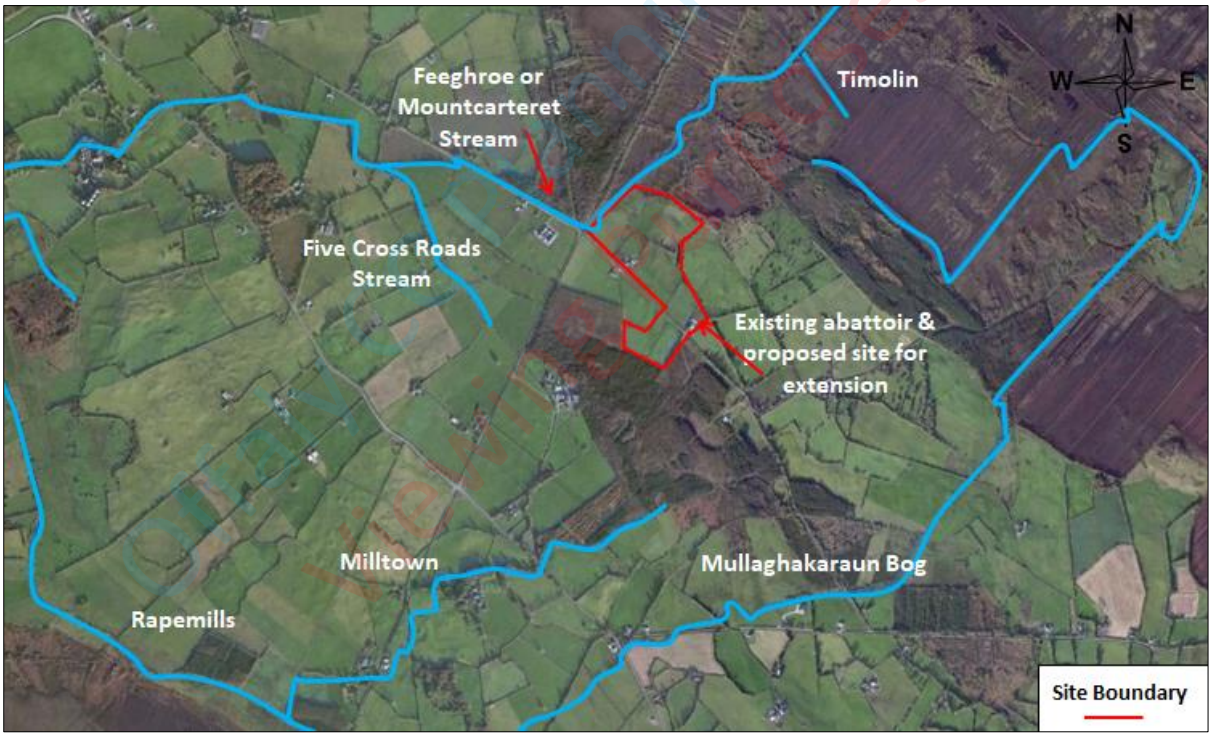

Figure 11.2: Surface water features in the immediate vicinity of the site.

11.6.1.2 Surface Waterbody Status, Pressure & Quality

For the purposes of the Water Framework Directive (WFD) the water quality status of the nearby surface water bodies has been categorised (2010-2015). In addition, the 'risk' of each water body not achieving 'good status' has also been assessed. The status and risk of the nearby surface water features are shown in Table 11.3. Surface Water bodies within the

immediate vicinity of the proposed extension to the existing abattoir were not assigned a status for the 2010-2015 monitoring period; and were all under review as of spring 2019.

The River Shannon, from Banagher Bridge upstream is designated as a Drinking Water River, along with its tributaries. The closest Drinking Water River to the site is the Grants Island Stream, a tributary of the River Shannon, located approximately 2.6 km north of the site. Drinking Water Rivers are outlined in Drawing No. IE1746-013-*Drinking Water Rivers*, in Attachment 11.1.

Drinking Water Rivers are those which are designated under Article 7: Abstraction for Drinking Water, of the WFD. Article 7 requires EU Member States to identify bodies of water for the abstraction of drinking water, and then to protect those water bodies so that the treatment regime will result in drinking water which meets the EU Drinking Water Directive (DWD) requirements. The EU DWD concerns the quality of water intended for human consumption, and its objective is to protect human health from the adverse effects of contamination.

Chapter 10 – Water Quality & Aquatic Biodiversity deals with the impacts of the proposed extension to the existing abattoir on water quality.

Table 11.3: WFD status for surface water features surrounding the site

WATER BODY	TYPE	STATUS 2010-2015	RISK OF NOT ACHIEVING GOOD STATUS
Feeghroe (Mountcarteret)	Stream	Unassigned	Under Review
Timolin	Stream	Unassigned	Under Review
Mullaghakaraun Bog	Stream	Unassigned	Under Review
Portavolla	Stream	Unassigned	Under Review
Grants Island	Stream	Unassigned	Under Review
Madden's Derry	Stream	Moderate	At Risk
Little Cloghan	Stream	Moderate	At Risk
Five Roads Cross	Stream	Unassigned	Under Review
Milltown	Stream	Unassigned	Under Review
Rapemills	River	Upper Catchment – Good; Lower Catchment – Unassigned.	Upper Catchment – Not at risk; Lower Catchment – Under Review.
Little Brosna	River	Upper Catchment – Good; Lower Catchment – Unassigned.	Upper Catchment – Not at risk; Lower Catchment – Under Review.
Shannon	River	Downstream of Banagher Bridge – Good; Upstream of Banagher Bridge – Unassigned.	Downstream of Banagher Bridge – Not at Risk; Upstream of Banagher Bridge – Under Review.

11.6.1.3 Site Hydrology

The site is relatively flat, with Ordnance Survey Mapping indicating it slopes gently from east (60 mOD) to west (50 mOD). Throughout the site there are several drainage channels/ditches. The Feeghroe (also known as the Mountcarteret stream) flows in a North-East to South-West direction adjacent to the western site boundary. The stream then flows in a South-East to North-West direction adjacent to the L3010 road. Throughout the site, there are several culverts to allow livestock/farm machinery pass over the drainage ditches to access each field. The site hydrology is outlined in Figure 11.3.

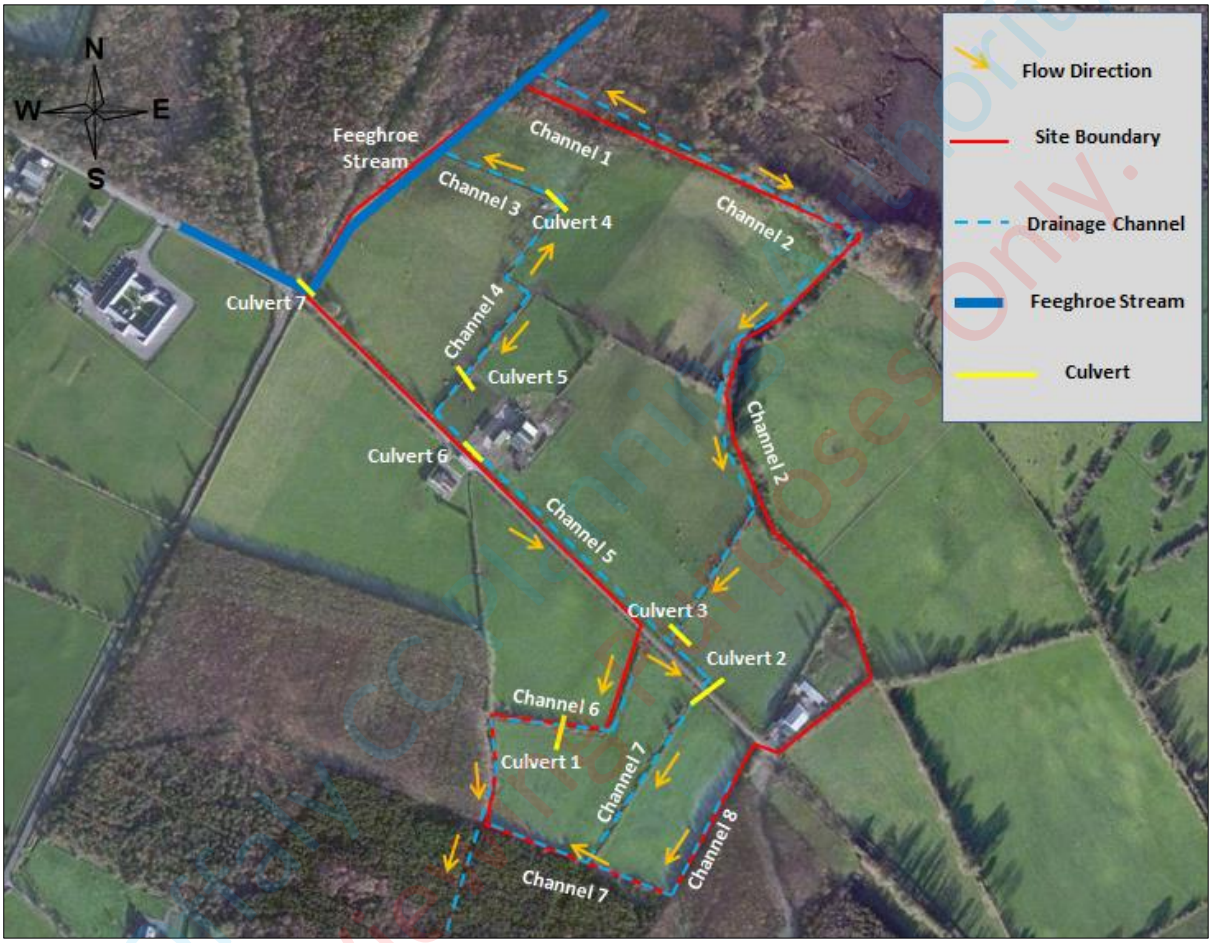

Figure 11.3: Site hydrology showing the drainage channels, culverts, flow directions and Feeghroe Stream.

11.6.1.4 Meteorology & Climatology Data

Monthly rainfall data (Table 11.4) and mean temperature data (Table 11.5) recorded at Gurteen Weather Station is outlined below. Gurteen weather station is located 10 km south of the proposed extension to the abattoir, in Co. Tipperary. The data shows that the rainfall is moderate, in the overall Irish context.

Table 11.4: Rainfall Data

Total Rainfall (mm) – Gurteen, Co. Tipperary													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Year**
2019	46.1	45.9	36.4										
2018	163.1	46.1	96.2	61.2	46.9	22.8	24.1	57.7	72.7	40.2	94.1	122.3	847.4
2017	41.2	62.9	98.7	16.9	81.5	92.5	58.9	95.8	103.7	111.0	95.0	124.4	982.5
2016	98.1	109.8	56.1	51.9	56.6	95.0	49.5	72.3	95.5	36.7	51.5	68.3	841.3
Mean	**96.4**	**66.2**	**74.5**	**59.8**	**68.0**	**71.8**	**66.7**	**84.9**	**74.8**	**103.8**	**89.8**	**91.5**	**948.2**

Table 11.5: Mean Temperature Data

Mean Temperature °C – Gurteen, Co. Tipperary													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Year**
2019	5.6	7.5											
2018	5.5	3.4	4.5	8.5	12.0	15.7	16.9	15.2	11.8	9.3	7.3	7.9	9.9
2017	5.9	6.0	7.8	8.4	12.0	14.3	15.0	14.2	12.4	11.0	6.8	5.4	10.0
2016	5.7	4.6	5.9	6.9	11.9	14.5	15.4	15.3	13.8	10.0	5.1	6.5	9.7
Mean	**5.2**	**5.3**	**6.7**	**8.1**	**10.8**	**13.6**	**15.3**	**14.7**	**12.7**	**9.9**	**7.2**	**5.5**	**9.6**

Long-term climate averages – rainfall and temperature for 1979-2008, at Birr, Co. Offaly, are presented in Table 11.6. Birr is located approximately 12 km south of the proposed extension to the abattoir. January is on average the coldest month, while July is the hottest month on average. October is typically the wettest month on average, while April is the driest month on average.

Table 11.6: Long term climate data for Birr, Co. Offaly

Long Term Climate Averages 1979-2008 - Birr, Co. Offaly													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Year**
Mean Monthly Rainfall Total (mm)	78.8	58.6	67.4	55.0	59.5	66.5	59.4	86.1	66.4	94.2	74.7	83.3	857.7
Mean Temperature °C	5.1	5.3	6.8	8.4	11.0	13.6	15.6	15.3	13.2	10.1	7.2	5.6	9.8

11.6.1.5 Site Specific Flood Risk Assessment

A site specific flood risk was completed for the site of the proposed extension to the existing abattoir facility and all the associated services and facilities. The flood risk assessment has determined that the majority of the proposed development site falls within **Flood Zone 'C' - Low to Negligible Probability of Flooding**. Developments in Flood Zone C are generally not considered at risk of fluvial flooding and would not adversely affect adjacent lands and properties from a flood risk perspective. There are some localised areas where fluvial flooding associated with potential culvert blockage may occur within the site.

The primary flood risk to the proposed development site can be attributed to a flood event in the Feeghroe Stream and a number of drainage channels located in the vicinity of the site.

Hydraulic analysis of the Feeghroe Stream and the drainage channels was carried out within the site.

This assessment has determined that all drainage channels and the Feeghroe Stream have sufficient hydraulic capacity to convey the 1 in 100 year (1% AEP – Annual Exceedance Probability) and 1 in 1000 year (0.1% AEP) flow rates. In consideration of the above analysis, the **fluvial flood risk to the proposed development site is considered to be low**.

The secondary flood risk to the proposed development site can be attributed to a potential pluvial event within the boundary of the site. 2-D surface water modelling was undertaken in consideration of an extreme 1 in 100 year rainfall event for duration of 6 hours including climate change. This assessment has determined that the pluvial flood risk to the site is considered to be low.

Secondary flood risk can also be attributed to a potential surcharge due to a blockage of the culverts located on the Feeghroe stream and drainage channels in the vicinity of the site. This may result in localised areas of flooding within the site. It is recommended that a maintenance programme is put in place to carry out quarterly checks to ensure all existing drainage channels and culverts are free from debris in order to prevent future blockage.

Part of the extension of the existing abattoir facilities requires some alterations to the existing site drainage channels:

- Removal of drainage channel No. 3, which is located within the proposed area of the Integrated Constructed Wetlands. This is a field drain and drains the lands immediately on either side within the boundary of the proposed development. This channel does not have an associated catchment upstream of the site. Therefore, their removal will not have any impact on the hydrological regime of the surrounding area.
- Removal of culvert 3, culvert 4, culvert 5 and culvert 6 which are no longer required for field access within the site.
- Diversion of drainage channel no. 2 and drainage channel no. 4 to accommodate the proposed development. This will require the installation of 2 culverts on the diverted route of channel no. 2 and channel no. 5. The diverted channel and new culverts will be designed to cater for the peak 1 in 1000 (0.1% AEP) flow rates including a 20% increase for climate change.

In consideration of the proposed drainage works and the implementation of a maintenance regime, to include quarterly monitoring of all existing and proposed drainage channels and culverts, the potential residual risk of culvert blockage to the site is considered to be low. Development of the site is not expected to result in an adverse impact to the hydrological regime of the area or increase flood risk elsewhere. Further details are contained in the report by *IE Consulting - IE1796-3149 - Site Specific Flood Risk Assessment - Banagher Chilling Ltd. Banagher, Co. Offaly, April 2019.*

11.6.2 HYDROGEOLOGY

11.6.2.1 Regional Hydrogeology

The GSI operates a classification system for aquifers, based on their hydrogeological characteristics, size and productivity. The have defined three main aquifer types:

- Regionally Important Aquifers.
- Locally Important Aquifers.
- Poor Aquifers.

The Waulsortian and Lucan Formations underlying the site, and the surrounding area are classified as a **Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones**. This is outlined in Drawing No. IE1746-014-*Regional Hydrogeology*, in Attachment 11.1. The proposed extension to the existing abattoir is located within the Banagher Groundwater Body (GWB), ID Code: IE_SH_G_040. The GWB is the management unit under the WFD that is necessary for the subdivision of large geographical areas of aquifer in order for them to be effectively managed.

Generally the Waulsortian and Lucan Formation limestone are unconfined aquifers due to the thin overburden but may be locally confined where the bedrock lies beneath the low permeability bases of raised bogs.

The bedrock aquifer flow paths are generally shallow and short, in the order of 30-300 m long, with groundwater discharging to the streams and rivers that traverse the aquifer. Local groundwater flows are determined by the local topography. There is no regional flow system within the GWB.

The rocks in this GWB are devoid of intergranular permeability. Therefore, groundwater flows occurs in fractures and faults. Zones of enhanced permeability can be encountered in fault zones. Permeability deceases with depth and most flow occurs within the upper 15 m of the bedrock. Significant yields can be achieved where wells intercept a fault zone.

This is demonstrated at the Banagher Water Supply Scheme (WSS), where borehole logs indicate the intersection with a large fault at 30-35 mbgl (meters below ground level). The Banagher WSS abstracts water from the Lucan Formation (Dinantian Upper Impure Limestones). The Waulsortian Limestones may have had their transmissivity enhanced further by dissolution of calcium carbonate along fractures, joints and bedding planes.

According to the Banagher GWB report, water levels are shallow, commonly <3 mbgl. At the Banagher WSS, <0.5 km North West of the proposed extension to the existing abattoir, static water levels vary between 2-5 mgbl.

Surface water bodies crossing the aquifer are generally gaining. Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. There are several fens and wetlands in the GWB that are dependent on groundwater.

Diffuse recharge will occur via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. In general, due to the generally low permeability of the aquifers within this GWB, a proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resources in the aquifer.

Groundwater discharges to gaining streams and rivers crossing the GWB, and to a few small springs. The specific dry weather flow of the Little Brosna River crossing GWB is very high (6.67 l/s/km^2). This is due to the presence of the overlying Birr Gravel Aquifer, which the river also crosses. The bedrock aquifers have low specific yields and are not capable of sustaining summer base flows.

Groundwater from the GWB has a strong calcium-bicarbonate signature. At the Banagher Water Supply Scheme, which abstracts water from the Lucan Formation (Upper Impure Limestone), groundwater is very hard (>350 mg/l as CaCO3) and has electrical conductivity values of 650-720 µS/cm.

In the Ballytsteen Formation, groundwater is also very hard (typically ranging between 380–450 mg/l), and high electrical conductivities (650–800 µS/cm) are often observed. Alkalinity is also high, but less than total hardness (250-370 mg/l as CaCO3), while pH is generally neutral. These values are typical of groundwater from limestone rocks across Co. Offaly (Cronin, 1999).

In the Lucan Formation, iron and manganese concentrations frequently fluctuate, often reaching problematic levels for drinking water supply. Hydrogen sulphide can often reach unacceptable levels in the Ballysteen Formation. These components come from the muddy parts of these rock units and reflect both the characteristics of the rock-forming materials and the relatively slow speed of groundwater movement through the fractures in the rock allowing low dissolved oxygen conditions to develop (Applin *et al.,* 1989).

11.6.2.2 Groundwater Vulnerability

Aquifer or groundwater vulnerability is a relative measure of the ease with which the groundwater could be contaminated by human activity and depends on the aquifer's intrinsic geological and hydrogeological characteristics. The vulnerability is determined by the permeability of any overlying deposits. For example, bedrock with a thick, low permeability, clay-rich overburden is less vulnerable than bedrock with a thin, high permeability, gravelly overburden.

The GSI uses five groundwater vulnerability categories – Extreme rock at or near surface or karst (X), Extreme (E), High (H), Moderate (M) and Low (L) for mapping purposes and in the assessment of risk to ground waters. The classifications are based on the thickness and permeability of the sub-soils overlying the aquifer. The classification is presented in Figure 11.4.

Depth to rock	Hydrogeological Requirements for Vulnerability Categories				
	Diffuse recharge			Point Recharge	Unsaturated Zone
	high permeability (sand/gravel)	Moderate permeability (sandy subsoil)	low permeability (clayey subsoil, clay, peat)	(swallow holes, losing streams)	(sand & gravel aquifers only)
0–3 m	Extreme	Extreme	Extreme	Extreme (30 m radius)	Extreme
3–5 m	High	High	High	N/A	High
5–10 m	High	High	Moderate	N/A	High
>10 m	High	Moderate	Low	N/A	High

i NA = not applicable.
ii Release point of contaminants is assumed to be 1–2 m below ground surface.
iii Permeability classifications relate to the engineering behaviour as described by BS 5930.
iv Outcrop and shallow subsoil (i.e. generally <1.0 m) areas are shown as a sub-category of extreme vulnerability.

(amended from Deakin and Daly (1999) and DELG/EPA/GSI (1999))

Figure 11.4: Groundwater vulnerability classification (GSI, 2019)

The vulnerability across the site is mapped as **Moderate (M) with localised zone of Low (L) vulnerability** mapped in the north west of the site. Groundwater vulnerability for the site is shown in Drawing No. IE1746-015-*Groundwater Vulnerability*, in Attachment 11.1.

Groundwater vulnerability correlates with the findings of the geophysics survey. The relatively thick, impermeable deposits of glacial till correlate with low groundwater vulnerability. The topographical high points which comprise sands and gravel are permeable, and are deemed to be of moderate vulnerability. This is not indicated on the GSI groundwater vulnerability mapping; however site specific information does allow modification of this.

11.6.2.3 Recharge

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall, the permeability and thickness of the subsoil and the aquifer characteristics. Effective rainfall is the amount of rainfall available as either recharge to groundwater or run-off to surface water after evaporation or take up by plants.

According to GSI the National Recharge Map, the recharge coefficient for the area of the proposed extension to the existing abattoir is 4%, which suggests that 96% of effective rainfall is available for runoff (480 mm), from the proposed site. Thus, the aquifer has a low recharge acceptance.

11.6.2.4 Site Specific Hydrogeology

The Waulsortian and Lucan Formations underlying the site, and the surrounding area are classified as a **Locally Important Aquifer (LI) - Bedrock which is Moderately Productive only in Local Zones**. A Locally Important Aquifer is defined as an aquifer unit capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or supplying 'good' yields (100-400 m3/d).

It is assumed that groundwater flow is towards the River, Shannon and the Feeghroe Stream, i.e. to the South West - West. No site specific information was available on the quality of the groundwater onsite. In the wider region, and which is common in limestone bedrock, the water is reported to have a strong calcium-bicarbonate signature with high electrical conductivities (650–800 µS/cm). Alkalinity is also high, but less than total hardness (250-370

mg/l as CaCO3), while pH is generally neutral. These values are typical of groundwater from limestone rocks across Co. Offaly (Cronin, 1999).

It is the intention of Banagher Chilling Ltd to develop a groundwater supply onsite to serve the existing and proposed extension to the abattoir. Two potential targets have been identified for trial well drilling following completion of the geophysical survey. The locations identified for potential trial well drilling are indicated in Drawing No. IE1746-020-*Potential Trial Well Locations - Identified by Geophysics*, in Attachment 11.1.

The expected water demand is 150-200 m^3/d and given the aquifer classification and the presence of viable targets, it is expected that the demand can be met from site. Following drilling, pump testing will be undertaken to establish the hydrodynamics of the aquifer and to explore its interaction with other water features. It is expected that the water quality will be similar to other areas in the same aquifer type, with high hardness, and the possibility of iron or manganese as well. Appropriate treatment processes will be designed and implemented to address these issues if they arise.

11.6.2.5 WFD Groundwater Body Status & Groundwater Quality

Under the requirements of the Water Framework Directive (WFD), the Banagher GWB was classified as having an overall Good Status for the 2010-2015 monitoring period. It was classified as 'not at risk' of achieving at least good ecological or chemical status in the next monitoring period.

11.6.2.6 Groundwater Dependent Features

This Section outlines those features which are groundwater dependent, and establishes their baseline for impact assessment within the context of this Section. These include Special Areas of Conservation (SAC); Special Protection Areas (SPA); Proposed Natural Heritage Areas (pNHA) and Natural Heritage Areas (NHA). A full review of ecological features and designated ecological sites in the study area are detailed in Chapter 9 – Terrestrial Biodiversity and Chapter 10 – Water Quality & Aquatic Biodiversity.

GWD Surface Water Features

The GWB has several streams which are fed by groundwater (GSI, 2003). Groundwater fed streams, also known as 'gaining streams' develop where the elevation of the stream is lower than that of the surrounding water table. Therefore, the head difference will cause groundwater to flow towards the lower head, thus into the Feeghroe Stream.

The closest major surface water feature, the Little River Brosna (5 km south of proposed extension to the existing abattoir) has been identified as a gaining stream. This is due to the presence of the overlying Birr Gravel Aquifer, which the river also cross cuts.

The Rapemills Stream is 2.5 km south of proposed extension to the existing abattoir and also crosses the Birr Gravel Aquifer. These features are within the Banagher GWB, and therefore require an impact assessment.

GWD Habitats

Habitats dependent on hydrogeological characteristics include Groundwater Dependant Terrestrial Ecosystems (GWDTE) and receptors that are dependent on groundwater flows or chemistries. The screening of all GWDTE sites within 6 km of the proposed extension to the existing abattoir is outlined in Table 11.7. The GWDTEs are outlined in Drawing No. IE1746-016-*Groundwater Dependant Terrestrial Ecosystems*, in Attachment 11.1.

Table 11.7: Groundwater dependent terrestrial ecosystems in the vicinity of the proposed site for the extension.

NAME	PROXIMITY	SCREENING	RESULT
All Saints Bog SPA (004103); All Saints Bog & Esker SAC (000566); NHA.	2.4 km SW	SAC south of the development; and within GWB.	Include in Impact Assessment to follow precautionary principle
Middle Shannon Callows SPA (004096) – part of River Shannon Callows (000216); pNHA.	3.47 km W	Within GWB	No impact assessment required due the distance from the existing abattoir and proposed extension.
River Little Brosna Callows SPA (004086); NHA.	3.5 km S		
Dovegrove Callows SPA (004137); pNHA.	5.6 km SE		
Redwood Bog SAC (002353); pNHA; Nature Reserve	8.5 km SW	Not classified as GWDTE	
Ridge Road SAC (000919); pNHA	4.3 km S		

According to the EPA GIS Portal, the proposed extension to the existing abattoir is mapped as a Groundwater in SAC Habitats as listed on the WFD Register of Protected Areas. These areas contain groundwater bodies which intersect with Designated Special Areas of Conservation (SAC).

Groundwater in SAC Habitats mapping for the region is shown in Drawing No. IE1746-017-*Groundwater in SAC Habitats*, in Attachment 11.1. A full review of ecological features and designated ecological sites in the study area are detailed in Chapter 9 – Terrestrial Biodiversity and Chapter 10 – Water Quality & Aquatic Biodiversity.

11.6.2.7 Groundwater Abstractions & Water Supply Schemes

The GSI Drinking Water and Wells Database were consulted. However, it is not a requirement for all wells to be registered with the GSI/EPA and it is not a complete inventory. The site of the proposed extension to the existing abattoir is mapped as a Drinking Groundwater Body, according to the EPA GIS Portal. No abstractions were recorded on the register on the site.

Banagher Water Supply Scheme

The Banagher - Clontotan Water Supply Scheme (WSS) boreholes are located <1 km North West of the proposed extension to the existing abattoir. Groundwater abstractions used for public supply have Source Protection Plans prepared by the GSI and EPA to define the groundwater Zone of Contribution (ZOC) for large public water supplies. The Source Protection Zone is divided as follows:

- **Inner Protection Area (SI).** This is designed to protect the groundwater source from microbial contamination and is defined by a 100-meter day time of travel from any point below the water table to the groundwater source.
- **Outer Protection Area (SO).** This comprises of the remainder of the zone of contribution to the groundwater source. The SO of the Banagher WSS is located <0.5 km from the western boundary of the proposed development site.

The Banagher WSS consists of a groundwater and surface water input (from the Shannon). Groundwater provides about 60% of the total demand through two boreholes, drilled in 1986 in the town land of Boheradurrow (EPA, 2011). The boreholes are alongside each other, each in their own separate concrete lined chamber with a padlocked galvanised cover.

The water is chlorinated at the pump house on site, and pumped to a reservoir at Mullaghakaraun. The reservoir has a storage capacity of 4000 m^3 (approximately 2 days) (Kelly, 2004). Details of the wells are outlined in Table 11.8. The location of the Banagher WSS in relation to the proposed extension of the existing abattoir in the regional geological setting is shown on Figure 11.5 below.

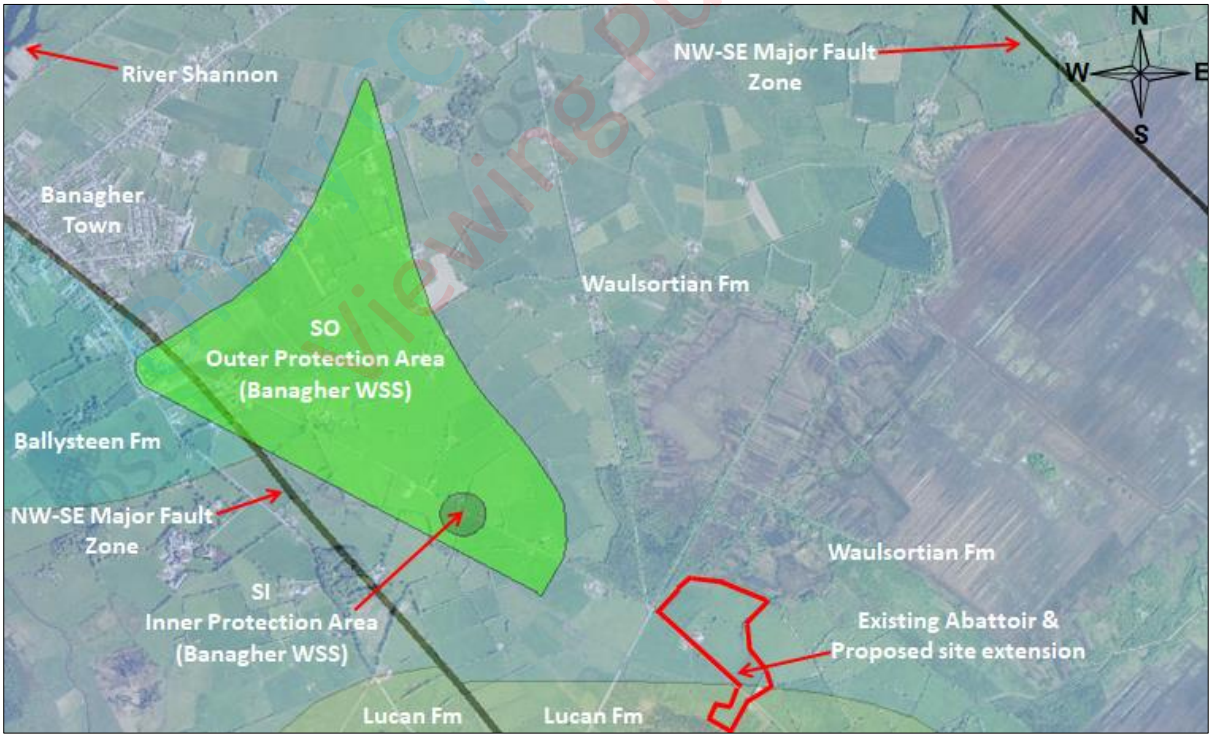

Figure 11.5: Banagher WSS SPZ and the regional bedrock/structural geology in relation to the existing abattoir and proposed site extension

The surface bedrock geological mapping indicates that the Banagher WSS site is underlain by the Waulsortian Formation (Dinantian Pure Unbedded Limestones). Kelly, 2004 has shown that the water bearing strata beneath the Banagher WSS belongs to the **Lucan Formation (Dinantian Upper Impure Bedded Limestones)** – based on information from the well logs, rock samples and the examination of outcrops in the nearby town land of Garrycastle.

A large NW-SE trending fault is mapped approximately 0.2 km south of the boreholes. According to the borehole logs, this is located between 30-35 mbgl. The borehole logs indicate that the vertical thickness of the fault zone ranges from approximately 2.5 m in PW1 to approximately 12 m in the trial borehole, indicating that it is a major fault. During pumping, groundwater is expected to be pulled toward the boreholes along the fault zone. The yield depends primarily on the available storage in the main fault network (Kelly, 2004). Thus, the Lucan Formation and major fault zones are key targets for groundwater exploration in the area. Details of the wells are outlined in Table 11.8.

Apart from the recorded water levels in the Public supply boreholes, there are no other water level data for the area. The streams in the area are assumed to represent the discharge level of shallow groundwater.

It is generally assumed that the water table is a subdued reflection of the topography, and that the groundwater flow direction will be perpendicular to the contour lines. At a local scale, in the vicinity of the wells, it is assumed that the higher ground to the north of the supply boreholes will be the recharge area, therefore water is expected to flow in a southerly direction toward the bog and a westerly direction toward the stream flowing past the boreholes. At a regional scale, it is expected that the regional groundwater and surface water flow direction is northwest toward the river Shannon.

The groundwater gradients are expected to be quite steep, because of the impure bedrock and the relatively steep topography; and, a value of 0.01 is assumed (Kelly, 2004).

Table 11.8: Well details for the Banagher WSS.

BANAGHER WSS – GROUNDWATER COMPONENT			
GSI No.	2021SWW002	2021SWW022	2021SWW008
Well Type	Borehole		
Well Name	Trial Well	PW-1	PW-2
Depth	48.8 m	61 m	59 m
Static Water Level	n/a	2-5 mbgl	2-5 mbgl
Pumping Water Level		Approx. 9 mbgl	Approx. 9 mbgl
Depth to Rock	8 m	9 m	14 m
Status	Disused	Alternates Pumping with PW2	Alternates Pumping with PW1
Pump Level	n/a	Approx. 44 mbgl	Approx. 46 mbgl
Normal Abstraction	n/a	400-420 m^3/d	
Maximum Abstraction	n/a	717 m^3/d (30/10/2002)	
Maximum Yield	654 m^3/d	916 m^3/d	870 m^3/d

BANAGHER WSS – GROUNDWATER COMPONENT			
	(72 hr test 1981)	(72 hr test 1986)	(72 hr test 1986)
Max Drawdown	11.43 m	36.7 m	40.97 m
Hours Pumping	n/a	20-21 hours/day	

According to the GSI classification of well yields, **the boreholes are "excellent" yielding wells, capable of 1000 m^3/d** (Kelly, 2004). However, this **yield is not sustainable**, and the abstraction quantities are only maintained:

- If one borehole is pumping at any one time (wells fail if both are pumping simultaneously).
- If the water level in either of the boreholes does not drop below the level of the fractures, which is possible during dry weather periods (Cullen, 1981).

Estimated aquifer properties in the vicinity of the fault zone are outlined in Table 11.9; according to Kelly, 2004.

Table 11.9: Estimate aquifer properties for the Banagher WSS groundwater component.

PARAMETER	RANGE/VALUE	SOURCE OF DATA
Transmissivity (m^2/d)	45-70	Local
Specific Capacity (Cullen, 1981)	35-55	Local
Permeability (m/d)	0.9-1.4	Local
Porosity	0.015	Assumed

Overall, **groundwater quality is reported as generally good**, but occasionally there are slightly elevated chloride and potassium levels suggesting that there is some human impact, probably contamination from organic waste. Agricultural activities and septic tanks are the principal hazards to the water quality in the area. The main potential sources of pollution within the ZOC are farmyards, septic tank systems, and land spreading of organic and inorganic fertilisers (Kelly, 2004). The Banagher WSS water quality is monitored as part of the EPA/Local Authority National Monitoring System.

Group Water Schemes

The National Federation of Group Water Schemes Database was consulted. There are no Group Water Schemes within 2 km of the existing abattoir/proposed extension area. There is one located 5.2 km west of the site, on the western bank of the River Shannon at Esker. This is not considered further, given its distance from the site.

Local Abstractions

The GSI Well & Spring Database was consulted. There are several wells/springs located within 7 km of the proposed site, which are outlined in Table 11.10. Overall, the main abstraction use is domestic and agricultural, with yields <100 m^3/d. There is one large industrial abstraction recorded at Midland Maltings Distillery.

Table 11.10: Local wells within the vicinity of the proposed extension

GSI Reference No.	Location Easting, Northing	Well Type	Distance/ Direction from site (km)	Drill Date	Depth (mbgl)	Depth to Rock (mbgl)	Yield (m^3/d)	Use	Abstraction (m^3/d)
2021SWW011	206,140 211,240	Dug Well	3.29 km E	1962	9.9	In drift	Poor	Domestic	-
2021SWW010	209,250 210,800		6.1 km E	1970	n/a	n/a	27	Domestic	Poor
2019NWW101	200,950 208,440	Borehole	5.9 km S	1899	20.7	n/a	21.8	n/a	Poor
1719NEW049	199,200 209,020		6.45 km S	1899	51.8	n/a	54.6	n/a	Moderate
1721SEW001	198,350 213,200		5.46 km SW	1899	27.4	n/a	n/a	n/a	n/a
1721SEW002	197,380 213,920		6.41 km SW	1998	30.5	2.1	87.3	Agri & domestic	Moderate
1721SEW003	196,240 214,270		7.6 km SW	2000	48	24.4	32.7	Agri & domestic	Poor
2021SWW001*	201,520 213,780		2.6 km W	1899	-	-	-	Industrial	-

*****GSI Well Reference No. 2021SWW001 refers to Midland Malting's (Distillery) at Montcarteret, near Banagher, Co. Offaly. According to the GWB Description, 2003, the yield is reported as 1000 m^3/d, as referenced from the EPA Database. This is located close to the North East – South West trending fault, on which the Banagher WSS is located. There are four bored wells on site (GSI Ref.: 2021SWW018; 2021SWW019; 2021SWW020; 2021SWW021), all drilled in 2003. The closest Midland Malting's well is within 1.2 km of the proposed extension to the existing abattoir. It is understood that Midland Malting's (Distillery) no longer operates. No information was available on the current status of the boreholes and if they are still in production by an alternative consumer.

Groundwater abstractions are shown in Drawing No. IE1746-019-*Groundwater Abstractions*, in Attachment 11.1.

11.6.2.8 Classification of Geological Environment

The generic type of geological/hydrogeological environment of the Proposed Development can be determined based on the IGI guidelines. In summary, the baseline information suggests that this is a **Type D – Sensitive geological/hydrogeological environment** e.g. potentially unstable hydrogeological environments with groundwater source protection zones and karst.

11.6.2.9 Conceptual Site Model

A conceptual site model was compiled, showing the subsurface strata and hydrogeological characteristics. This conceptual model is presented in Attachment 11.2.

- The site is located at Boheradurrow, approximately 3.5 km south east of Banagher, Co. Offaly. The site is relatively flat, with Ordnance Survey mapping indicating it

slopes gently from east (60 mOD) to west (50 mOD). Mullaghakaruan Bog is located along the northern boundary of the site. To the west, the town of Banagher is present, and the River Shannon, which flows in a south westerly direction.

- An existing slaughter house, lairage, office and associated facilities are located onsite; along with a farm yard comprising several cattle sheds. Overall, the site is dominated by large, open green fields which were used for pastoral farming.
- The top soils mapped across the site are dominated by peat along the north of the site with the remainder of the site covered in a 'fine loamy' drift with limestone clasts (drained basic soil).
- The subsoils underlying the soil are mapped as Till derived from limestones with peat present in the North West and along the northern boundary of the site. The topographic high points contain sand and gravels.
- The depth of the soils/sub soils does not vary greatly throughout the site and ranges between 4 to 8.5 mbgl. The South West and West of the site were identified as having the shallowest bedrock. This has been estimated, based on the geophysical survey completed across the site. It is understood that an intrusive site investigation would completed to ground truth the findings of the geophysical survey.
- The groundwater vulnerability across the site is mapped as Moderate (M) with localised zone of Low (L) vulnerability mapped in the north west of the site. The low vulnerability can be attributed to relatively thick, impermeable deposits of clay across the site. Moderate vulnerability can be attributed to the topographical high points consisting of relatively permeable sands and gravels.
- The Lucan Formation (dark-grey to black, fine-grained, micritic limestone) underlies the south east of the site, while the Waulsortian Limestone Formation underlies the remainder of the area. A geological contact between the Lucan and Waulsortian Formation is mapped in the South East of the site on the GSI Bedrock Geology Map. The Lucan Formation overlies the Waulsortian Formation.
- The geophysical survey identified the true location of the contact between the Lucan and Waulsortian Formations is located in the North West of the site, not in the South East of the site, as mapped by the GSI. The contact is gradational between the formations and correlates to an extensive zone of karst which was identified by the geophysical survey.
- An extensive zone of karst is present in the Northwest of the site. A linear karst feature has been identified running in a South West – North East direction, immediately south of the abandoned farm yard. Elsewhere, localised karst anomalies were identified in the south of the site, running parallel to the L3010 road.
- The upper zone of bedrock across the site is highly weathered, or overlain by firm to stiff clay. Below the weathered upper zone of bedrock, the limestone is strong and fresh.
- Regionally the structural geology consists of a series of major North East – South West striking normal faults, with a series of minor North West – South East striking, younger faults. The closest mapped, most probable location of a fault is 1.10 km south the proposed extension to the existing abattoir, which strikes North West – South East.

- It is understood that an intrusive site investigation (boreholes) would be completed to gain further information on the bedrock underlying the site.
- The Feeghroe stream also referred to as the Mountcarteret in the literature/mapping forms the western boundary of the site. The flood risk assessment has determined that the majority of the proposed development site falls within Flood Zone 'C' - Low to Negligible Probability of Flooding.
- The Waulsortian and Lucan Formations underlying the site, and the surrounding area are classified as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. The proposed extension to the existing abattoir is located within the Banagher Groundwater Body.
- According to GSI the National Recharge Map, the recharge coefficient for the area of the proposed extension to the existing abattoir is 4%, which suggests that 96% of effective rainfall is available for runoff (480 mm). Thus, the aquifer has a low recharge acceptance.
- The Banagher - Clontotan Water Supply Scheme (WSS) boreholes ZOC Outer Protection Area is located <0.5 km West of the proposed extension to the existing abattoir with groundwater flow generally from North to South within the ZOC. The proposed development site is mapped outside the Outer Protection Area of the ZOC.
- Aquifer properties within the vicinity of the WSS are estimated follows: transmissivity 45-70 m2/d; permeability 0.9-1.4 m/d; specific capacity 35-55; and porosity 0.015.
- There are several springs/wells located within 7 km of the site, which are used for domestic and agricultural purposes. The yields are <100 m3/d, with the exception of Midland Malting's (Distillery) at Montcarteret (<1.2 km away from the proposed extension) where the yield is reported at 1000 m3/d. It is understood that Midland Malting's (Distillery) no longer operates. No information was available on the current status of the Midland Malting's (Distillery) boreholes and if they are still in production for an alternative consumer.
- The environment surrounding the proposed extension is classified as a sensitive geological/hydrogeological environment according to the IGI guidelines.

11.7 WATER SUPPLY & MANAGEMENT

The water supply for the proposed extension and the existing abattoir is planned to be sourced from a well, drilled onsite. A geophysical survey has identified two potential locations for trial well drilling. The locations identified for potential trial well drilling are indicated in Drawing No. IE1746-020-*Potential Trial Well Locations - Identified by Geophysics*, in Attachment 11.1.

The Waulsortian and Lucan Formations underlying the site, and the surrounding area are classified as a (LI) Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. A Locally Important Aquifer is defined as an aquifer unit capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or supplying 'good' yields (100-400 m^3/d) (GSI, 2017).

It is proposed to undertake trial well drilling, well development and well testing to confirm the nature of a groundwater supply for the proposed extension and existing abattoir. It is estimated that peak water consumption at the site would be **150-200 m^3/d**. However, this is likely to be an overestimate.

Given the aquifer classification and the presence of viable targets, it is expected that the demand can be met from site.

Following drilling, pump testing will be undertaken to establish the hydrodynamics of the aquifer and to explore its interaction with other water features. It is expected that the water quality will be similar to other areas in the same aquifer type, with high hardness, and the possibility of iron or manganese. Appropriate treatment processes will be designed and implemented to address these issues if they arise.

In conjunction with the development of a sustainable groundwater source onsite, all underground water pipes would be upgraded.

11.7.1 WATER CONSERVATION

Water conservation measures have been included as part of the proposed extensions design. These measures include:

- Rainwater harvesting of all roof water for used in staff sanitary facilities and landscaping.
- The final WWTP (Waste Water Treatment Plant) will include a 20 m3 holding tank for grey water to be used in the lairage and lorry wash-out. It is estimated that 5 m3/d of water will be required for the lorry washout and 5m3/d for the lairage. This practice is currently undertaken at existing abattoirs throughout Ireland.

11.8 WASTEWATER TREATMENT

The existing abattoir waste water treatment system consisted of the following:

- There were no discharged to sewer at the site. Foul water drainage from staff facilities was directed to a septic tank and percolation area.
- Process emissions from the factory, dirty yard drainage and lorry-wash runoff were all directed to a waste water inlet sump and wastewater storage sump. The contents of the waste water storage sump were tankered off-site for either land spreading or for treatment a municipal Waste Water Treatment Plant (WWTP). No treatment of effluent was carried out onsite.
- Storm water from the roof areas was directed to a surface water tank. It is presumed that the contents of this tank were directed to a percolation area.

Effluent generated on the site comprises of wash-down of the production floor, drainage from dirty yard areas, drainage from the floor of chill areas, domestic effluent and centrate return

from fertiliser by-product (belly-grass) dewatering. All process drains, domestic drains and dirty yard surface water drains would be directed to the on-site effluent treatment plant.

The existing septic tank and percolation area will be decommissioned. A Wastewater Treatment Plant (WWTP) will be constructed along with Integrated Constructed Wetlands. The WWTP will be will be designed for a maximum capacity of 15,667 P.E (where 1 P.E. = 64 g BOD / person / day) and 250 m^3/d. It is proposed to discharge the final treated effluent to the Feeghroe Stream, which travels along the western site boundary. The proposed waste water treatment process for the existing abattoir and proposed extension, are shown in Figure 11.6.

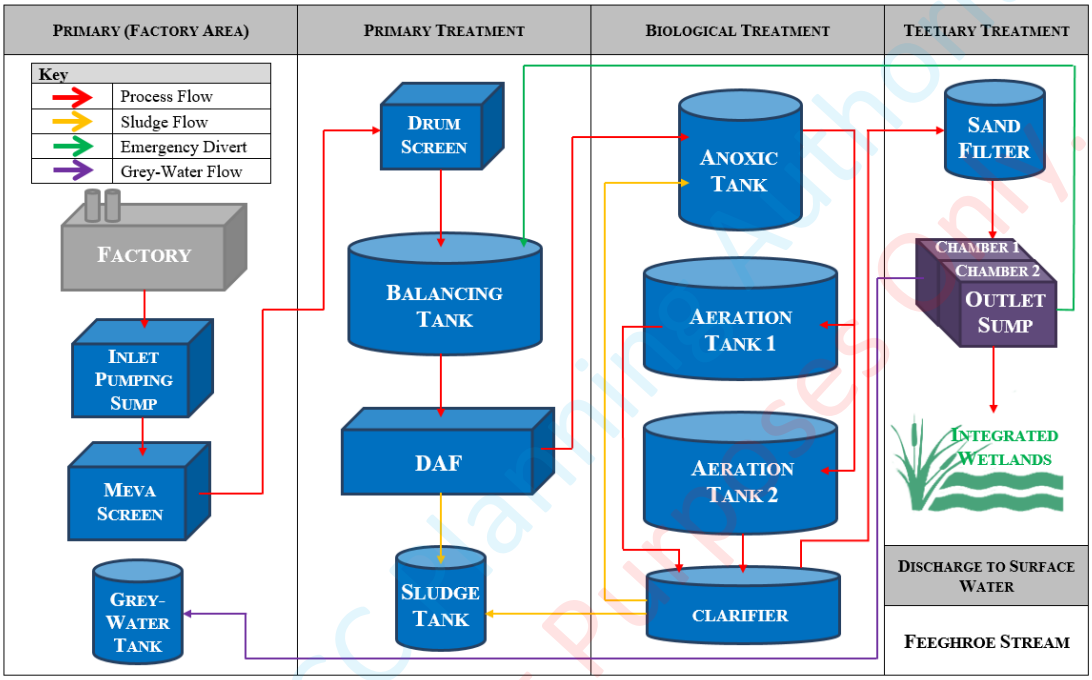

Figure 11.6: WWTP & ICW system for existing and proposed extension to abattoir.

11.8.1 FEEGHROE STREAM – MAX DISCHARGE RATE

The EPA employs a general rule of thumb for effluent discharge to surface waters of 1:20 dilutions. It should be noted that this is dependent on the river being of pristine quality prior to the discharge.

Where an excess of 1:20 dilutions is proposed, a high degree of effluent treatment would generally be required, unless there it can be demonstrated that the river is of very high quality and the discharge would not significantly impact this quality. Table 11.11 provides the Theoretical Maximum Discharge Rates which would be allowed based on the drought / low flow in each watercourse.

Table 11.11: Theoretical maximum discharge rates to the Feeghroe Stream

WATERBODY	LOCATION (ING)	DISTANCE TO SITE BOUNDARY (KM)	WATERCOURSE 95%ILE FLOW (M3/S)	HYDRAULIC DISCHARGE RATE (M3/D)
Feeghroe Stream	202790 213849	0.9	0.009	778

An assimilative capacity assessment was conducted in order to determine the risk of negative impacts upon the Feeghroe stream from a proposed discharge of treated trade effluent from the site. Chapter 10 – Water Quality & Aquatic Biodiversity deals with the impacts of the proposed extension to the existing abattoir on surface water quality. Further details are contained in the *Effluent Process Description Report, PES_ETP_19_9201*.

11.8.2 WASTEWATER TREATMENT PLANT (WWTP)

The proposed WWTP would be operated and managed using the F/M ratio (Food to Mass). This method relies on regulating the rate of growth and metabolism of the microbial population. The F/M ratio is an important control parameter as the quantity of biomass present will influence the removal efficiency. The F/M ratio relates to the biological state of the plant and is independent of the size of the aeration tank. If the operator is aware of the load entering the plant, he/she can ensure that sufficient biomass (micro-organisms) is present in the aeration tank to react with the load.

Where the optimum F/M ratio has been determined, the optimum or desired mass of MLSS (mixed liquor suspended solids) may be calculated. If the actual mass of MLSS is less than the desired mass of MLSS, then the concentration of MLSS must be allowed to increase by reducing the amount of sludge wasted from the system. If the actual mass of MLSS is greater than the desired mass of MLSS, then a proportion of the mixed liquor must be wasted from the system.

The operator and back-up operator of the WWTP would receive extensive training and support when the effluent plant is being commissioned and becomes operational. Training would include the following:

- Discharge licence parameters and conditions – compliance.
- Operating the effluent treatment plant effectively.
- Maintaining an efficient waste water processing environment.
- Receiving, recording and transmitting information.
- Laboratory testing.

The effluent treatment plant will consist of the following stages:

A. Primary Treatment

- Raw inlet sump
- Meva Screen
- Drum Screening

- Balance Tank
- DAF Unit
- Sludge Holding Tank
- Sludge Screw Press
- Grey water tank (final effluent re-use tank)

B. Biological Treatment

- Anoxic Tank
- Aeration Basins x 2
- Clarifier

C. Tertiary Treatment

- Sand Filter

Following treatment at the WWTP plant the effluent will then enter into a system of ICWs, for further tertiary treatment, which is discussed in Section 11.8.3. The proposed waste water treatment process for the existing abattoir and the proposed extension, are shown in Figure 11.6. Further information on the WWTP process can be studied in the *Effluent Process Description Report, PES_ETP_19_9201*. Chapter 10 – Water Quality & Aquatic Biodiversity deals with the impacts of the proposed extension to the existing abattoir on surface water quality.

11.8.3 INTEGRATED CONSTRUCTED WETLANDS (ICW)

Following treatment at the proposed WWTP, treated effluent would be pumped to the proposed ICW system. The ICW configuration for the proposed development site comprises a five-treatment cell system. The system is designed with cascading levels to enable gravity flow across the system, and has been designed to maximise the distance over which the influent must travel for optimum residence time and treatment.

The treated effluent from the WWTP would be pumped to the first ICW cell, and from here would flow sequentially through the remaining cells via interconnecting pipework. The final treated effluent from the ICW would be directed to the Feeghroe Stream, located immediately to the west of the proposed ICW system.

The ICW would serve as a tertiary treatment system, and would treat up to 250m^3 of wastewater a day from the WWTP. The functional wetland treatment area achieved in the proposed design is 40,000m^2, as detailed in Table 11.12.

Table 11.12: ICW treatment cell areas

CELL NO.	CELL AREA (M^2)
Cell 1	7,000
Cell 2	7,935
Cell 3	9,620
Cell 4	7,740
Cell 5	7,705
Total ICW Area	40,000

An ICW treatment area of $150m^2$ per m^3 of influent has been determined to be appropriate to satisfy the required treatment performance and achieve proposed licence limits for discharge to the Feeghroe Stream, as set out in Table 11.13.

Table 11.13: Proposed discharge licence limits for discharge to the Feeghroe Stream

PARAMETER	UNITS	PROPOSED DISCHARGE
Volume Flow	m^3/d	250
pH	pH Units	6-9
BOD	mg/l O2	5
COD	mg/l O2	50
Ortho-phosphate	mg/l PO4-P	0.2
Total Ammonia	mg/l N	0.4
Total Nitrogen	mg/l N	5
Suspended Solids	mg/l SS	20

Each cell would be densely planted with a selection of emergent plant species, including Reed Sweet-grass (*Glyceria maxima*), Common Sedge (*Carex riparia*), Reed Mace (*Typha latifolia*), Lesser Reedmace (*Typha angustafolia*) and Yellow Flag (*Iris pseudacorus*), along with a quantity of other suitable emergent plant species.

The final cell, Cell 5, will be planted with a mixture of deciduous and evergreen tree species on mounds amongst the emergent wetland plants. This arrangement is designed to reduce the overall outflow from the system.

The proposed plants will reduce the through-flowing water of its various potential pollutant contaminants. The vegetation would also play a very important role in reducing the volume of final treated effluent discharging from the ICW to the receiving waters, especially through the process of evapotranspiration.

The operational water depth within each cell would be between 150 mm and 200 mm, with capacity to allow for increased water depth during high rainfall events. The treatment wetland cells would have a minimum embankment height of 1m. The maximum expected discharge flow from the ICW system would be variable due to the open nature of the system.

Chapter 10 – Water Quality & Aquatic Biodiversity deals with the impacts of the proposed extension to the existing abattoir on surface water quality. Further details on the Integrated Constructed Wetlands are outlined in the *VESI Environmental Ltd April 2019* report.

11.9 POTENTIAL IMPACTS OF THE PROPOSED EXTENSION

The following is the wording of the proposed development for which planning permission is being sought:

"We Banagher Chilling Limited intend to apply for permission for development at Boheradurrow and Meenwaun, Banagher, Co. Offaly R42HX24 the development will consist of a single storey extension to existing abattoir of 1061 square meters to include processing rooms, staff changing rooms, offices, increase roof height by 2 meters, extend existing lairage and elevation alterations. In addition the construction of a food processing factory of 4925 square meters with a part first floor of 2299 square meters to include processing rooms, cold store, loading bay, chill rooms, plant rooms, staff changing rooms, staff canteen and administration offices. External works consisting of staff car parking, service yards, new public road entrance, widening of existing public road, effluent treatment compound, water storage tank, gas storage tanks, truck wash bay, integrated constructed wetlands, security hut of 23 square meters, electrical room of 168 square meters, water treatment building of 72 square meters, effluent treatment control house of 30 square meters, all associated siteworks and landscaping works on a site of 19.60 hectares. This application is accompanied by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement.

The planning application, EIAR and Natura Impact Statement may be inspected, or purchased at a fee not exceeding the reasonable cost of making a copy, at the offices of the Planning Authority during its public opening hours. A submission or observation in relation to the application may be made in writing to the planning authority on payment of the prescribed fee (€20) within the period of 5 weeks beginning on the date of receipt by the authority of the application."

The proposed upgrade and extension of the existing facility would facilitate a **maximum cattle slaughter rate of 140 per day**. Banagher Chilling Limited intends to provide for the discharge of final treated effluent to the Feeghroe Stream, which passes along the western site boundary. Prior to discharge to this watercourse, the final treated effluent would be directed to new integrated constructed wetlands following treatment in a waste water treatment plant.

The main features uncovered on the site and in the surrounding environment which have the potential of being impacted by the proposed extension to the existing abattoir are summarised in Table 11.14. These features are ranked in terms of importance. The features are divided into four categories: land/soils; surface water; groundwater resources; and ecosystems.

The existing abattoir and proposed extension are detailed in *Attachment 2.3 / Drawing Ref. 1806-06-5.*

Table 11.14: Summary of important features within the project study area

FEATURE	LOCATION RELATIVE TO PROPOSED DEVELOPMENT	IMPORTANCE RANKING	JUSTIFICATION
Land/Soils			
Peat	On site	Low	Peat has low agricultural potential
Fine loamy soils	On site	Low	Limited agricultural potential, poorly drained, shallow depth
Sands/Gravel	On site	Medium	Potential for reuse onsite during construction
Till	On site	Low	Low economic value
Groundwater Resources			
Locally Important Bedrock Aquifer	On site	Medium	Supplies Banagher-Clontontan WSS Supplies domestic/ agricultural dwellings private abstractions
Banagher - Clontotan Water Supply Scheme	Outer Source Protection Zone <0.5 km North West of western boundary	Very High	Groundwater supplies 60% of demand to WSS. Main supply for surrounding region
GSI Well Ref. No. 2021SWW001 *(understood not to be currently in use)*	1.2 km to the west of the proposed extension	High	Commercial Supply to Midland Malting's Distillery
GSI Well Ref. No. 2021SWW011	3.29 km east of the proposed extension	Low	Private supply for domestic/agricultural use
Ecosystems			
All Saints Bog SPA (004103); All Saints Bog & Esker SAC (000566); NHA.	2.4 km South West of site	Extremely High	European Site - SAC, SPA, NHA, Groundwater Dependent Terrestrial Ecosystem

Potential impacts of the proposed extension to the existing abattoir are described below, before mitigation measures are applied. The nature, extent and duration of the impacts are also assessed.

11.9.1 CONSTRUCTION PHASE

During the construction phase, the following activities may pose an impact:

- Excavation and storage of soils and subsoils.
- Contamination of soils during earth moving.
- Contamination of groundwater.
- Contamination of the Feeghroe stream during earth moving.
- Karst activation through collapse.

11.9.1.1 Excavation & Storage of Soils & Subsoils

Removal of soils and subsoils overlying the locally important bedrock aquifer will increase the groundwater vulnerability across the site. This increases the risk of pollution from surface activities, and increases the need for good practices when handling potential contaminants at the surface. This poses a Negative, Moderate and Permanent Effect on the groundwater vulnerability across the site.

Incorrect excavation and storage of peat on site has the potential for collapse in the form of a slump or slide. This may occur if the peat is stacked too steeply. In addition, surrounding water courses, construction machinery/equipment etc. are at risk of damage if a stockpile of peat was to collapse. This poses a Negative, Significant and Short Term Effect to the existing environment.

11.9.1.2 Contamination of Soils During Earth Moving

Soils and subsoils have the potential to become contaminated through leakages, spillages or burst pipes on site. Hydrocarbons, chemical and waste water pose a contamination risk to soils if used or stored incorrectly. This poses a Negative, Significant, and Short Term Effect to the soils/subsoil across the site.

11.9.1.3 Contamination of Groundwater

Hydrocarbons, grease and chemicals used in the construction of the proposed extension have the potential to contaminate groundwater. This may occur through leakages, spillages or incorrect storage practices.

The locally important aquifer underlying the site is karst, and supports the Banagher - Clontotan WSS. The Outer Source Protection Zone is located <0.5 km from the western boundary of the site. Although groundwater originating on the site is unlikely to be drawn into the sources, the risk is not zero. Contamination of the bedrock aquifer underlying the site could lead indirectly to contamination could pose a risk to the domestic abstractions in the vicinity of the site and any downgradient abstractions. Contamination of the bedrock groundwater system represents a Negative, Significant and Long Term Effect on the existing environment.

11.9.1.4 Contamination of the Feeghroe Stream during Earth Moving

Elevated concentrations of suspended sediment, hydrocarbons and other run-off may enter the Feeghroe stream during the construction phase. This may occur due to poorly managed excavation works or the use of fuels/chemical across the site. This has the potential to reduce water quality and harm aquatic life. This poses a Negative, Significant and Short Term Effect to the Feeghroe Stream.

Chapter 10 – Water Quality & Aquatic Biodiversity deals with the impacts of the proposed extension to the existing abattoir on surface water quality.

11.9.1.5 Activation of Karst Through Collapse

Karst has been identified in the North West of the site. This poses a risk of subsidence or collapse to any structures which would be located in this area of the site. This has the potential to damage equipment and cause harm/injury to people working in structures built in karst areas. This poses a Negative and Significant risk to human life and the surrounding environment.

11.9.2 OPERATIONAL PHASE

During the operation phase, the following activities may pose an impact:

- Banagher – Clontotan WSS Impacts.
- Groundwater Dependent Terrestrial Ecosystem Impacts.
- Contamination of Groundwater.
- Culvert Blockages & Drainage Diversions.
- Land Take.

11.9.2.1 Banagher – Clontotan WSS Impacts

The water supply for the proposed extension to the existing abattoir and current abattoir onsite is planned to be sourced from a well drilled onsite. The Banagher-Clontotan WSS Outer Source Protection Zone is located <0.5 km from the western boundary of the proposed development site.

It should be noted that the proposed location of any production well, when chosen, will not be within the ZOC of the public supply, and so is not expected to have any impact on the public supply. It is estimated that water consumption at the proposed development site would be 150-200 m^3/d. However, this is likely to be an overestimate.

Development of a groundwater supply on the proposed development site may interfere with the existing abstractions in the area. In other words, a second large scale abstraction within 1 km of the Banagher WSS may lead to competition for groundwater, and stress the locally important aquifer. This may lead to excessive drawdown, and in times of severe drought, the productivity of the aquifer may be significantly reduced. This has the potential for an effect

on the Banagher WSS, and other commercial abstractions already operating in the vicinity of the site.

11.9.2.2 Groundwater Dependent Terrestrial Ecosystems Impacts

As discussed in Section 11.9.2.1 (above), the development of an additional large scale abstraction in the area has the potential to lower water levels in the surrounding town lands.

The All Saints Bog is a groundwater dependent terrestrial ecosystem, located 2.4 km South West of the proposed site where a large scale groundwater abstraction is planned. Any lowering of regional groundwater levels may stress the sensitive ecology of the All Saints Bog. It is unlikely that any measurable impact will occur to Bogs by virtue of its distance from the proposed extension to the existing abattoir.

11.9.2.3 Contamination of Groundwater

Storage of oil, grease and chemicals has the potential to contaminate the bedrock aquifer underlying the site in the event of a spillage or leak. Contamination of groundwater on site would pose a risk of pollution to the sites proposed water supply. This would have a Negative, Very Significant, Long-Term impact on the groundwater supply for Banagher Chilling Ltd.

11.9.2.4 Culvert Blockages & Drainage Diversions

Secondary flood risk can also be attributed to a potential surcharge due to a blockage of the culverts located on the Feeghroe stream and drainage channels in the vicinity of the site. This may result in localised areas of flooding within the site. This poses a Negative, Significant, Temporary impact on the proposed development and surrounding environment.

Part of the extension of the existing abattoir facilities requires alterations to the existing site drainage channels, as outlined in Section 11.6.1.5. This poses an Adverse, Slight, Long-Term impact on the hydrology of the site.

11.9.2.5 Land Take

Land take is the removal of productive land from potential agricultural or other beneficial uses. The entire site covers an area of approximately 19.6 hectares. Within the landholding, there is an established farmyard complex of buildings and an existing permitted abattoir extending to approximately 748 m^2.

The land across the proposed extension area is used for pastoral farming. However, its productivity is limited by the poor drainage and shallow low fertile soils. Thus, the agricultural potential of the site is low. The area to the North/North West is underlain by peat. The agricultural potential of peat is limited.

Overall, the proposed extension to the existing abattoir will not remove highly productive, fertile agricultural land from the environment. Overall, this can be described as a Negative, Slight, Long term impact.

11.9.3 DO NOTHING SCENARIO

In the absence of the proposed extension to the existing abattoir, the site would remain in a stable condition, as outlined in Section 11.5 the Land & Soil Baseline Environment and Section 11.6 the Water Baseline Environment.

In contrast, the proposed extension to the existing abattoir will enhance the existing Land, Soil and Water environment in the following ways:

- The addition of trees, shrubs and landscaping across the ICW area will benefit the local ecology.
- Redevelopment of the existing abattoir will remove an abandoned visually unpleasant site from the surrounding landscape.

11.9.4 UNPLANNED EVENTS

Under a 'worst case' scenario, the accidental release of fuel, oil, paints or other hazardous material occurs on site during the construction phase or operation phase, through the failure of secondary containment or a materials handling accident on the site. If this were to occur over open ground then these materials could infiltrate through the soil contaminating soil, subsoils and groundwater. Runoff from the site may transport these contaminants into the Feeghroe stream which would degrade water quality and damage the aquatic ecology.

11.10 MITIGATION MEASURES

In this Section, measures are recommended to prevent and/or limit the potential impacts of the Proposed Extension, as outlined in Section 11.9.

11.10.1 CONSTRUCTION PHASE

- Excavation and storage of soils and subsoils.
- Contamination of soils during earth moving.
- Contamination of groundwater.
- Contamination of the Feeghroe stream during earth moving.
- Karst activation through collapse.

11.10.1.1 Excavation & Storage of Soils/Subsoils

The proposed method of excavation is 'cut and fill'. Earthworks operations which involve peat shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe run-off and prevent ponding and collapse following heaving rainfall. Excavations will be minor and not involve substantial excavation depths.

The following procedures will be adhered to when excavating soils/subsoil:

- Stripping of topsoil will be carried out in a controlled and carefully managed way and coordinated with the proposed staging for the development.
- At any given time, the extent of topsoil strip (and consequent exposure of subsoil) will be limited to the immediate vicinity of active work areas.
- Topsoil stockpiles will be protected for the duration of the works and not located in areas where sediment laden runoff may enter watercourses.
- Where feasible, excavated material will be reused as part of the site development works (e.g. for landscaping works and for backfill in trenches under non-trafficked areas).
- Existing topsoil will be retained on site to be used for the proposed development.
- Topsoil will be stored in an appropriate manner on site for the duration of the construction works and protected for re-use on completion of the main site works.
- Top-soiling and landscaping of the works will take place as soon as finished levels are achieved, in order to reduce weathering and erosion and to retain soil properties.
- Stockpiled material will be covered and/or dampened during dry weather to prevent spreading of sediment/dust.
- Specialist machinery such as track machines will be used to minimise compaction of soils.
- Good housekeeping (site clean-ups, use of disposal bins, etc.) on the site project.

11.10.1.2 Contamination of Soils During Earth Moving

During construction all machinery operating onsite will refuel at a designated depot. The fuel tanks will be bunded, and the secondary containment area will be capable of holding 110% of the volume of fuel stored. The depot will contain a hard standing area, where all equipment and mobile machinery will repaired and serviced.

11.10.1.3 Contamination of Groundwater

It is anticipated that the water supply onsite will be one of the first elements of the proposed extension to be developed. To protect the water supply during the construction phase, appropriate fencing, signage and lighting will be installed around the well head. It is anticipated a 15 m radius will be provided around the well to prevent machinery driving close to the well head and damaging the well.

The well will be designed in accordance with all the relevant guidelines issued by the EPA, IGI and Irish Water. Particular attention will be paid to the well head protection to prevent ingress of contamination from the surface water/surface based activities to protection the locally important bedrock aquifer.

11.10.1.4 Contamination of the Feeghroe Stream During Earth Moving

Soil and subsoil stockpiles will be protected for the duration of the works and not located in areas where sediment laden runoff may enter watercourses. The Feeghroe stream will have a

silt fence installed along its bank to protect it from runoff with elevated levels of suspended solids. This will be inspected regularly, and after periods of heavy rainfall.

11.10.1.5 Karst Activation Through Collapse

Mitigation through avoidance was deployed at the planning and design stage to reduce the risks associated with karst. No structures will be built in the areas where karst has been identified.

If karst is found during the excavation phase of the construction on site, a hydrogeologist or engineering geologist will be consulted to inform of the safe way forward. Until the safe way forward is found, the karst feature (e.g. swallow hole, cavity etc.) will be covered over to prevent ingress of surface contamination into the bedrock aquifer. The discovery will be secured with fencing and appropriate signage.

11.10.2 CONSTRUCTION PHASE

- Banagher – Clontotan WSS Impacts.
- Contamination of Groundwater.
- Culvert Blockages & Drainage Diversions.

11.10.2.1 Banagher – Clontotan Impacts

The development of a groundwater supply for the existing abattoir and proposed extension will be undertaken in a risk based manner to ensure there are no impacts on the Banagher WSS boreholes. Following trial well drilling, a step test and pump test will be completed on the well to understand the impact of the well on the surrounding abstractions. A source protection zone will be delineated and a monitoring programme will be implemented to allow for management of the resource. Stakeholder engagement will ensure the sustainable development of the well, in light of existing abstractions.

11.10.2.2 Contamination of Groundwater

All chemicals, fuels, oils, grease and wastes which have the potential to contaminate groundwater will be stored in an area protected by bunds. Each bund surrounding a potential contaminant will be capable of retaining 110% of the volume of material stored on site. In addition, safe handling practices, maintenance and good housekeeping will also limit incidents of spillage and leaks.

The WWTP is designed to be fully contained, and will only discharge to the environment after appropriate treatment. The final sump of the WWTP will have an emergency return connection to the balancing tank, providing storage for emergencies or other such contingency purposes.

The groundwater supply well proposed onsite will be designed in accordance with the best practice guidelines. Appropriate grouting and well head protection will be deployed to ensure the groundwater is abstracted in a safe manner, with the potential for surface contamination to enter the well kept to a minimum.

11.10.2.3 Culvert Blockages & Drainage Diversions

The culverts located on the Feeghroe Stream and Drainage Channels in the vicinity of the site should be inspected on a regular (quarterly) basis to ensure they are free from debris in order to prevent blockage/surcharge which may lead to secondary flooding.

The diverted channel and new culverts will be designed to cater for the peak 1 in 1000 (0.1% AEP) flow rates including a 20% increase for climate change. In consideration of the proposed drainage works and the implementation of a maintenance regime, to include quarterly monitoring of all existing and proposed drainage channels and culverts, the potential residual risk of culvert blockage to the site is considered to be low.

11.11 CUMULATIVE IMPACTS

There is a cumulative impact in relation to the Water component of the proposed extension to the existing abattoir. The safe, secure and sustainable development of a groundwater supply for Banagher Chilling Ltd presents a challenge in itself, given the close proximity to the Banagher WSS well field and other abstractions. Failure to manage the groundwater resource in the region would lead to Negative, Very Significant, Long Term impacts for the many stakeholders and ecosystems which depend on it.

Future expansion of the Banagher Chilling Ltd abattoir may be constrained due to the current capacity constraints on the Irish Water public supply network. The development of additional groundwater supplies for Banagher Chilling Ltd to facilitate expansion of the slaughter rate beyond 140 cattle a day is also limited. This is due to many sensitive groundwater dependent terrestrial ecosystems in the region, along with the existing public, agricultural, commercial and private abstractions operating in the region.

No cumulative impacts are anticipated for the Land/Soils component of the proposed extension to the existing abattoir.

11.12 RESIDUAL IMPACTS

Residual impacts are defined as those impacts that remain following the implementation of the mitigation measures outlined in Section 11.10. A summary of the potential impacts along with the residual impacts are outlined in Table 11.15.

Table 11.15: Summary of impacts and residual impacts

SUMMARY OF IMPACTS & RESIDUAL IMPACTS PROPOSED EXTENSION OF EXISTING ABATTOIR – BANAGHER CHILLING LTD.			
PHASE	**ACTIVITY**	**RECEPTOR**	**IMPACT (QUALITY, SIGNIFICANCE, DURATION)**
Construction Phase	Excavation & Storage of Soils/Subsoils	Soils/Subsoils	Negative, Significant, Short Term Effect
	Contamination of Soils during Earth Moving	Soils	Negative, Significant, Short Term Effect
	Contamination of Groundwater	Locally Import Aquifer/Existing abstractions	Negative, Significant, Long Term Effect
	Contamination of Feeghroe Stream during Earth Moving	Feeghroe Stream	Negative, Significant, Short Term Effect
	Activation of Karst	Structures on Site – subsidence/collapse risk	Negative, Significant, N/A
Operational Phase	Banagher-Clontotan WSS Impacts	Banagher Public WSS	Impact unlikely as site does not encroach on ZOC
	GWDTEs	All Saints Bog/Reduced water table	Impact unlikely due to distance from site
	Contamination of Groundwater	Proposed well onsite to supply Banagher Chilling Ltd.	Negative, Very Significant, Long-Term
	Culvert Blockages	Localised areas susceptible to secondary flood risk	Negative, Significant, Temporary
	Drainage Ditch Diversions & New Culverts	Localised areas susceptible to secondary flood risk	Adverse, Slight, Long-Term
	Land Take	Shallow, low agricultural potential, poorly drained soils across the site	Negative, Slight, Long Term

PHASE	ACTIVITY	MITIGATION	RESIDUAL IMPACT (QUALITY, SIGNIFICANCE, DURATION)
Construction Phase	Excavation & Storage of Soils/Subsoils	Adhere to procedures	Negative, Imperceptible, Temporary
	Contamination of Soils during Earth Moving	Designated refuelling area/machinery repair area	Negative, Imperceptible, Temporary
	Contamination of Groundwater	Fencing around well; design well to guidelines; 15 m radius around well during construction	Negative, Not Significant, Long Term
	Contamination of Feeghroe Stream during Earth Moving	Silt fences; inspect silt fences after periods of heavy rainfall.	Negative, Imperceptible, Short Term
	Activation of Karst	Mitigation through avoidance at design stage	Neutral, N/A, N/A
Operational Phase	Banagher-Clontotan WSS Impacts	Banagher WSS/ implement monitoring programme/ interact with stakeholders	Unlikely as site does not encroach on ZOC
	Contamination of Groundwater	Bunds, safe handling, good housekeeping	Negative, Imperceptible, Long Temporary
	Culvert Blockages	Quarterly Inspections	Neutral, Imperceptible, Temporary
	Drainage Ditch Diversions & New Culverts	Designed to 0.1% AEP flow rates with 20% increase for climate change & maintenance/monitoring	Neutral, Imperceptible, Temporary

11.13 MONITORING

The following monitoring is recommended as part of the proposed extension to the existing abattoir:

- Monitoring of the groundwater to ensure there is no contamination entering the Locally Important bedrock aquifer from onsite activities, storage areas or the integrated constructed wetlands. It is recommended to install monitoring wells across the site (one upgradient; two down gradient) to monitor for potential contaminants and to protect the abstractions in the vicinity of the site (Banagher WSS and the Midland Maltings Distillery).
- Monitoring of groundwater levels and water usage to ensure the safe and sustainable management of the water resources underlying the site, and in the wider area of the proposed extension to the existing abattoir.
- The culverts located on the Feeghroe Stream and Drainage Channels in the vicinity of the site should be inspected on a regular (quarterly) basis to ensure they are free from debris in order to prevent blockage/surcharge which may lead to secondary flooding.
- Monitoring of the influent and effluent at the Integrated Constructed Wetlands, along with monitoring of the vegetation around the cells will be completed. Operational monitoring will be utilised to ensure water levels are being controlled appropriately.

11.14 DIFFICULTIES ENCOUNTERED IN COMPILING INFORMATION

The following minor difficulties were encountered in compiling this Land, Soil and Water EIRA Chapter:

- Lack of site specific information to ground truth the geophysics investigation on the depth to groundwater, groundwater flow direction and groundwater/surface water quality on, and within the immediate vicinity of the site.
- Lack of technical information to fully quantify the risk to the nearby sensitive receptors (Banagher WSS and the All Saints Bog Groundwater Dependent Terrestrial Ecosystem).

11.15 REFERENCES

Applin, K. R. and N. Zhao (1989) The Kinetics of Fe (II) Oxidation and Well Screen Encrustation. Ground Water, Vol. 27, No 2.

Cronin, C., Daly, D. (1999). An Assessment of the Quality of Public and Group Scheme Groundwater Supplies in County Offaly. Geological Survey of Ireland report to Offaly County Council.

EPA, 2011. Water Framework Direction Groundwater Monitoring Programme – Site Information – Banagher Boreholes. Environmental Protection Agency & Offaly County Council.

EPA, 2017. Guidelines on the Information to be contained in Environmental Impact Assessment Reports, Draft 2017. Environmental Protection Agency.

GSI, 2017. A description of Irish Aquifer Categories. Geological Survey, Ireland, Department of Communication, Climate Action and the Environment.

GSI, 2019. Spatial Resources Viewer. Geological Survey, Ireland, Department of Communication, Climate Action and the Environment.

IGI, 2013. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. Institute of Geologists of Ireland.

Kelly, 2004. Banagher Water Supply Scheme - Clontotan Boreholes – Groundwater Source Protection Zones. Geological Survey of Ireland & Offaly County Council.