HYDROLOGY IMPACT ASSESSMENT

FOR THE PROPOSED DEVELOPMENT: A RESIDENTIAL DEVELOPMENT CONSISTING OF 165 NO RESIDENTIAL UNITS AND ALL ASSOCIATED AND ANCILLARY SITE DEVELOPMENT AND INFRASTRUCTURAL WORKS, HARD AND SOFT LANDSCAPING AND BOUNDARY TREATMENT WORKS

AT DUNLO, BALLINASLOE, CO GALWAY

Savithri Senaratne

B. Sc.(Engineering), MICE(Lond), C.Eng.,
M.Sc. (Hydrology), Ph. D.(Hydrology)

Consultant Engineering Hydrologist

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Hydro-S,
Kilcolgan,
Co Galway
www.hydros.ie

Mob: 086 1738119
Email : info@hydros.ie

CONTENTS

1 Introduction 1

1.1 General 1

1.2 Scope of the present study 1

1.3 Aims and Objectives 2

1.4 Organization of the report 2

2 Baseline study 2

2.1 Topography 3

2.2 Soils 3

2.2.1 Top Soil and subsoil 3

2.2.2 Present status of the susceptibility of soil 4

2.2.3 Bedrock 6

2.3 Surface water hydrology 6

2.3.1 Protected status of the relevant rivers 7

2.3.2 Present status of the rivers 7

2.3.3 Estimated risks and pressures 8

2.4 Groundwater hydrology 9

2.4.1 Protected status of groundwater 10

2.4.2 Estimated risks and pressures 10

3 Methodology 11

3.1 Source – Pathway – Receptor model 11

3.1.1 Sources 12

3.1.2 Pathways 12

3.1.3 Receptors 13

3.2 Graded system of effects 13

4 Assessment of the effects from the proposed development 14
4.1 Construction Stage 14
4.1.1 Clearing vegetation on site 14
4.1.2 Construction of access roads 14
4.1.3 Storage and erection of temporary structures to facilitate construction phase 15
4.1.4 Sewerage from construction personnel 15
4.1.5 Excavations based on construction designs 15
4.1.6 Drainage during construction 15
4.1.7 Hydrocarbons from machinery and vehicles 16
4.1.8 Cement based products suspended in water 16
4.1.9 Landscaping 16
4.1.10 Flooding of site partly or fully 16
4.2 Operational Stage 17
4.2.1 Drainage from paved areas that have access to vehicles 17
4.2.2 Drainage from other paved areas 17
4.2.3 Sewerage from dwelling houses 18
4.2.4 Flooding of the development partly or fully 18
5 mitigation and residual effects 18
5.1 Construction Stage 18
5.1.1 Clearing vegetation on site 18
5.1.2 Construction of access roads 19
5.1.3 Storage and erection of temporary structures to facilitate construction phase 20
5.1.4 Sewerage from construction personnel 20
5.1.5 Excavations based on construction designs 21
5.1.6 Drainage during construction 21
5.1.7 Hydrocarbons from machinery 22

5.1.8 Cement based products suspended in water....22
5.1.9 Landscaping....23
5.1.10 Flooding of site partly or fully....23
5.2 Operational Stage....24
5.2.1 Drainage from paved areas that have access to vehicles....24
5.2.2 Drainage from other paved areas....24
5.2.3 Sewerage from dwelling houses....25
5.2.4 Flooding of the site partly or fully....26
6 Conclusions....26

1 INTRODUCTION

1.1 General

This study is carried out at the request of R. G. Greene & Associates of Caher House, Loughrea, Co. Galway as agent of Limehill Esker Ltd who are seeking planning permission from Galway County Council for a residential development consisting of 165 No residential units and all associated and ancillary site development and infrastructural works, hard and soft landscaping and boundary treatment works. This site is at Dunlo, Ballinasloe, Co. Galway and the location of the site is as shown on Figure 1.

Figure 1 : Location of the site on an extract of discovery series map

The subject site is to the North of M6, Motorway from Galway to Athlone, East and South of R446, regional road from Oranmore to Athlone (formerly N6) and to the West of L4602, local road from R446 at Dunlo. The subject site is accessed through a roundabout at the entrance to Tesco supermarket.

1.2 Scope of the present study

The present study is a hydrological study to examine the compliance of the proposed development with various EU directives stemming from Water Framework Directive (WFD) and EPA guidelines to comply with the EC Environmental Objectives any other relevant legislation. The guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA 2022) is used as a main reference material. These guidelines reference the amended EU Directive 2014/52/EU.

1.3 Aims and Objectives

Aim of this study is to examine the compliance of the proposed development with the guidance documents of EPA in relation to EC Environmental Objectives and any other relevant legislation. This site is at Dunlo, Ballinasloe, Co. Galway. The objectives are:

1. A baseline study of the topography, geology, surface hydrology and groundwater hydrology in relation to the subject site.
2. Examining the Effects of the development on the identified hydrological receptors.
3. Examining mitigation measures based on the effects, if necessary.
4. Examining any residual effects on the receptors.

To achieve these objectives, the present study entails following aspects.

1. Demarcating the area of study.
2. Baseline study and identifying indicators of the hydrology within the study area.
3. Examining the existing conditions of these indicators.
4. Examining the effect on these indicators from the proposed development.
5. Examining the methods of mitigation of the identified effects from the proposed development.
6. Examining whether there are any residual effects.

1.4 Organization of the report

This report is a hydrological assessment of the proposed development and is organized under sub-headings. It starts with stipulating the aims and objectives of the study. The first item after identifying the study area is the Baseline study of the general area of the subject site. Baseline study is covered in Section 2. Section 3 details the Methodology followed in the assessment. Section 4 includes the main tasks identified in the proposed development with their effects on the receptors. Section 5 covers the mitigation measures and residual effect of the selected tasks in the previous Section. Conclusions arrived from the study are in the final section of the report.

2 BASELINE STUDY

Initial objective of the present study is to demarcate the study area and to carry out a baseline study and identify indicators of relevance. The site is marked on a map as shown on Figure 1. The baseline study is carried out with respect to the topography, Soils, surface water hydrology, geology and groundwater hydrology.

2.1 Topography

The general area is in the midst of a development. The subject site area is a greenfield and the area to the North-West and East are mainly housing estates and to the North are commercial (retail) buildings. The area to the West and South-West are mixture of green fields and detached dwellings.

The topography of the general area of the subject property is as shown on Figure 2. The Lidar data Contains Irish Public Sector Data licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0), the image layer is obtained from World imagery and contours are generated by GIS software.

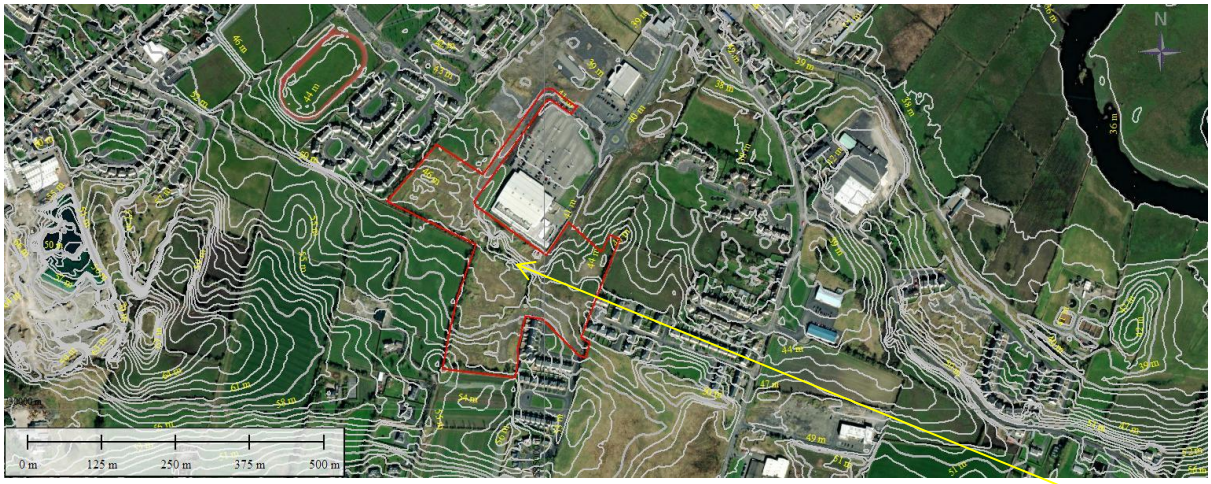


Figure 2: General geography of the subject site area

A high ground area is to the South-West of the subject site and the ground is sloping to the East and North-East. The gentle slope to the North-East is towards the flood plain of River Suck although a high ground area separates the River Suck flood pains from the ground area to the East. This high ground area is to the East of Polboy industrial estate.

2.2 Soils

Topsoil and subsoil are considered in the present Section and the present status of susceptibility to nitrogen and Phosphorous is also examined.

2.2.1 Top Soil and subsoil

The topsoil map is as shown on Figure 3. This is the SIS national soil map and the soil type is described as coarse loamy soil and well drained.

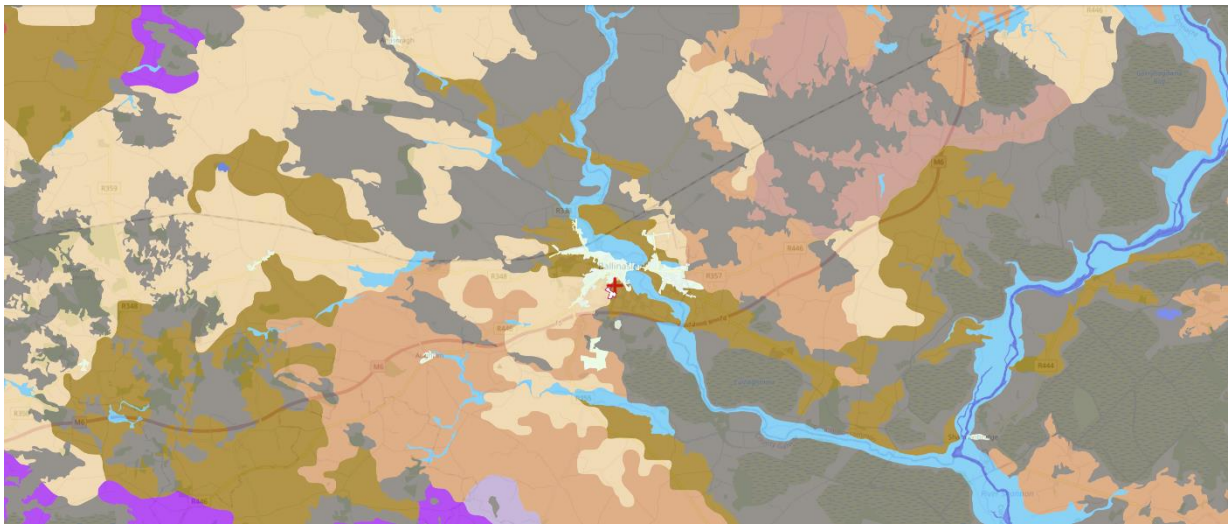


Figure 3: Soil Map (Source: EPAMaps)

The subsoil map is as shown on Figure 4. The subsoil is described as till derived from Limestone and the texture is variable.

Figure 4: Subsoil map (Source: EPAMaps)

2.2.2 Present status of the susceptibility of soil

The susceptibility of soil to Nitrogen and Phosphorus is examined in the present section. The relevant maps are as shown below.

The near Surface Nitrate Susceptibility map is as shown on Figure 5. This is described as areas where nitrate can be transported by water overland and through soils and subsoils. The West part of the subject site is within the area of low susceptibility and the East part is as shown as moderate susceptibility.

The Near Surface Phosphate Susceptibility is as shown on Figure 6. This is described as areas where phosphate can be transported by water overland and through soils and subsoils.

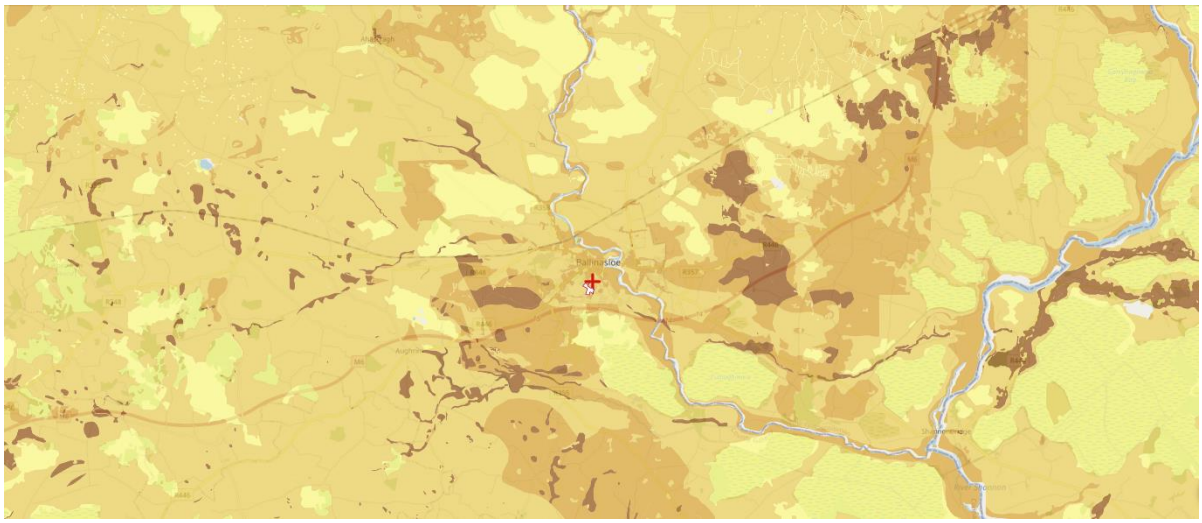


Figure 5: Near Surface Nitrate Susceptibility map (Source: EPA maps)

Figure 6: Near Surface Phosphate Susceptibility map (Source: EPA maps)

The Sub Surface Nitrate Susceptibility map is as shown on Figure 7. This is described as areas where nitrate can be transported through groundwater. The entire site is within moderate whereas the small part South of Tesco supermarket is within the area of very high susceptibility.

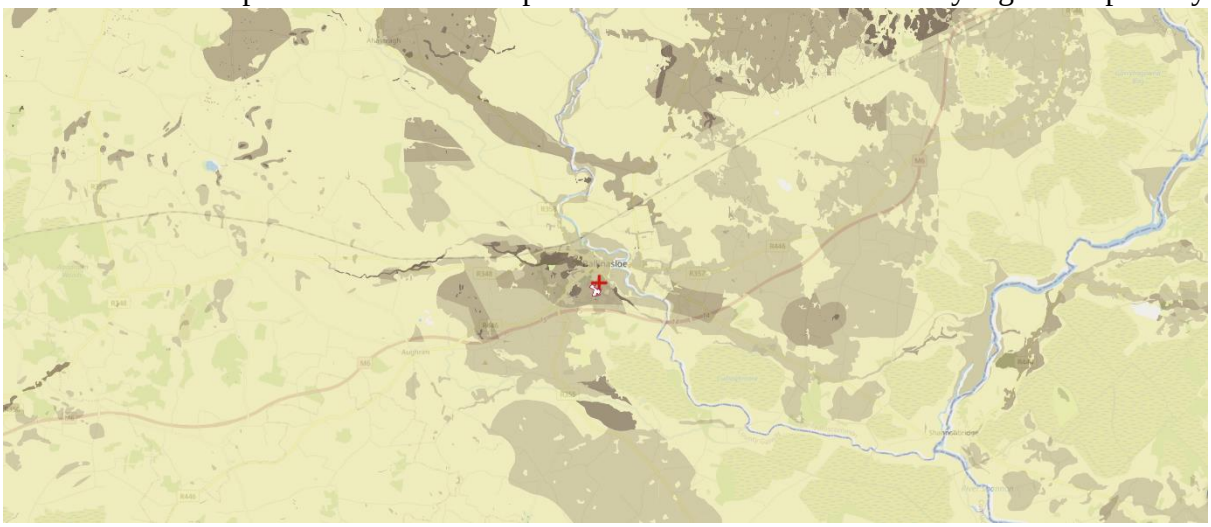


Figure 7: Sub Surface Nitrate Susceptibility map (Source: EPA maps)

2.2.3 **Bedrock**

The bedrock is described as Dinatian Pure bedded Limestone (www.gsi.ie) and the bedrock map is as shown on Figure 8.

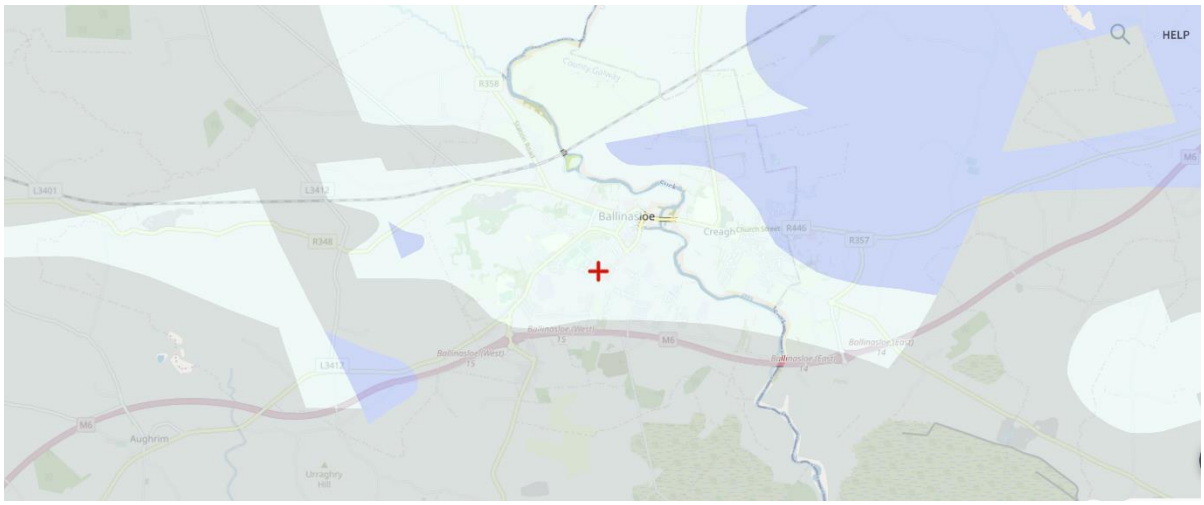


Figure 8: Bedrock map (Source: gis.epa.ie/EPAMaps)

2.3 Surface water hydrology

The surface water features relative to the subject site are as shown on Figure 6. The direction of flow is shown by the arrow heads along the blue line. The minimum distance to the centreline of River Suck is approximately 840 m to the North-East and the short drain to the South of Shearwater hotel is approximately 500 m North-East.

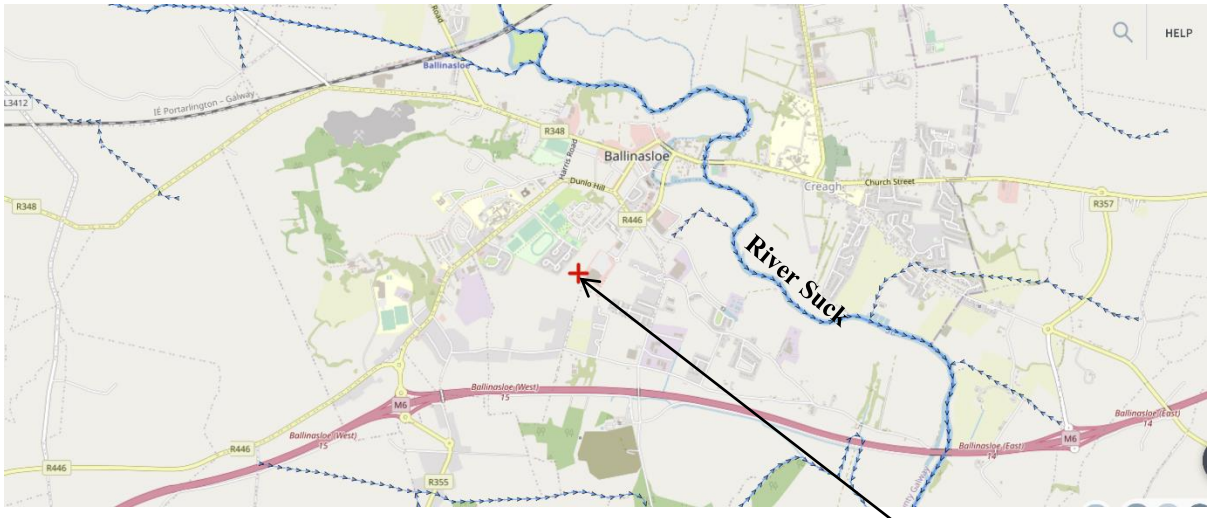


Figure 9: Surface water bodies relative to the subject site

Deerpark river North of the subject site and Ballinure river South of the subject site are much further than River Suck and the drain.

2.3.1 **Protected status of the relevant rivers**

The parts of the rivers that have extra protection are as shown on Figure 10. These are the drinking water river lines delineated in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007). River Suck East of the subject site from the Bellagill bridge upstream of Ballinasloe town up to the bridge across the motorway has the drinking water protected status.

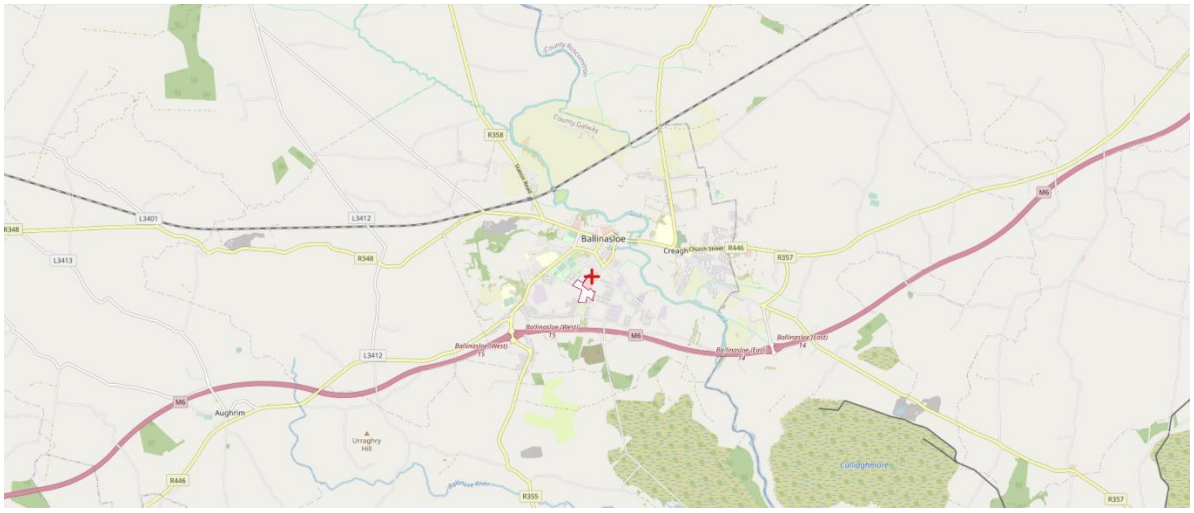


Figure 10: River stretches showing drinking water protected status

2.3.2 **Present status of the rivers**

The present status of the rivers are measures from Q values that describes the biological status of water. The latest Q values at selected locations in the general area of the subject site is as shown on Figure 11.

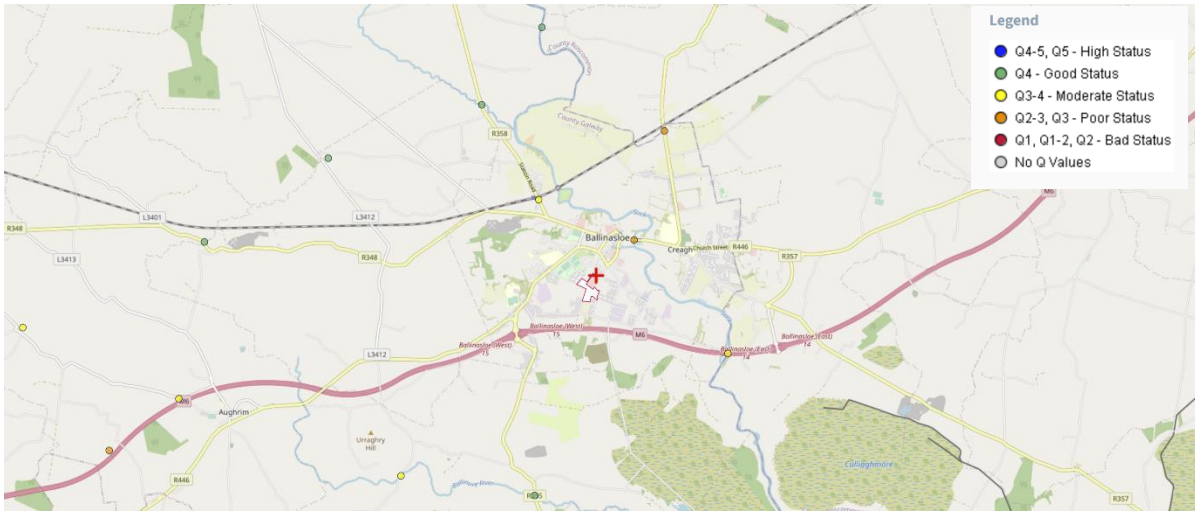


Figure 11: Q values shown at selected locations

The status of River Suck is poor (Q3) at the bridge within the town although at the railway bridge and motorway bridge it is of moderate status (Q4). The subject site is between the town and the motorway.

The naturalised flow estimation points are as shown on Figure 12. The naturalised flow percentiles (NATQ1-99%) and naturalised mean monthly flows (NATMMF1-12) are available at these points. There are two points of interest to the North-East of the subject site and to the South-East.

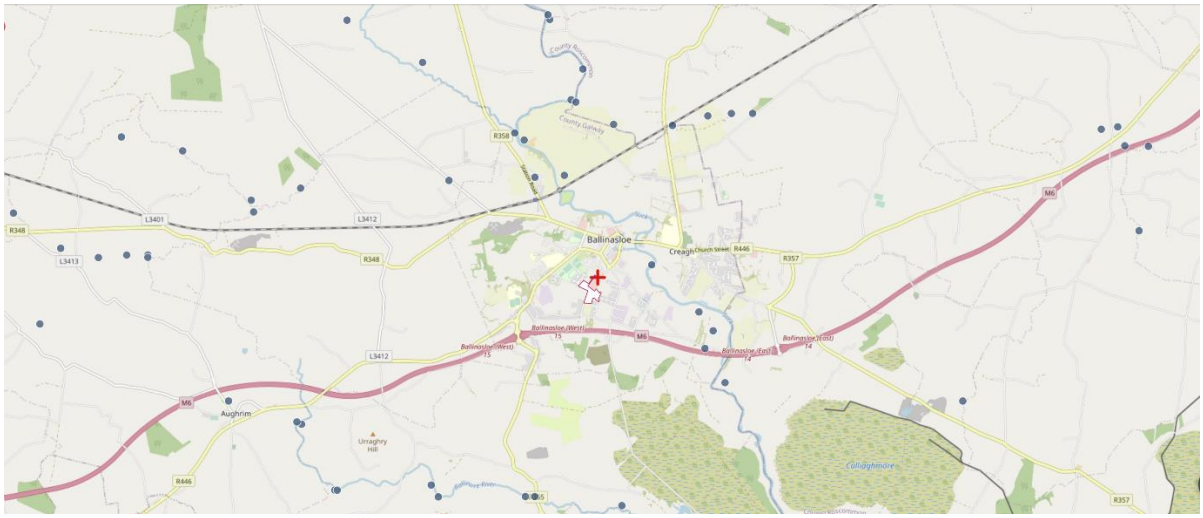


Figure 12: Naturalised flow estimation points on the rivers in the general area

2.3.3 Estimated risks and pressures

The risk of waterbodies failing to meet their Water Framework Directive (WFD) objectives by 2027 in the general area of the subject site is as shown on Figure 13.

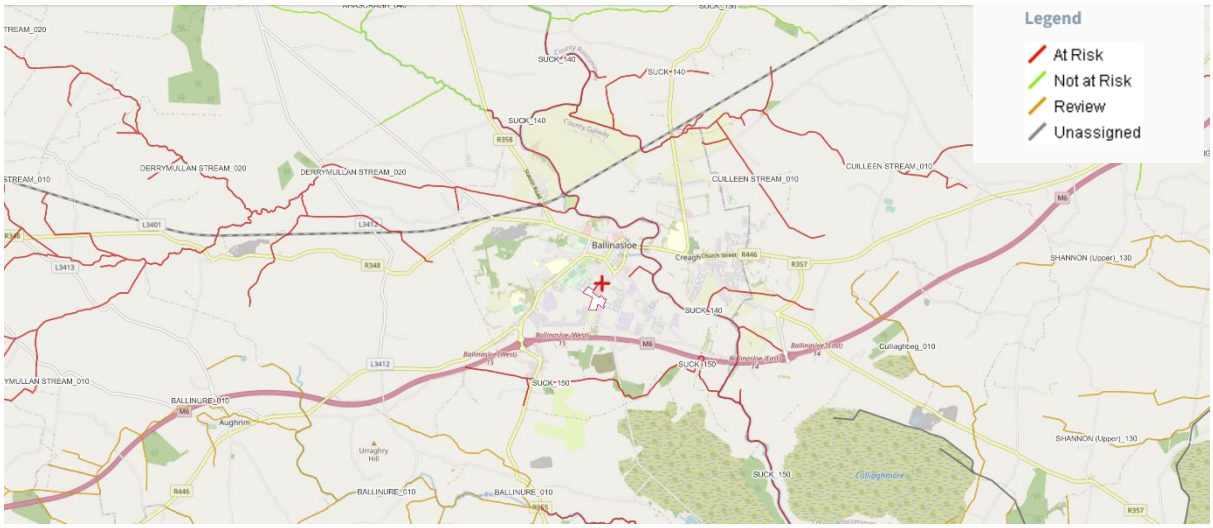


Figure 13: Waterbodies at risk of not meeting WFD objectives

The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are At Risk are prioritised for implementation of measures. This is based on data up to 2018.

River Suck from Bellagill bridge upstream of the subject site, to the Ballinure confluence downstream of the subject site, is at risk of not meeting the WFD objectives in 2027.

The flow delivery paths map of Pollution Impact Potential (PIP) of Phosphates is as shown on Figure 14.

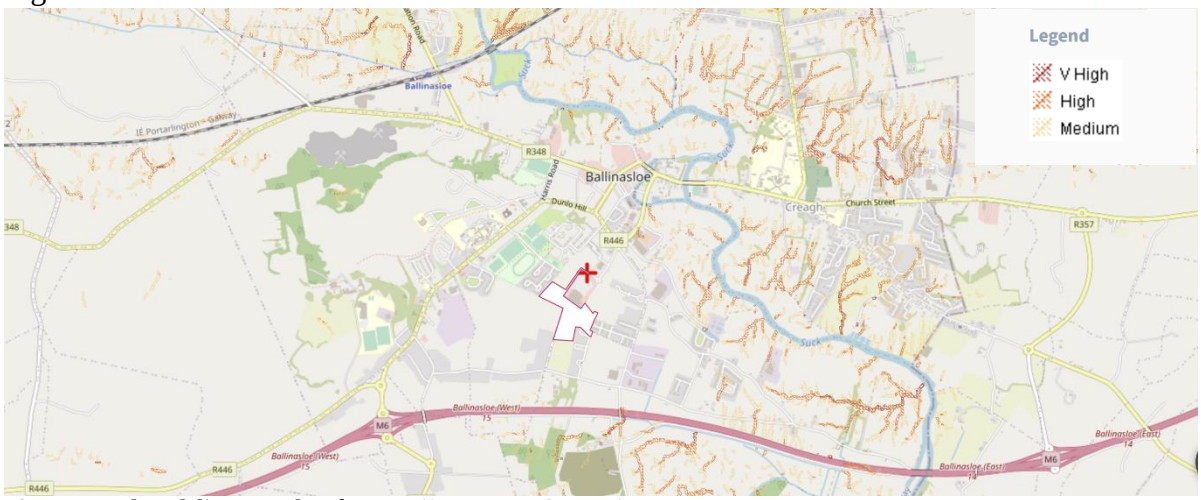


Figure 14: Flow delivery paths of PIP-P (Source: EPA maps)

There aren't flow delivery paths on the subject site.

2.4 Groundwater hydrology

The groundwater vulnerability map is as shown on Figure 15. The groundwater vulnerability rating at the subject site is H (High) (www.gsi.ie).

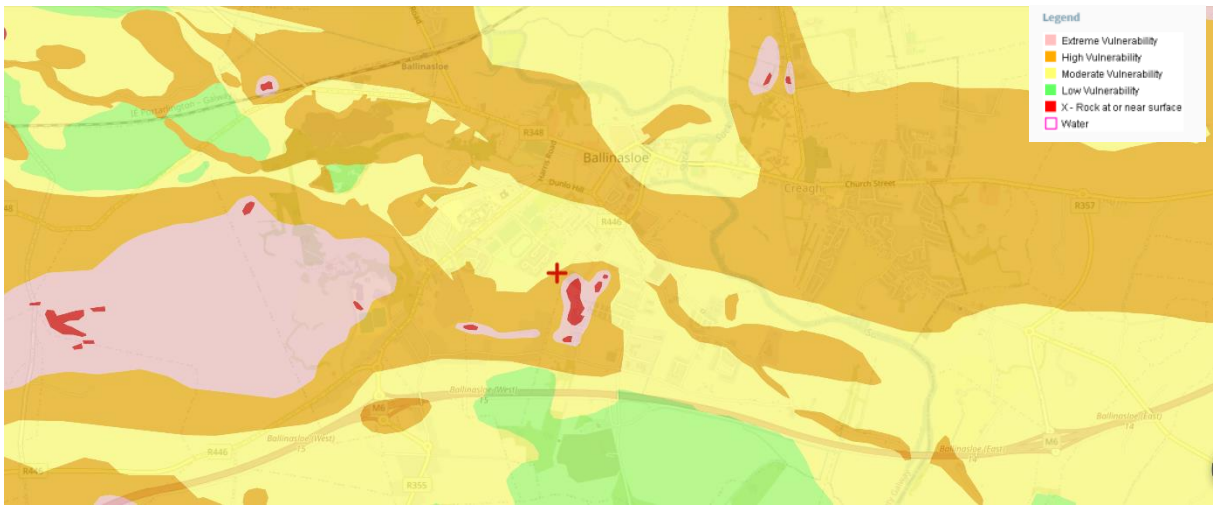


Figure 15: Groundwater vulnerability map (Source: EPAMaps)

The West part of the subject site is in Moderate and High groundwater vulnerability whereas the East part is in Extreme and high vulnerability areas.

The aquifer map is as shown on Figure 16. The subject site is within the aquifer type described as Rkc (Regionally Important Aquifer - Karstified (conduit)).

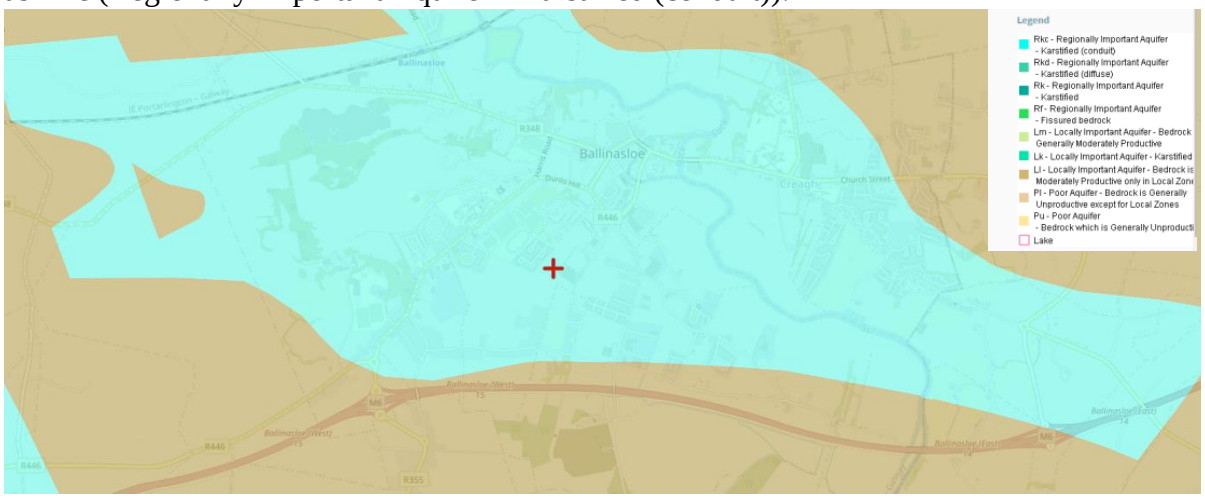


Figure 16: Aquifer map (Source: EPAMaps)

2.4.1 Protected status of groundwater

The groundwater body that has extra protection is as shown on Figure 17. These are the Drinking water ground water body polygons delineated in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007). Lower River Suck groundwater body where the subject site is located, has the drinking water protected status.

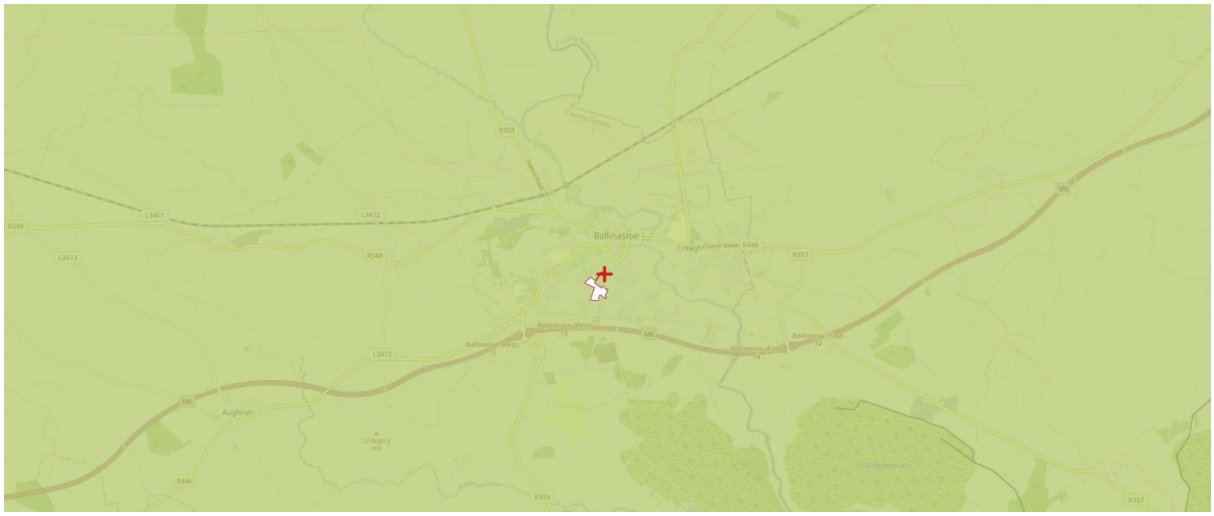


Figure 17: Groundwater body showing drinking water protected status

2.4.2 Estimated risks and pressures

The risk of waterbodies failing to meet their Water Framework Directive (WFD) objectives by 2027 in the groundwater body where the subject site located is as shown on Figure 18.

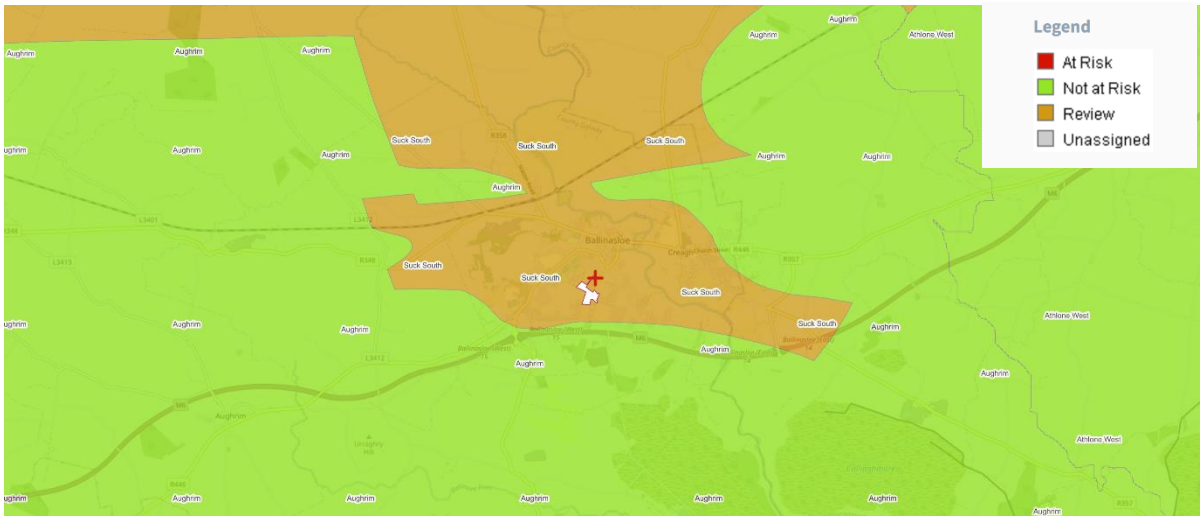


Figure 18: Waterbodies (groundwater) at risk of not meeting WFD objectives

The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are At Risk are prioritised for implementation of measures. This is based on data up to 2018.

The subject site is within Suck South groundwater body and it is within the category of Review. The category Review is described as either because additional information is needed to determine their status before resources and more targeted measures are initiated or the measures have been undertaken, e.g. a wastewater treatment plant upgrade, but the outcome hasn't yet been measured/monitored. The groundwater body Aughrim outside Suck South is in the Not at Risk category.

3 METHODOLOGY

The assessment is carried out on the effects on surface water and groundwater. The effects are assessed for the construction stage and operational stage. The methodology for assessing the effects is detailed in the present Section.

The Source – Pathway – Receptor model is used for the assessment and this is detailed in Section 3.1. The effects are assessed on the indicators that are identified in the baseline study in Section 2. These effects are noted in a grade system as detailed in Section 3.2.

3.1 Source – Pathway – Receptor model

The three different items of this model is detailed in the present Section.

3.1.1 **Sources**

The Source is the proposed development as detailed in Section 1.1. The development is for construction of 165 no. residential units comprising 59 houses and 106 apartments/duplexes and all associated site works. The source differs during construction and operational stages.

3.1.1.1 Construction stage

The construction stage is the more important stage in relation to impacts and the main activities in general are as follows:

- Clearing vegetation on site.
- Construction of access roads.
- Storage and erection of temporary structures to facilitate construction phase.
- Sewerage from construction personnel
- Excavations based on construction designs.
- Drainage during construction
- Hydrocarbons from machinery
- Cement based products suspended in water
- Landscaping
- Flooding of site partly or fully

3.1.1.2 Operational stage

The main activities/incidences during operational stage that could cause impacts are as follows:

- Drainage from paved areas that have access to vehicles
- Drainage from other paved areas
- Sewerage from dwelling houses
- Flooding of site partly or fully

3.1.2 **Pathways**

The pathways are surface, subsurface and through conduits in bedrock. The surface pathways are drains, natural flow paths and overland sheet flow.

The subsurface pathways are vertical and horizontal. The vertical pathways are determined from top soil and subsoil permeability and groundwater vulnerability. The top soil is described

in Section 2.1 as well drained, coarse loamy soil and subsoil is till derived from limestone and the groundwater vulnerability is high to extreme. The horizontal pathways are identified from the aquifer type and the flow regime in groundwater. The bedrock type is pure bedded limestone as shown on Figure 7. The aquifer is Rkc (Regionally Important Aquifer - Karstified (conduit)) as shown on Figure 8. Therefore, the horizontal pathways are possible.

3.1.3 **Receptors**

The relevant receptors are as follows:

- River Suck
- River Suck flood plain
- The underlying aquifer that is classified as Regionally Important Aquifer - Karstified (conduit) (Rkc).
- The closest wells are in the townlands of Creagh and Kilcloony. These wells are further from the subject site and could be taken as upgradient. Therefore, they are not considered as receptors in the present study.

3.2 Graded system of effects

The effects are described based on its significance. The graded system as given on Table 3.4 of the guidelines on EIA (EPA, 2022) is as given below on Table 1.

Effect	Description
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.

Table 1: Significance of the effects on the environment

This is determined by combining the significance and sensitivity of the receiving environment (receptor) with the description of the effect.

The description of the effect is based on the following aspects although the specific effect may not have all of them as items of interest.

- Character or quality
- Magnitude
- Duration
- Probability
- Consequences

4 ASSESSMENT OF THE EFFECTS FROM THE PROPOSED DEVELOPMENT

This assessment is carried out as detailed in the Methodology, Section 3.2 for the Sources noted in Section 3.1.1. The sources were identified for the construction stage and operational stage. The same categorisation is continued in the present Section. The proposed development is considered in its entirety than individual parts.

4.1 Construction Stage

4.1.1 Clearing vegetation on site

Clearing of vegetation on site will result in change of biodiversity, degradation of the topsoil due to erosion and presence of suspended solids in surface runoff. Biodiversity is outside the scope of the present report and erosion could happen only during the period of the land is exposed after the vegetation is removed and construction work commences. A worst-case scenario is the site is left for a long duration after the vegetation is removed. The receptors are the surface water channels, River Suck and the drain South of Shearwater hotel. The quality is negative and magnitude is low and the probability is low and is temporary. There aren't any direct routes to both these water bodies as shown on Figure 14. Therefore, the effects are moderate.

4.1.2 Construction of access roads

This will also cause suspended solids in surface runoff. The quality is negative and magnitude is moderate and the probability is moderate and is temporary. The receptors are the surface water channels, River Suck and the drain South of Shearwater hotel. There aren't any direct routes to both these water bodies as shown on Figure 14. However, the effects are significant.

4.1.3 Storage and erection of temporary structures to facilitate construction phase

Hydrocarbons and cement are considered under a separate heading and is not considered in the present Section. The quality is negative and magnitude is moderate and the probability is moderate and is temporary. The receptors are the surface water channels; River Suck, drain South of Shearwater hotel and probably groundwater, depending on the material on storage. There aren't any direct routes to the surface water bodies as shown on Figure 14. The effects are significant.

4.1.4 Sewerage from construction personnel

The proposal is to connect the sewerage of the proposed development to the public system and this Section deals with the sewerage during construction phase and provided by temporary methods. The receptors are surface water channels, River Suck, drain South of Shearwater hotel and probably groundwater. The quality is negative and magnitude is moderate. Probability is low and is temporary. The effects are significant.

4.1.5 Excavations based on construction designs

Large excavations are not envisaged during the construction of the proposed development based on the site layout. There aren't structures that need deep excavations as shown on the site layout. The main receptors are surface water channels, River Suck, drain South of Shearwater hotel. Groundwater could be a receptor with low probability. The effects are similar to those noted in Section 4.1.2 and 4.1.3. The quality is negative, magnitude moderate, probability is moderate and is temporary with significant effects.

4.1.6 Drainage during construction

The drainage considered in the present Section is those provided during construction stage in order to have the construction areas dry. The main receptors are surface water channels, River Suck and drain South of Shearwater hotel. The quality of the drainage water is considered under separate headings based on the source. The main effect is erosion based on velocities and quantity. The quality is negative, magnitude is moderate, probability is also moderate and is temporary. The effects are significant.

4.1.7 Hydrocarbons from machinery and vehicles

These constitute storage, leaks and accidental spills of fuels and lubricants. They are all petroleum-based products. The main receptors are surface water channels, River Suck, drain South of Shearwater hotel and groundwater. The quality is negative, magnitude low, probability is low and is temporary with significant effects.

4.1.8 Cement based products suspended in water

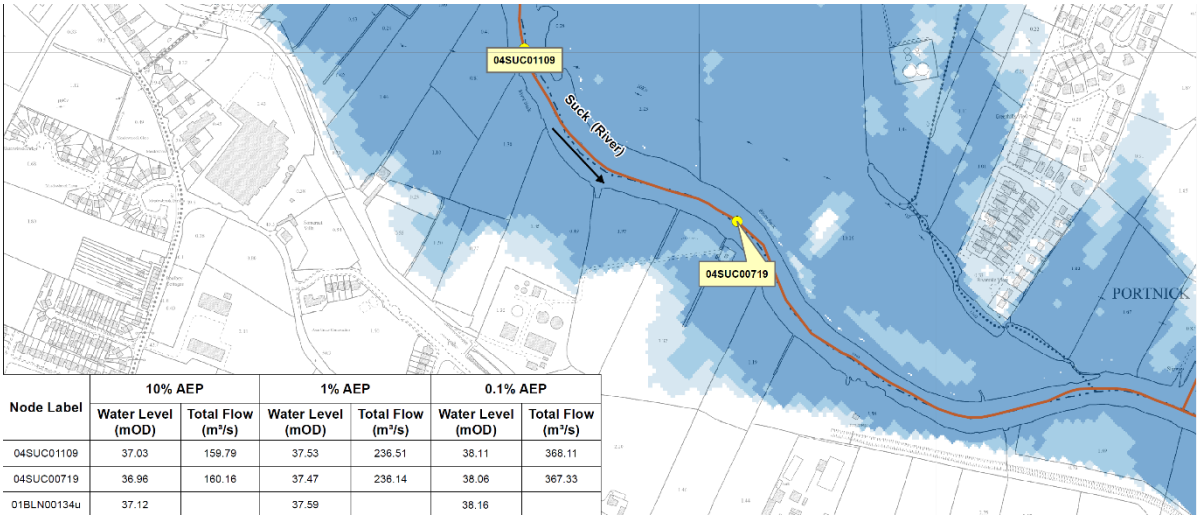
Cement will be used in concreting throughout the site and any wash aways and other spillage from use and transport. The main receptors are surface water channel, River Suck, drain South of Shearwater hotel and groundwater. The quality is negative, magnitude low, probability is moderate and temporary with significant effects for surface water and the quality is negative. The magnitude is low, probability is low and temporary with significant effects on groundwater.

4.1.9 Landscaping

The effects from landscaping are similar to the effects from Section 4.1.1 and Section 4.1.2. The receptors are the surface water channels, River Suck and the drain South of Shearwater hotel. The quality is negative and magnitude is low and the probability is low and temporary. The effects are moderate.

4.1.10 Flooding of site partly or fully

The CFRAM final maps are available on River Suck to the East of the subject site and is copied as Figure 19 and the relevant flood levels are as shown on Table 2.



Node Label	10% AEP		1% AEP		0.1% AEP	
	Water Level (mOD)	Total Flow (m³/s)	Water Level (mOD)	Total Flow (m³/s)	Water Level (mOD)	Total Flow (m³/s)
04SUC01109	37.03	159.79	37.53	236.51	38.11	368.11
04SUC00719	36.96	160.16	37.47	236.14	38.06	367.33
01BLN00134u	37.12		37.59		38.16	

Figure 19: CFRAM flood map for the general area of the subject site (source: www. floodinfo.ie)

	10% chance flood (Return period 10 years)		1 % chance (Return period 100 years) flood		0.1% chance (Return period 1000 years) flood	
	Flood level m AOD	**Flow (m^3/sec)**	**Flood level m AOD**	**Flow (m^3/sec)**	**Flood level m AOD**	**Flow (m^3/sec)**
Node 04SUC00719	36.96	160.18	37.47	236.14	38.06	367.33

Table 2: Design flood levels from CFRAM study (source: www.floodinfo.ie)

The lowest site levels are 40.3 m AOD and has a freeboard exceeding 2 m. Therefore, the risk of flooding of the site from River suck has chances less than 0.1%. The effects of flooding will affect the items noted from Section 4.1.1 to 4.1.9.

The quality is negative, magnitude is moderate, probability is very low and temporary with significant effects for surface water. The quality is negative, magnitude low, probability is very low and temporary with significant effects for groundwater

4.2 Operational Stage

The operational stage is after the development is constructed and the dwelling houses are occupied.

4.2.1 Drainage from paved areas that have access to vehicles

Drainage of surface water runoff from paved internal roads, driveways and other parking surfaces. The increase of surface water runoff volumes and the time of concentration (travel time) could increase the flood peaks in the surface water channels, River Suck and drain South of Shearwater hotel. The quality is negative, magnitude low, probability is moderate and temporary with moderate effects on surface water.

The surface runoff could have dissolved hydrocarbons and could affect groundwater. The quality is negative, magnitude moderate, probability is moderate and with significant effects on groundwater.

4.2.2 Drainage from other paved areas

Drainage of surface water runoff from roofs. The increase of surface water runoff volumes and the time of concentration (travel time) could increase the flood peaks in the surface water channels, River Suck and drain South of Shearwater hotel. The quality is negative, magnitude low, probability is moderate with moderate effects on surface water.

4.2.3 Sewerage from dwelling houses

The proposal is to connect the sewerage of the proposed development to the public system. Therefore, this will occur only if an overflow occurs at a manhole due to blockages. The receptors are surface water channels, River Suck, drain South of Shearwater hotel and could be groundwater. The quality is negative and magnitude is low, Probability is low and is temporary. The effects are significant

4.2.4 Flooding of the development partly or fully

The CFRAM flood map is as shown on Figure 19 and the flood levels are as shown on Table 2. The lowest finished floor levels are 44.75 m AOD and has a freeboard exceeding 6 m. Therefore, the risk of flooding of the site from River suck has a chance significantly less than 0.1%. The effects of flooding will affect the items noted from Section 4.2.1 to 4.2.3.

The quality is negative, magnitude is low, probability is very low and temporary with significant effects for surface water. The quality is negative, magnitude low, probability is very low and temporary with significant effects for groundwater.

5 MITIGATION AND RESIDUAL EFFECTS

The mitigation and residual effects are also examined under the same headings as for effects from the proposed development.

5.1 Construction Stage

5.1.1 Clearing vegetation on site

5.1.1.1 Mitigation measures

To reduce the effects mitigation methods are to be implemented. The effects are mainly associated with heavy rainfall on the exposed surfaces. The mitigation of the effects are two fold. These are the general mitigation measures and specific mitigation measures.

General mitigation measures

These measures are to contain the suspended solids in the surface runoff from the cleared areas reaching surface drainage and are as follows:

- The site drainage system to be designed to suit the final surface water drainage system of the proposed development
- The existing site is sloping from South-West to North-East and the ground rises to the South-West and therefore interceptor drains at South boundary of the land parcel to the West and South-West boundary of the land parcel to the South of Tesco building would reduce surface runoff as sheet flow over the subject site. These interceptor drains should have grass banks and on the side of the construction side should have silt fences.
- The weather conditions and seasonal variation of weather should be taken into account when planning clearing vegetation and stripping of top soil.
- The areas of stock piles should have silt fences to reduce erosion and the silt finding its way to the drainage system.
- The temporary drains from these areas need to be directed to on-site settlement ponds designed with safety measures.

Specific mitigation measures

The specific mitigation measures are as follows:

- Groundworks should not be carried out during very heavy rain and severe weather conditions based on forecasts available.

5.1.1.2 Residual effects

The quality is negative, magnitude is low, probability is very low and temporary with imperceptible effects for surface water.

The condition of the drainage network built on the site has to be monitored and all the measures taken to mitigate the effect are to be maintained and monitored for their efficient use.

5.1.2 **Construction of access roads**

5.1.2.1 Mitigation measures

The mitigation measures are similar to those detailed in Section 5.1.2.1 and are as follows:

- The weather conditions and seasonal variation of weather should be taken into account when constructing access roads.

- The temporary drains from these areas need to be directed to on-site settlement ponds designed with safety measures.
- Any groundwork should not be carried out during very heavy rain and severe weather conditions based on forecasts available.

5.1.2.2 Residual effects

The quality is negative, magnitude is low, probability is very low and temporary with imperceptible effects for surface water.

5.1.3 Storage and erection of temporary structures to facilitate construction phase

This Section does not cover cement and petroleum-based products. Majority of the products under this category are inert.

5.1.3.1 Mitigation measures

- These temporary structures should be on hard stands to prevent any spills or leaks on to ground or to the drainage network.
- The drainage channels to be protected from any spills or leaks of any material stored and these spills and leaks need to removed following environmentally safe methods.

5.1.3.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on surface water.

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on groundwater.

5.1.4 Sewerage from construction personnel

This will be only during the construction stage.

5.1.4.1 Mitigation measures

A self-contained port-a-loos with integrated waste holding tanks to be provided based on the number of personnel working on site. They need to be maintained by the providing contractor and be removed from the site in its entirety by the same contractor. They should be located at pre-selected locations.

5.1.4.2 Residual effects

The quality is negative, magnitude is very low, probability is very low and temporary with imperceptible effects on surface water.

The quality is negative, magnitude is very low, probability is very low and temporary with imperceptible effects on groundwater.

5.1.5 Excavations based on construction designs

Surface water could pond in excavated areas and need to be pumped out for construction work.

5.1.5.1 Mitigation measures

- The weather conditions and seasonal variation of weather should be taken into account when excavations are done.
- The temporary drains from these areas need to be directed to on-site settlement ponds designed with safety measures.
- Any groundwork should not be carried out during very heavy rain and severe weather conditions based on forecasts available.
- Any pumped-out water from an excavation should be directed to a settlement tank.

5.1.5.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on surface water.

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on groundwater.

5.1.6 Drainage during construction

This covers the effects on the entire drainage network during construction. Some of the issues of the drainage canals are discussed previously based on the source.

5.1.6.1 Mitigation measures

- The drainage canals have to be protected from erosion by designing them for a 30 year flood.
- SUD measures are required to be adopted as practical.

- The canal banks to be protected by grass and overflow from settlement tanks to be at a safe rate predesigned previously.

5.1.6.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on surface water.

5.1.7 Hydrocarbons from machinery

These cover accidental spills and leaks associated with storage of oils and fuels, leaks from construction machinery and spillage during refuelling and maintenance of the machinery and other vehicles.

5.1.7.1 Mitigation measures

- All storage of the oils and fuels to be on a bunded hardstand area and not on the small area that has rock on the surface as shown on Figure 15.
- Refuelling and servicing of construction machinery will take place in a designated hardstand area which is also remote from any surface water inlets.
- Accidental spills are managed contained within Environment management plan and spill kits are to be available on site.

5.1.7.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on surface water.

The quality is negative, magnitude is low, probability is low and temporary with insignificant effects on groundwater.

5.1.8 Cement based products suspended in water

This covers Concrete runoff, particularly discharge of wash water from concrete trucks.

5.1.8.1 Mitigation measures

- Concrete batching will take place off site and wash down and wash out of concrete trucks or plants will take place off site.

- Any form of necessary washouts of concreting equipment to be directed to be impermeable lined dedicated areas and these areas are to be removed and disposed environmentally on the completion of construction phase.
- Concreting work should not be carried out during very heavy rain and severe weather conditions based on forecasts available.

5.1.8.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on surface water.

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on groundwater.

5.1.9 Landscaping

Landscaping of the site involves similar works as earth works.

5.1.9.1 Mitigation measures

- The weather conditions and seasonal variation of weather should be taken into account during landscaping.
- Preventative and precautionary measures to be taken to keep clear from all drains.
- Any groundwork should not be carried out during very heavy rain and severe weather conditions based on forecasts available.

5.1.9.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on surface water.

5.1.10 Flooding of site partly or fully

Flooding from river Suck has a very low probability as detailed in Section 4.1.10 and the subject site is within flood zone C. The localised spots of flooding from surface water should be mitigated.

5.1.10.1 Mitigation mesures

- The temporary drains from these areas need to be directed to on-site settlement ponds designed with safety measures.
- SUDS measures such as swales could be used depending on the localised flood location.

5.1.10.2 Residual effects

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on surface water.

The quality is negative, magnitude is low, probability is low and temporary with imperceptible effects on groundwater.

5.2 Operational Stage

Mitigation measures for the items that are detailed in Section 4.2 are detailed in this Section

5.2.1 **Drainage from paved areas that have access to vehicles**

These areas are driveways, internal roads of the completed housing estate and other parking areas.

5.2.1.1 Mitigation measures

- Surface water discharge will be through an oil/fuel interceptor before discharging onto the surface water drainage network.
- A maintenance program should be in place for maintenance of the oil/fuel interceptors and the entire drainage network.

5.2.1.2 Residual effects

The quality is negative, magnitude is low, probability is low and long term with imperceptible effects on surface water.

The quality is negative, magnitude is low, probability is low and long term with imperceptible effects on groundwater.

5.2.2 **Drainage from other paved areas**

These are from roofs and other paved areas not included in section 5.2.1.

5.2.2.1 Mitigation measures

- Surface water could be used in rainwater harvesting or discharged using SUDS methods such as swales or rain gardens.
- A maintenance program should be in place for maintenance of the common surface water disposal measures whereas individual measures are maintained by the households.

5.2.2.2 Residual effects

The quality is negative, magnitude is low, probability is low and long term with imperceptible effects on surface water.

The quality is negative, magnitude is low, probability is low and long term with imperceptible effects on groundwater.

5.2.3 Sewerage from dwelling houses

The sewerage from the development will be connected to the public sewer system. There isn't onsite sewerage disposal. Therefore, the only effect is overflows from accidental blockages.

5.2.3.1 Mitigation measures

- Blockages within the individual properties is the responsibility of the owner and be dealt with by licensed blockage removal specialist contractor.
- Blockages in the common system is the responsibility of the management entity of the housing estate and be dealt with by licensed blockage removal specialist contractor, promptly.

5.2.3.2 Residual effects

The quality is negative, magnitude is very low, probability is low and short term with imperceptible effects on surface water.

The quality is negative, magnitude is very low, probability is low and short term with imperceptible effects on groundwater

5.2.4 **Flooding of the site partly or fully**

The proposed development is in flood zone C as detailed in Section 4.2.4 and flood risk from River Suck is significantly less than 0.1% as the freeboard against a flood of 0.1% chance flood is exceeding 4 m.

Mitigation measures are localised flooding from surface runoff.

5.2.4.1 Mitigation measures

This is covered under surface water drainage in Section 5.2.1.1 and Section 5.2.2.1.

5.2.4.2 Residual effects

The quality is negative, magnitude is low, probability is low and short term with imperceptible effects on surface water.

The quality is negative, magnitude is low, probability is low and short term with imperceptible effects on groundwater.

6 CONCLUSIONS

The objectives of the present study as given in section 1.3 are as follows:

1. A baseline study of the topography, geology, surface hydrology and groundwater hydrology in relation to the subject site.
2. Examining the Effects of the development on the identified hydrological receptors.
3. Examining mitigation measures based on the effects, if necessary.
4. Examining any residual effects on the receptors..

A baseline desk study is carried out as detailed in Section 2. This covered the topography, soils and bedrock geology, surface water hydrology and groundwater hydrology. The topography is detailed by a contour map of the general are of the subject site. The top soil and subsoil of the general area with their susceptibility are as shown by the maps in Section 2.2. The top soil is well drained soil and the subsoil is till derived from limestone whereas the bedrock is pure bedded limestone. This indicates groundwater as a possible receptor.

The surface water hydrology is detailed in Section 2.3. Suck river and its flood plains are to the East of the subject site and the minimum distance to the centreline of River Suck is

approximately 840 m to the North-East. The short drain to the South of Shearwater hotel is approximately 500 m North-East of the subject site. The status of River Suck is poor (Q3) at the bridge within the town although at the railway bridge and motorway bridge it is of moderate status (Q4). The subject site is between the town and the motorway. River Suck East of the subject site is within the area of being of risk not meeting the WFD objectives in 2027. Therefore, any effects from the proposed development on River Suck should be "Not significant" or "imperceptible".

Groundwater hydrology is detailed in Section 2.4. The West part of the subject site is in Moderate and High groundwater vulnerability whereas the East part is in Extreme and high vulnerability areas. The subject site is within the aquifer type described as Rkc (Regionally Important Aquifer - Karstified (conduit)). The subject site is within Lower Suck groundwater basin and this basin is within the category of Review for meeting WFD objectives in 2027. The category Review is described as either because additional information is needed to determine their status before resources and more targeted measures are initiated or the measures have been undertaken, but the outcome hasn't yet been measured/monitored. Therefore, the effects from the proposed development on groundwater should be "Not significant" or "imperceptible".

The methodology used in the impact assessment is detailed in Section 3 of the present report. The source – pathway – receptor model is used in this assessment as detailed in Section 3.1 and the graded scale describing the impacts are detailed in Section 3.2. The receptors are Suck river, its flood plain, the drain to the South of Shearwater hotel and groundwater. There aren't wells within an area of influence downgradient of the subject site. There aren't direct pathways to the Suck river and its flood plains or to the drain South of Shearwater hotel.

The sources are tasks and items identified in the construction phase and operational phase as detailed in Section 4. There are 10 tasks identified in the constriction phase and 4 tasks in the operational phase. The construction phase tasks include groundworks such as stripping of topsoil, excavations etc.; petroleum products storage and usage, cement products in concrete, wastewater, drainage network and flood risk from River Suck and surface water. The operational phase consists drainage network for surface runoff, wastewater and flood risk. The risks from these tasks on the receptors are noted under each task in Section 4.

The mitigation measures for each of these tasks are detailed in Section 5 with residual effects. The residual effects of the specific tasks on the receptors, are imperceptible or insignificant after the proposed mitigation measures.

Therefore, the receptors, River Suck, its flood plains, drain to the South of Shearwater Hotel and the groundwater basin of Lower Suck have a imperceptible or insignificant effect from the proposed development.