

**HYDROGEOLOGICAL ASSESSMENT FOR PROPOSED LARGE SCALE RESIDENTIAL DEVELOPMENT (LRD), BY
LOUGHGLYNN DEVELOPMENTS LIMITED, AT A SITE ON THE KILDALKEY ROAD, TRIM, COUNTY MEATH –
LAND, SOILS, GEOLOGY, HYDROLOGY AND HYDROGEOLOGY**

FINAL REPORT

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EXECUTIVE SUMMARY

Dr. Robert Meehan was retained on behalf of Loughglynn Developments Limited to undertake an assessment of the potential likely and significant effects of A proposed Large Scale Residential Development (LRD) on a site on the Kildalkey Road, Trim, County Meath, on the Land, Soils, Geology, Hydrology and Hydrogeology aspects of the receiving environment.

The Site is located in the central area of the Plains of Meath, at ground surface elevations between approximately 52 m - 66mAOD, and is bounded by the third class 'Kildalkey Road' at the north. The overall form / geometry of the site itself is of a ridge or 'bank' type feature along the mid-backslope of a much higher, bedrock-cored ridge, undulating with gentle to moderate slopes. The northern portion of the site itself is comprised of recently tilled and sown land, with a narrow band of wetland forestry running west to east along the southern extremity of the site.

The subject site has a relatively homogeneous and uniform soils geology, with grey brown podzolics and brown earths in evidence across the area to be developed, and gleyed, saturated soils on the lower portion of the site adjacent to the River Boyne. The subsoils across the site comprise glacial till derived chiefly from limestones in the northern portion, glaciofluvial sands and gravels in a central band, and alluvium along the River Boyne, beneath it's floodplain. The bedrock geology beneath the site is of Lucan Formation 'Calp' limestones, which are impure and have a low potential for karstification compared to pure limestone rock. The majority of the site area has deep soils and subsoils across it (greater than 3 m), as evidenced by extensive trial pitting across the site, while one small pocket in the southeastern corner has bedrock coming close to the surface, recorded as 2.2 m from it while drilling a Site Investigation borehole.

The annual recharge and runoff rates for the proposed LRD Site are estimated to be 238.31 mm/year and 120.04 mm/year respectively. The Site is located in the regional River Boyne Catchment within Hydrometric Area 07 of the Eastern River Basin District (ERBD), while on a more local scale is located in the majority in the Boyne_SC_070 surface water subcatchment, with the portion of the site crossing the river to host the proposed new foul sewer protruding in to the Boyne_SC_060 surface water subcatchment. The proposed LRD Site in it's entirety drains to the River Boyne which flows through the site, and this is designated as both SAC and SPA just outside the site's southern boundary.

Field mapping as part of the site investigation for this proposed LRD Project has led to the discovery of six previously undocumented springs at the southern end of the site, all within the area designated as SAC. These springs are ephemeral, petrifying and tufa-forming, and there is an approximate minimum dilution factor of between 2,301 and 20,492 on the spring flows once they meet the River Boyne, depending on the time of year and the antecedent weather conditions.

Currently, the hydrological regime across the site involves rainfall infiltrating through the permeable soils and subsoils to the water table, which is generally hosted in the deep subsoils. This water table flows at depth beneath the higher portion of the site, and emerges at springs at the floodplain break of slope, *via* preferential flowpaths (probably gravel beds) before flowing as streamlets over a short distance, and into the River Boyne.

Along the River Boyne each side of the site, EPA Q-rating data shows that the river surface water consistently has 'Moderate' status river waters either side of Trim. The dark limestones and shales of the Lucan Formation bedrock are poorly permeable and relatively unproductive, and are classified as a Locally Important Bedrock Aquifer - Bedrock that is Moderately Productive. The water table is at a relatively deep depth beneath the site, and will be well below all surface construction activities, including any (shallow) cut-and-fill.

The site specific groundwater flow direction, as determined by groundwater levels beneath the site and spring emergence levels, is towards the River Boyne, as would be expected given the impure nature of the underlying limestone bedrock. The groundwater vulnerability beneath the site is in the majority 'High', with the small pocket with bedrock close to the surface having 'Extreme' groundwater vulnerability. The groundwater quality hydrochemistry of the springs sampled on the site is generally 'good', with exceedances of ammonia and ortho-phosphate in one of them in July 2025, potentially owing to low flows and adjacent (naturally occurring) organic matter in relict tufa soils.

The Trim Groundwater Body beneath the site is at 'Good' status in terms of the EU Water Framework Directive. The River Boyne flowing through the site is at 'Moderate' status in terms of its surface water condition, and is 'At Risk' owing to a number of pressures. The River Boyne has a surface water-fed drinking water supply approximately 3.5 km downstream the proposed LRD Site, and is therefore identified as a Drinking Water Protected Area.

Due to the nature of proposed LRD developments being near-surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The design of the proposed LRD Project has maintained the existing hydrological and hydrogeological regime on the site in as much as possible.

This means that all SUDS measures will discharge as diffusely as possible and at as shallow a depth as possible, using individual shallow soakaways for each house individually and wide, expansive, shallow soakaways for the road network.

This will mean no significant effects on groundwater levels and / or flows, and / or surface water, will occur as a result of the proposed LRD Project.

1.0 INTRODUCTION, BACKGROUND AND OBJECTIVES

Dr. Robert Meehan was retained on behalf of Loughglynn Developments Limited in January 2025, to undertake an assessment of the potential likely and significant effects of the proposed Large Scale Residential Development (LRD) by Loughglynn Developments Limited (Proposed Project) on a site in the townland of Crowpark (1st Division), Kildalkey Road, Trim, County Meath (*Irish Transverse Mercator Grid Reference 679375 757125*), where it is proposed to construct a residential development comprising a number of accommodation unit types, on the Land, Soils, Geology, Hydrology and Hydrogeology aspects of the receiving environment.

The Proposed LRD Project is described in full in the enclosed Stage 2 Development Description.

Where the 'proposed LRD Site' is referred to it refers to the entire site boundary encompassing the proposed 183 residential units, consisting of

- 127 no. houses (ranging from two to two and a half storeys in height); 19 no. detached 4-bedroom houses, 9 no. semi-detached / end-terrace 4-bedroom houses, 4 no. detached 3-bedroom houses, 43 no. semi-detached/end-terrace 3-bedroom houses, and 52 no. mid-terrace 3-bedroom houses,
- 56 apartments within two blocks (ranging up to four storeys in height); 16 no. one-bedroom and 40 no. two-bedroom apartments; this apartment element comprises 56 no. units in two blocks of up to four storeys, including 16 no. one-bedroom and 40 no. two-bedroom units, and
- a creche facility

and all ancillary site works.

The scheme also includes the provision of new vehicular and pedestrian accesses from Kildalkey Road.

The proposal provides for associated infrastructure and site works, including landscaping, public and communal open space, internal streets and footpaths, car and bicycle parking, bin stores, private open space, boundary treatments, plant and waste management areas, utility infrastructure and a foul sewer connection to the existing network adjoining the OPW offices on Jonathan Swift Street, to be delivered. Important in terms of geology and hydrogeology is the proposed new foul sewer connection to the existing foul water network adjoining OPW offices on Jonathan Swift Street (to be delivered underneath the River Boyne and Trim Pitch & Putt).

This report provides a baseline assessment of the environmental setting and description of the Proposed Project, as described in the enclosed Stage 2 Development Description, in terms of Land, Soils, Geology, Hydrology and Hydrogeology, and discusses the potential likely and significant effects that the construction and operation of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to Land, Soils, Geology, Hydrology and Hydrogeology (i.e. natural water resources) are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

The site (*ITM 679375 757125*) is located approximately 600 m west-northwest of the centre of the town of Trim, at an elevation of approximately 52 m - 66mAOD and is approached by the third class 'Kildalkey Road' at the north, with other adjacent Regional and third class roads to the south and east (**Figure 1**).

The Proposed Project study area with regard Land, Soils, Geology, Hydrology and Hydrogeology is defined by the red line Site Boundary. The full extent of the area which is the subject of the investigations is identified in **Figure 1** below as a red outline, which is a site covering a total of c. 6.087 hectares (and comprising 5.648 hectares of developed site area). Through the desk study and investigations undertaken and having regard to other environmental and design considerations a suitable design of the Proposed Project was subsequently identified for the site, which includes the absence of basement storeys and associated inherent construction mitigation measures. This has also in turn informed the extent and level of detail of this report on Land, Soils, Geology, Hydrology and Hydrogeology (again for the site outlined in red below). Because the regional geology, hydrology and hydrogeology has a bearing on the site geology, hydrology and hydrogeology, in this case, the study area is larger than the application site; thus, much of the baseline data presented in this report extends beyond the application site itself.



Figure 1: Application Site Area and Surrounding Features, illustrating surrounding topography and surface water stream and river features (OS Licence EN 0057926). See the incising Boyne channel running through the site, and the generally higher ground to both the north and south. Grid squares are 1 km distance.

The objectives of the assessment are:

- Produced a baseline study of the existing water environment (surface water and groundwater natural resources) in the area of the proposed LRD Project;
- Identify likely significant effects of the Proposed Project on surface water and groundwater natural resources during the construction and operational phases of the proposed LRD Project;
- Identify mitigation measures to avoid, reduce or offset significant negative effects, and;
- Assess the potential for any significant residual effects.

The Water Study Area for assessing the potential zone of impact and cumulative effects assessment is the Boyne River catchment. The detail of the Boyne River catchment is shown on **Figure 2** below (Regional Hydrology Map).

The closest surface watercourse on the Discovery Series Map flows through the southern end of the site, where the River Boyne flows from west to east. The majority of the area of the subject site is several metres above this hydrological base level. A full set of site location maps and drawings of the layout of the development are contained in the accompanying planning application.

This report provides a description of the geological character of the site and details the nature, extent and complexity of the geological material from the surface downwards through the mineral subsoil to the bedrock. To compliment the study mapping of surface water features, and a well audit and walkover of the site and a 500 m radius was completed. Hydrogeological field investigations undertaken include supervision of trial pitting and dynamic probe testing by Ground Investigations Ireland Limited, Catherinestown House, Hazelhatch Road, Newcastle, County Dublin, D22 YD52, across the site in February 2025, as well as dipping of an on-site borehole, which had been drilled previously in April 2025. Water quality analysis of samples taken from springs on-site (see accompanying report by Denyer Ecology 11 Dargle View, Rathfarnham, Dublin, D16 XY51) was also taken, and the samples were forwarded to Eurofins Environment Testing Ireland, Hoffman Park, Inchera, Cork, T45 PC80, for hydrochemical analysis.

The results of all of the desk study work, walkover survey, trial pitting well audit, groundwater level analysis, and groundwater sample analysis were collated to assess the potential likely and significant effects that the construction and operation of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to Land, Soils, Geology, as well as Hydrology and Hydrogeology (i.e. natural water resources) are recommended, and the residual effects of the Proposed Project post-mitigation are assessed.

2.0 STATEMENT OF AUTHORITY

EurGeol. Dr. Robert Meehan, PGeo. (B.A., Ph. D, PGeo., EurGeol.) is a specialist geological, hydrological, hydrogeological and environmental sole trader who delivers a range of water and environmental management consultancy services to the private and public sectors across the Republic

of Ireland. Robert began working as a self-employed Consultant Geologist in 2003, with his office located in Navan, County Meath.

Robert's core areas of expertise and experience includes soils, subsoils, geology, hydrogeology and hydrology. Robert routinely completes impact assessments for land, soils and geology, hydrology and hydrogeology for a large variety of project types including housing developments, large-scale infrastructure projects, and quarry enterprises.

Robert is an Environmental Geologist / Hydrogeologist with over 30 years' environmental consultancy experience in Ireland. Robert initially worked for Geological Survey Ireland (GSI) between 1993 and 1998, on the initiation of Groundwater Protection Schemes across the country, and then worked for Teagasc between 1998 and 2006 completing the first countrywide mapping of subsoil (and related soils) coverage, which is that still used today in all Environmental Impact Assessments across the Irish landmass. Since beginning life as a consultant while with Teagasc in 2003, Robert has completed numerous hydrological and hydrogeological impact assessments of various types of development in Ireland. He has also worked for GSI on their National Groundwater Protection Scheme, as well as Irish Geological Heritage Audits of all counties across Ireland. Robert acts as a consultant to the Environmental Protection Agency (EPA) on on-site waste water treatment systems, and was a co-author of the current Code of Practice (Domestic Waste Water Treatment Systems, 2021). Robert has been a lead trainer on the (formerly FAS, now Water Services Training Group) course on 'Site Assessment for On-Site Waste Water Treatment Systems' since its inception in 1998. Robert has managed the geological and hydrogeological aspects of EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in geological and hydrogeological site investigations, tiered risk assessments and site suitability assessments for on-site waste water, geological heritage mapping and appraisal, wetland hydrology and hydrogeology, water resource assessments, surface water drainage and SUDs design, and surface water/groundwater interactions.

3.0 RELEVANT LEGISLATION

This Land, Soils, Geology, Hydrology and Hydrogeology report is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. The requirements of the following legislation are complied with:

- The Planning and Development Act 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;

- S.I. No. 94/1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722/2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it replaced a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41/1999: Protection of Groundwater Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 294/1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 74/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. S.I. No. 99/2023: European Communities Environmental Objectives (Drinking Water) (Amendment) Regulations 2023;
- S.I. No. 287/2022: European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2016;
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Water) Regulations 2009;
- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019;
- S.I. No. 50/2025: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2025, and;
- The Heritage Act 1995, as amended.

4.0 RELEVANT GUIDANCE

This Land, Soils, Geology, Hydrology and Hydrogeology report was prepared in accordance with, where relevant, the guidance contained in the following documents:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- European Commission (2017): Environmental Impact Assessment of Projects - Guidance on the Preparation of the Environmental Impact Assessment Report;
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual - Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 - Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).

5.0 ASSESSMENT METHODOLOGY

5.1. Desk Study

A desk study of the Site was completed in advance of undertaking the walkover survey, mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the Site and Water Study area. This included consultation with the following data sources:

- the Environmental Protection Agency's online environmental database (www.epa.ie);
- Geological Survey Ireland's (GSI's) Groundwater and Geology Databases (www.gsi.ie/geology or www.gsi.ie/groundwater) and Geological Heritage site mapping (www.gsi.ie/geoheritage);
- GSI's Bedrock Geology 1:100,000 Scale Map Series, Sheet 13 (Geology of Meath). Geological Survey Ireland (GSI, 2001);
- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 13 (Geology of Meath). Geological Survey Ireland (GSI, 2001);
- Geological Survey Ireland (2003) - Trim, Athboy and Longwood Groundwater Body Initial Characterization Reports;
- General Soil Map of Ireland (Teagasc, 1980, 2nd edition, viewable on www.epa.ie); and,
- Soil Map of County Meath (Teagasc, 1983, on <https://teagasc.ie/environment/soil/soil-maps/>);
- Aerial Photography, 1:5,000, and Ordnance Survey Ireland 6 inch sheet base mapping.
- OPW Past Flood Event Mapping (www.floodinfo.ie); and,
- OPW Flood Extents Mapping and National Indicative Fluvial Mapping (www.floodinfo.ie/map/floodmaps).

5.2. Baseline Monitoring and Site Investigations

Walkover surveys, including geological/hydrological/hydrogeological baseline monitoring and site investigations, were undertaken by Robert Meehan (refer to Section 2 above for qualifications and experience) on 28th January, 10th February, 7th July, 2nd September and 13th October 2025.

Intrusive Site Investigations were conducted across the site area both prior to and during this time by Ground Investigations Ireland, Catherinestown House, Hazelhatch Road, Newcastle, County Dublin, D22 YD52, on 10th February (trial pitting and dynamic probing) , and 7th, 8th and 9th April 2025 (borehole drilling), and by Traynor Environmental Limited, Belturbet Business Park, Creeny, Belturbet, County Cavan, H14 AY94, on 21st November 2024 and 14th October 2025 (BRE Digest soakaway testing).

Allied to this, archaeological investigations comprising trial pitting were conducted in December 2016 and on 1st and 2nd September 2025.

The objectives of the intrusive site investigations included mapping the distribution and depth of mineral subsoils at the proposed LRD Site along with assessing the mineral subsoil / bedrock conditions at key Proposed Project locations. These data were used to inform the final layout design.

Site investigations to address the Land, Soil, Geology, Hydrology and Hydrogeology sections of this report included the following:

- Walkover surveys and geological mapping of the Site area were undertaken to assess ground conditions;
- A total of 11 no. deep trial pits excavated inside the proposed LRD Site boundary, to determine the thickness and geomorphology of mineral subsoils overlying the Site;
- A total of 20 no. dynamic probe tests were completed inside the proposed LRD Site boundary, to assess the strength and properties of the mineral soil and subsoil across the Site;
- The logging and assessment of soil and subsoil profiles in the shallow trenches dug during the archaeological survey of the site;
- The drilling of two boreholes; one on-site in the southeastern portion of the proposed LRD site itself, and one across the river along the proposed rising main route;
- Determination of groundwater flow directions was completed by triangulation of groundwater levels as measured in the on-site borehole, in one of the on-site trial pits, and at the spring emergences;
- Measurement of flow in springs issuing in the southern portion of the site and that then flow through the southern extreme of the site into the river Boyne; and
- Mineral subsoils were logged according to the British Standard BS: 5930 Subsoil Classification scheme.

As there is an absence of peat of any depth across all portions of the site (see following Sections), and as the soil and subsoil is all mineral, the requirement for a Peat Stability Risk Assessment Report and Peat Management Plan does not arise.

5.3. Impact Assessment Methodology

The desk study investigations commissioned were to characterise the detailed three-dimensional soils, subsoils and bedrock geology of the proposed LRD Site, as well as resultant interpreted hydrology and hydrogeology. As well as this, an assessment as to whether there would be any impact on SACs, SPAs, NHAs or pNHAs around the site, was an inherent part of this study. The resulting report provided the resultant description of the geological character of the lands, and details the nature, extent and complexity of the geological material from the surface downwards through the mineral subsoil to the bedrock. As part of this desk study mapping and modelling exercise, field investigations were

undertaken and involved a detailed walk over of the site and its surrounding environs, and mapping of salient features.

Overall therefore, the results of the desk study, visual assessment of the site, groundwater and surface water level analysis and trial pit analysis have been collated to conclude that the lands could be used for the construction of the proposed LRD development, as well as the associated drainage scheme, and assert that there will be no detrimental impact on the soils and subsoils geology, or hydrogeology and drainage on the site or at any nearby SACs, SPAs, NHAs or pNHAs, from the construction of same.

The rating of potential environmental impacts on the soils and geology environment is based on **Table 1** following which takes account of the quality, significance, duration and type of impact characteristic identified.

Impact characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences
	Slight	An impact which causes noticeable changes in the character
Impact	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
	Short term	Impact lasting one to seven years
Duration	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasting for one year or less
	Cumulative	The addition of many small impacts to create one larger, more significant impact
Type	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminate	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is not permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents
	'Worst Case'	The impact arising from a development in the case where the mitigation measures may substantially fail

Table 1 Glossary of potential impacts following EPA (2022) Guidance document.

The appraisal methodology is completed in accordance with the Environmental Protection Agency (EPA) document '*Guidance on the Information to be contained in Environmental Impact Statements*' (EPA, 2002), the Institute of Geologists of Ireland (IGI) publication '*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapter of Environmental Impact Statements*' (2013) and the EPA document entitled '*Guidelines on the information to be contained in Environmental Impact Assessment Reports*' (2022) classification of environmental impacts. In addition, the document entitled '*Guidelines on Procedures for Assessment and Hydrogeology for National Road Schemes*' by the National Roads Authority (NRA, 2009) is referenced where the methodology for assessment of impact is appropriate.

In an EIA assessment, consideration is given to both the importance of an attribute and the magnitude of the environmental impacts of the proposed activities on that cited attribute. These impact ratings presented in below are in accordance with impact assessment criteria provided in the EPA (2022) publication. Though the proposed development on this site is below the EIA threshold, given the sensitivity of the site immediately north of the River Boyne and The River Blackwater SAC and the River Boyne and The River Blackwater SPA, regard will be given to an appraisal in line with EIA Guidance.

The duration of each impact is considered to be either temporary, short-term, medium term, long-term, or a permanent impact. Temporary impacts are considered to be those which are construction related and last less than one year. Short term impacts were seen as impacts lasting one to seven years; medium-term impacts lasting seven to fifteen years; long-term impacts lasting fifteen to sixty years; and permanent impacts lasting over sixty years.

The NRA criteria for rating the magnitude and significance of impacts at EIA stage on the geological related attributes are also relevant in determining impact assessment and area shown in **Table 2** below.

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 2 Criteria for rating impact magnitude at EIS stage - Estimation of magnitude of impact on soil / geology attribute (NRA, 2009).

The guideline criteria (EPA, 2022) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment report are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in **Table 3** following.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Unlikely	A low likelihood of occurrence of the impact.
	Likely	A medium likelihood of occurrence of the impact

Table 3 Additional Impact Characteristics

Impact Characteristics	Potential Hydrological Impacts	
	Significance	Potential Hydrological Impacts
Negative only	Profound	Widespread permanent impact on: <ul style="list-style-type: none"> The extent or morphology of a cSAC. Regionally important aquifers. Extents of floodplains. Mitigation measures unlikely to remove impacts.
Positive or Negative	Significant	Local or widespread time-dependent impacts on: <ul style="list-style-type: none"> The extent or morphology of a cSAC / ecologically important area. A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area. Mitigation measures (to design) will reduce but not fully remove impact - residual impacts will occur.
Positive or Negative	Moderate	Local time-dependent impacts on: <ul style="list-style-type: none"> The extent or morphology of a cSAC / NHA / ecologically important area. A minor hydrogeological feature. Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time-dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

Table 4 Impact Descriptors relating to the Receiving Environment

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in **Table 4**.

5.4. Overview of Impact Assessment Process

The conventional source-pathway-target model (see following) was applied to assess potential impacts on downstream environmental receptors (see below as an example) as a result of the Proposed Project.



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the guidance document “Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2022)” produced by the Environmental Protection Agency (EPA).

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

Step 1	Identification and Description of Potential Impact Source: This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or erosion are physical mechanisms by which a potential impact is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

Table 5 Impact Assessment Process

In order to provide an understanding of the stepwise impact assessment process applied following, a summary guide has first been presented above that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operation and decommissioning activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

5.5. Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils, Geology, Hydrology and Hydrogeology report. The site investigations and follow up monitoring carried out were thorough and exhaustive.

6.0 EXISTING ENVIRONMENT

6.1. Site Description and Topography

The Site is located in the central area of the Plains of Meath, in the townland of Crowpark (1st Division), approximately 600 m west-northwest of the centre of the town of Trim, in west central County Meath (see **Figure 1**). The site lies at ground surface elevations between approximately 52 m - 66mAOD, and is bounded by the third class 'Kildalkey Road' at the north, with other adjacent Regional and third class roads to the south and east. The existing Elder Grove housing development is immediately adjacent at the east of the site, with a set of detached houses on the northern side of the Kildalkey Road and along a *cul-de-sac* laneway at Crowpark to the north (see **Figure 2**). The site itself comprises in the majority a relatively square field used for tillage farming, and the entrance to the proposed LRD site is proposed from the northwestern end of this, along the Kildalkey Road.

The Ordnance Survey Ireland 1:50,000 Discovery Series Map shows a multi-contoured topography in and around the site (**Figure 1**) and apart from the River Boyne which flows west to east along the southern boundary of the proposed LRD site, there are no streams or other watercourses shown as flowing through or adjacent to the site on this Discovery Series map.

It is noted that a holy well, St. Patrick's Well, is shown just outside the western boundary of the proposed LRD Site on the first edition Ordnance Survey six inch to one mile sheet of the locality from the early 1800's (1836), and on the late-1800's (1882 - 1884) 'Cassini' six inch to one mile sheet as well as on the 25 inch to one mile sheet of the Ordnance Survey from that time, a separate 'spring' is shown approximately 50 m southeast of this holy well (**Figure 3**). As well as this, the lower ground on the site, adjacent to the River Boyne, has a stippled 'marshy' symbol on the maps.



Figure 2: Site Layout Map of the proposed LRD Site (O'Daly Architects).

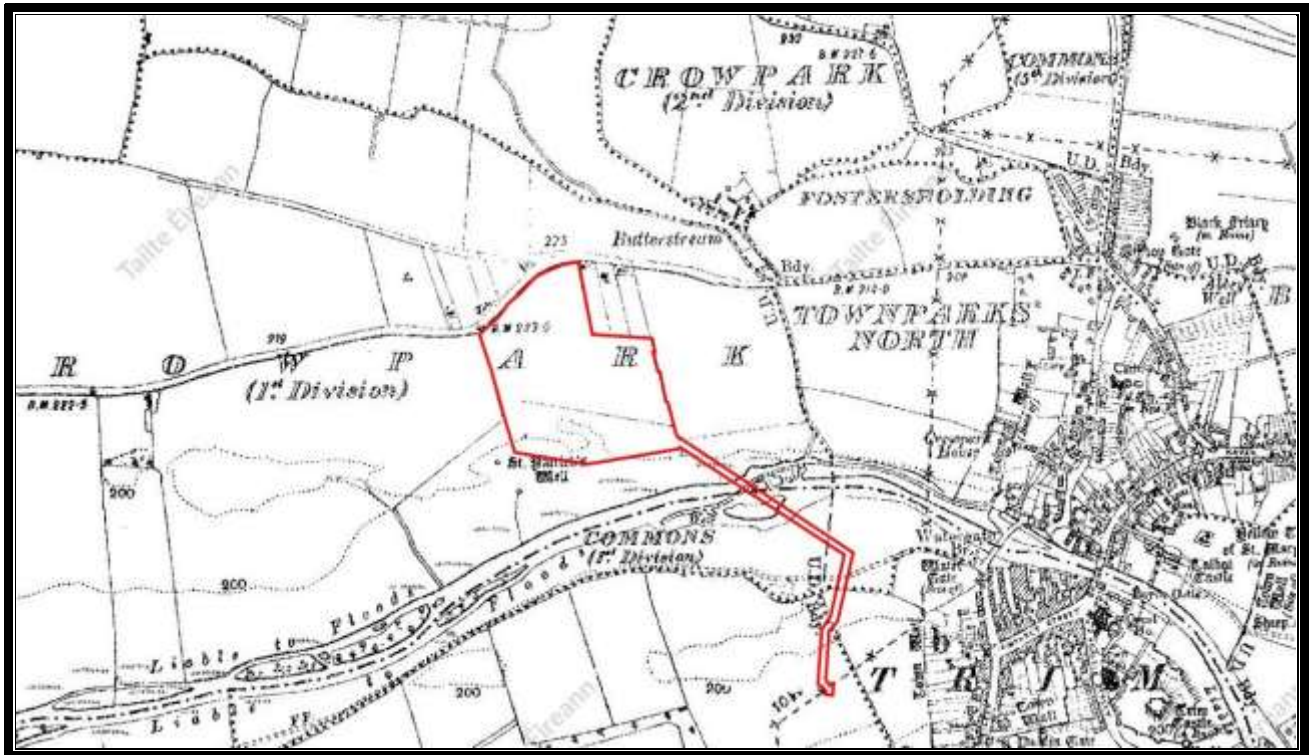


Figure 3: Ordnance Survey 'Cassini' six inch to one mile sheet (1882 - 1884), with the proposed LRD site boundary overlain (OS Licence EN 0057925). Surrounding topography and surface water stream and river features are clearly seen. See the locality of 'St. Patrick's Well' approximately 50 m northwest of the spring feature (both outside the red line boundary of the proposed LRD site), as well as the stippled, marshy ground shown along the River Boyne.

The proposed LRD Site itself is situated on the southern backslope of a low, unnamed, linear ridge feature at Dunleever Glebe - Crowpark, which segues into the northern glaciofluvial terrace of the River Boyne on the site itself (GSI, 2025). The linear ridge on which the northern portion of the proposed LRD site is located rises to 72 m elevation AOD approximately 900 m northwest of the site (**Figure 1**).

The overall form / geometry of the site itself is of a ridge or 'bank' type feature along the mid-backslope of a much higher, bedrock-cored ridge, undulating with gentle to moderate slopes. A marked hillock also occurs at the southeastern extremity of the site. The southern extreme of the site encompasses part of the River Boyne floodplain.



Plate 1 View of the proposed LRD site, from the southwest near the current entrance on the Kildalkey Road



Plate 2 View of the southern edge of the proposed LRD site, from the north, with the wetland forestry along the River Boyne visible



Plate 3 The marked hillock just outside the southeastern extremity of the site

6.2. Land and Land Use

Based on the Corine 2018 land cover mapping, the proposed LRD Site comprises agricultural pastures. The CORINE land cover map is a pan-European land cover inventory with 44 thematic classes, created to standardize land cover data, and updated every six years. The resolution of the data are coarse, produced at 25 hectare resolution.

In 2018, the Ordnance Survey of Ireland (OSi) and the Environmental Protection Agency (EPA) initiated a new national land cover mapping programme for Ireland under a partnership agreement. For the first time, it provides a comprehensive, national-scale mapping of all land cover types of the country including broadleaved woodland and hedgerows, a range of peatlands, wet and dry heathland, wet and dry grasslands, artificial surfaces, exposed rock and sediments. The land cover is at 5 hectare resolution, and the land cover of the proposed LRD site in this dataset is of arable crops, with a narrow strip of riparian woodland at the southern extreme of the proposed LRD site along the River Boyne.

Currently (October 2025) the majority of the northern portion of the site itself is comprised of recently tilled and sown land, with a narrow band of wetland forestry running west to east along the southern

extremity of the site. Matures hedgerow / treelines flank the western and eastern boundaries of the site, and a fence occurs along the Kildalkey Road at the north. Small pockets of scrub vegetation and unmanaged grassland also occur in the southern portion of the site, between the tilled land and the wetland forestry. There are currently no buildings across any locality within the site confines, and the only portions of the proposed LRD site covered by concrete or hardstand are the existing road beneath which the proposed rising main will run at the southeastern extreme.

To the east, the land in the housing estate has a concrete, tarmacadam or hardstand cover, as does the land covered by detached housing to the north. To the north and northwest, arable crops are also grown.

6.3. Soils Geology (Topsoils)

According to the An Foras Taluintais General Soils Map of Ireland (Gardiner and Radford, 1980) the region containing the subject site has a relatively homogeneous and uniform soils geology.

The site locality itself is shown as being characterised by soils of Soil Association 37. This association includes soils which are dominated by grey brown podzolic soils (75% of the land area of this category). These are deep, well drained, alkaline mineral soils. Within this association, the limestone-dominated subsoil is moderately permeable, and leaching of clay to the 'B' horizon has taken place.

The remainder of the area of this soils association is mapped as being underlain gley soils (20% of the area). Gleys are poorly drained mineral soils, which are generally of clay loam texture and are imperfectly to poorly drained, owing to the fact that they are in either low portions of the landscape or are hosted within pockets of subsoil with low permeability. These soils are usually no more than 0.7m deep.

The final 5% of the soils of this area are brown earth soils. The brown earths are again well drained soil materials.

Previously, this locality was also specifically shown as being underlain by grey brown podzolics of the Rathowen Series (Finch et al., 1983), following detailed, field-scale mapping of the soils of the area, with a narrow band of Boyne River alluvium shown in a strip along the River Boyne at the southern end of the site. The site is also specifically mapped as being underlain by deep, well drained mineral soils derived mainly from basic parent materials (Teagasc/EPA, 2006a).

The majority of the soils within this subject proposed LRD Site are therefore expected to be well drained mineral soils. From this, any subsoil on the site is likely to be of high to moderate permeability, with a moderate to low likelihood of surface water runoff and/or impeded vertical drainage (particularly given the slope gradients on the site also, see **Plates 1, 2 and 3**). This supports a conceptual understanding of the site in that surface water will in the majority flow through any topsoil and permeable subsoil to the bedrock and water table beneath the site, throughout the year.

A walkover survey of the site and examination of the cuttings in the banks of the adjacent hedgerows, as well as the spring channels in the south of the site, noted that deep, well drained, basic topsoil is

present around the site area. Trial pitting associated with the ground investigations and the archaeological survey on the site also proved this to be the case.



Plate 4 Section into well drained soil formed within moderate permeability subsoil along the western bank boundary of the site

6.4. Subsoils Geology (Quaternary Geology)

The Quaternary period extended from 1.6 million years ago to the present day. During this period great Ice Ages took hold in Ireland, the last of these extending from 73,000 years before present (BP) until 10,000 years BP.

General information concerning the Subsoil (Quaternary) Geology is contained in the GSI publication “Geology of Meath” (2001). There were several phases of ice flow affecting west central County Meath. Within these phases, ice flowed from a number of different centres. The ice from the northwest would have been the last ice to cross over the site as the existing glacial landforms indicate that ice flow direction during the Last Glacial Maximum was approximately southeasterly across central County Meath. Following this there was a period of deglaciation, when waterlain glaciofluvial sediments were deposited. Since deglaciation ended, a period of post-glacial geological processes has continued until the present day, where natural landscape processes in Ireland are dominated by the action of water.

On a regional basis, in general it would be interpreted that depths of subsoil in the region of the proposed LRD Site are of relatively deep depth in the majority (>3m, Meath County Council Groundwater Protection Scheme Map), and are projected to be at least 5 m deep in places. In particular, significant piles of till subsoil debris has been interpreted as being left by previous glacial activity along the northern edge of the proposed LRD Site.

In general glacial deposits in this specific area around Crowpark (1st Division) are often relatively deep, with only isolated pockets of much older bedrock poking through the glacially-derived subsoils. Thus, on the proposed LRD Site itself much of the land surface has had significant depths of subsoil deposited across it, and bedrock is mapped by GSI as being between 3 m and 5 m below the ground surface (GSI, 2025), while on the higher ground north and northwest of the proposed LRD Site itself, bedrock is mapped as being between 5 m and 10 m from the surface across wide belts of land.

Further east, around the town of Trim itself, bedrock crops out at surface beneath Trim Castle, as well as in the bed of the River Boyne and beneath the Yellow Steeple adjacent to this, and in the grotto of St. Patrick's Church.

Where glacial debris is found on top of the bedrock, it generally consists of tills (boulder clays), which were deposited at the base of the moving ice. All of the subject site is mapped by GSI as having deep till as the subsoil, above bedrock at a deeper level, in a such a fashion (**Figure 4**).

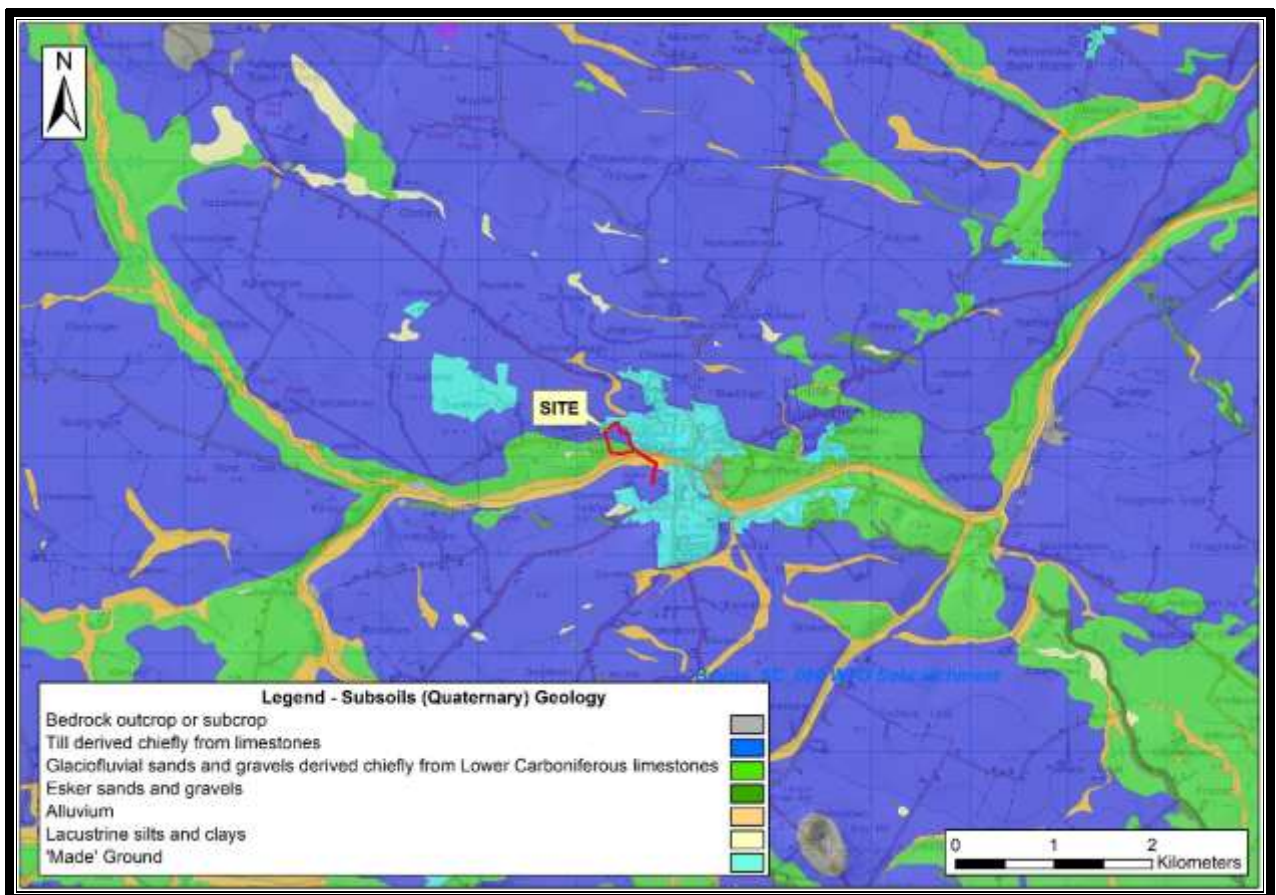


Figure 4: Subsoils geology of the site and its environs (O.S. Licence EN 057926).

The powerful glacial activity has therefore moulded and sculpted the macro-scale landscape character in this area. Ice moved across west central County Meath, flowing southeastwards towards Dublin and Wicklow, while sculpting and planing the underlying bedrock. During the advancement of the glaciers, the weight and pressure of the ice broke the bedrock upon which the glaciers moved and ground it down to particle sizes ranging from boulders to clay. This material was bulldozed off and smeared by the advancing ice on the pre-existing bedrock. This material is therefore unsorted, cohesive and consolidated reflecting its crushing, smearing depositional process at the base of the ice. In many areas this bedrock was scraped clean of overburden, whereas in others thousands of tonnes of limestone rock material was crushed, bulldozed and redeposited as till (boulder clay). Thick till debris overlying the bedrock is common in the lowlands across central Meath, but generally shallows along portions of the Boyne channel, such as in pockets around Trim Town itself (**Figure 4**).



Plate 5 Low elevation, gently undulating till ridge at the northern end of the site, viewed from the south.

Overall, the proposed LRD Site therefore lies in a transitional area between relatively deep glacial sediments to the north between Tremblestown and Phillistown, where a till plain is in evidence, and limestone bedrock outcrop to the east / southeast, within the town of Trim and along the River Boyne there.

According to the GSI Quaternary sediments (subsoil) map (GSI, 2025, **Figure 4**), the tills at the proposed LRD Site are comprised of till derived chiefly from Lower Carboniferous limestones (TLs). This subsoil will generally have a SILT to CLAY texture, as the limestone, when crushed mechanically by glacial ice, breaks down to a SILT texture, with CLAY also being derived from shale bands in the bedrock around the area. Consequently, the permeability of this material is generally moderate, and is mapped by GSI as such (GSI, 2025).

During deglaciation, when the ice covering Ireland melted, huge amounts of meltwater were released. At this time the wide valleys hosting the River Boyne along the southern end of the proposed LRD site was a wide, deglacial river. In this wide valley setting glaciofluvial sands and gravels were deposited by the deglacial meltwaters; these now form elevated terraces on either side of the River Boyne. The northern sand and gravel terrace of the Boyne forms the majority of the proposed LRD site itself.

In the lower areas of these modern valleys, where the River Boyne now flows, alluvium has been deposited over the millennia by the present day rivers across the lower, flatter floodplain strips flanking the watercourse. Much of the land east and northeast of the proposed LRD Site itself, having been sealed by concrete and/or hardstand in recent years, is mapped on the subsoil map as 'Made' ground (see **Figures 4** and **5**).



Plate 5 Gravelly SILT (till) subsoil exposed in small, disused borrow at the western end of the proposed LRD site, January 2025.

The walkover survey of the site noted that subsoil is present across the entirety of the site area, with no bedrock seen to outcrop at surface. This is particularly the case along the streamlet conduits downstream of the springs incising into the till subsoil, which run through the site from (broadly) north to south, and have incised channels up to 3.3 m deep in places.

6.4.1 *Site Investigations (Drilling and Trial Pitting)*

In order to determine the full geological profile (soil, subsoil and bedrock) at the proposed LRD Site, extensive ground investigations were carried out in February, April and September 2025 to determine the geological and hydrogeological setting of the proposed LRD Site.

A total of 12 no. deep trial pits were excavated inside the proposed LRD Site boundary, 20 dynamic probe tests were completed, and 2 no. boreholes were drilled inside the proposed LRD Site boundary. As well as this, 14 no. shallow archaeological trenches were opened, 7 no. in December 2016 and 7 no. in September 2025. The locations of these investigation point localities are shown on **Figure 5**, which also shows the GSI mapped subsoils (see Section 6.3 above) as a backdrop.

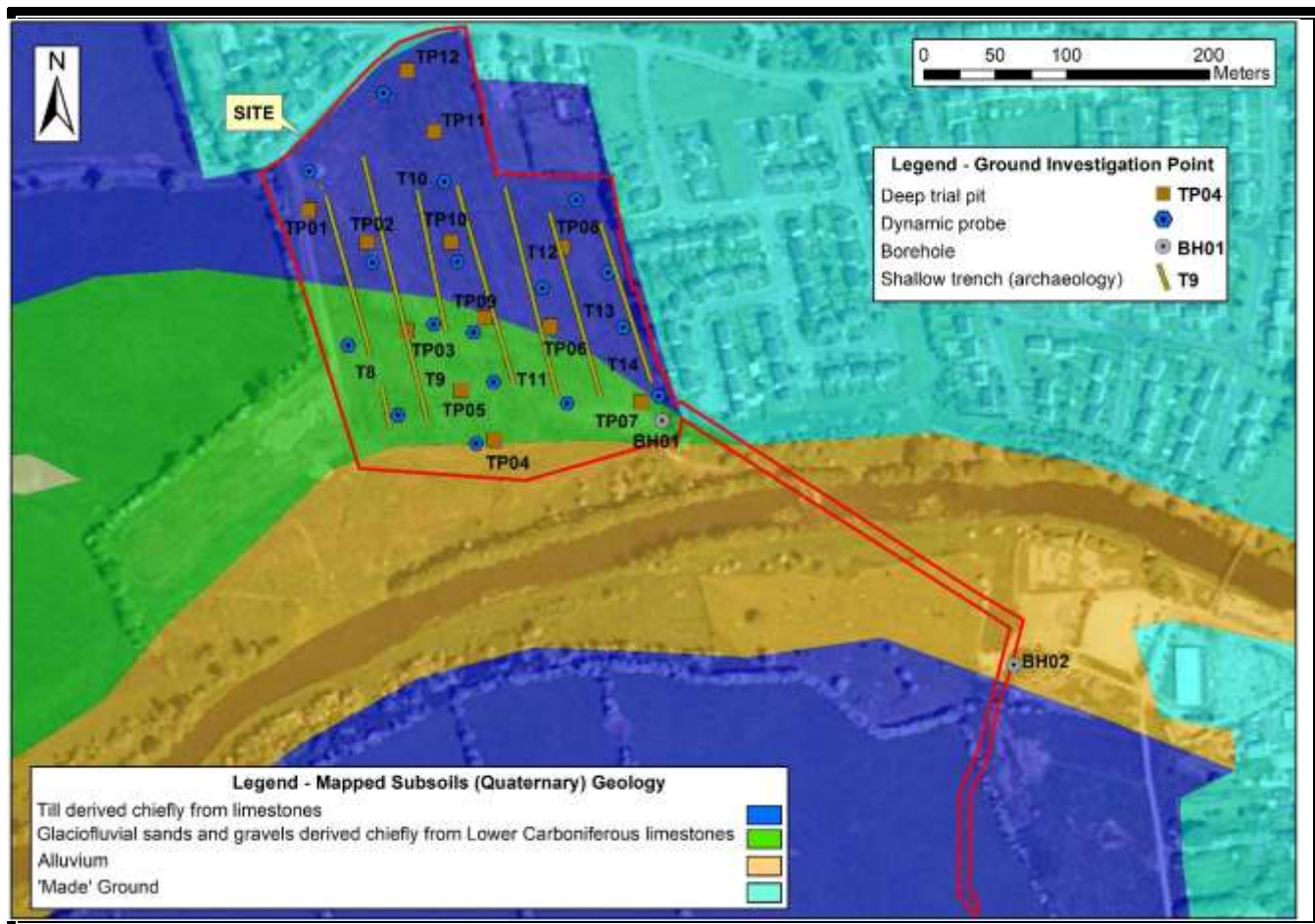


Figure 5: Location of ground investigation point localities excavated / bored across the proposed LRD Site area (O.S. Licence EN 057926).

Trial pit logs are included as a separate report with this application “Ground Investigations Ireland: Kildalkey Road, Trim, Ground Investigation Trial Pitting Report” from February 2025, and borehole logs are included as a second separate report “Ground Investigations Ireland: Kildalkey Road, Trim, Ground Investigation Borehole Report” from May 2025. Refer also to **Tables 6** and **7** following for a summary of the ground investigation deep trial pitting and drilling. The archaeological investigations are summarised as another separate report “Kildalkey Road, Trim, County Meath: Archaeological Impact Assessment” by Archer Heritage Planning, from September 2025.

6.4.1.1. Site Investigation - Topsoils

Across the majority of the proposed LRD Site, the majority of topsoils observed in the trial pits on the site matched the mapped topsoils of Teagasc (after Teagasc/EPA, 2006a; Finch et al., 1983, see **Table 6**). The majority of soils across the site were consequently grey brown podzolics (in TP1, TP2, TP9, TP10, TP11 and TP12, as well as potentially in BH02), with slightly heavier ‘B’ horizons owing to leaching of CLAY down profile. These soils generally occur across the area of the site mapped by GSI as dominated by ‘till’ subsoil (see **Figure 5**), and were between 0.7 m and 1.0 m deep. Where the subsoil was particularly gravelly or sandy, the soils were shallower, and comprised well drained brown earths. These brown earth soils extended to 0.3 m to 0.6 m depth only, and generally occurred across the area of the site mapped by GSI as ‘glaciofluvial sands and gravels’ subsoil (TP3, TP5, TP6 and TP7, see **Figure 5**). At one locality (TP8), a gley soil was encountered, with mottling in the profile, and very localised drainage impedence. Also, at the southern end of the site, a topsoil comprising partially-decomposed organic branches, twigs and roots was observed, where relict, petrified tufa was encountered in a pit (TP4, see also **Table 7** and **Plate 6**).

Location	Date	Depth (m)	Topsoil depth (m)	Topsoil sequence and description
TP1	10.2.2025	1.5	0.7	Silt loam over gravelly SILT/CLAY (grey brown podzolic)
TP2	10.2.2025	2.2	0.7	Sandy silty loam over gravelly SILT/CLAY (grey brown podzolic)
TP3	10.2.2025	1.3	0.6	Silt loam over gravelly SILT/CLAY, to 0.6 m (brown earth)
TP4	10.2.2025	2.2	0.3	Organic loam intermixed with branches, twigs, roots to 0.3 m
TP5	10.2.2025	2.4	0.3	Sandy silty loam (brown earth)
TP6	10.2.2025	2.5	0.6	Silt loam over silty SAND, to 0.6 m (brown earth)
TP7	10.2.2025	1.3	0.3	Sandy loam (brown earth)
TP8	10.2.2025	2.0	1.2	Silty clay loam over gravelly SILT/CLAY (gley)
TP9	10.2.2025	1.5	0.7	Silty clay loam over gravelly SILT/CLAY (grey brown podzolic)
TP10	10.2.2025	1.0	1.0	Silty clay loam over gravelly SILT/CLAY (grey brown podzolic)
TP11	10.2.2025	1.3	0.8	Sandy silty loam over gravelly SILT/CLAY (grey brown podzolic)
TP12	10.2.2025	2.4	0.9	Sandy silty loam over gravelly SILT/CLAY (grey brown podzolic)
BH01	7.4, 8.4.2025	20.2	n/r	Not recorded (potentially brown earth given GRAVEL content ?)
BH02	9.4.2025	20	n/r	Not recorded (potentially grey br. podzolic given CLAY content ?)

Table 6 Summary topsoil data from trial pitting and drilling across the proposed LRD Site

The archaeological investigations carried out in September 2025 (see **Figure 5** for locations) allowed an assessment of how soil type and depth varies across the site, given that seven long trenches were

opened, exposing profiles between 120 m and 190 m long. Soils were observed as grey brown podzolics in the majority, to depths over 0.45 m to 0.8 m deep, as the trenches bottomed out at that depth, still in the 'B' horizons of grey brown podzolic topsoil material (see **Appendix B**). Only in the southeastern extreme of the site, where the proposed Block B Apartment Building, Pumping Station and outlet for the proposed rising main are sited, were shallow soils of 0.3 m to 0.5 m depth atop glaciofluvial sands and gravels observed across a relatively wide area.

Soakaway tests have been carried out in topsoils across the site (Traynor Environmental, 2025). The tests were completed at depths of between 0.4 m and 0.6 m below ground level only. This is owing to the fact that in order to maintain the hydrological regime at this sensitive site, infiltration of rainwater dispersed using SUDS measures will be through topsoils and subsoils rather than at depth into subsoils only.

6.4.1.2. Site Investigation - Subsoils

Across the majority of the proposed LRD Site, the subsoils observed in the trial pits on the site matched the mapped subsoils of GSI. Till (boulder clay) was found as subsoil throughout trial pits TP11 and TP12, at the northern extreme of the site, and in the uppermost 1m approx. in trial pits TP1, TP2, TP8 and TP9, which run across the north centre of the site. The till deposits are typically comprised of sandy gravelly SILT, with some cobbles and boulders (**Table 7**). In these latter trial pits though, the till overlies sorted glaciofluvial sands and gravels at depth, and sorted sands and gravels also forms the entirety of the profiles of trial pits TP3, TP5, TP6, TP7 and TP10. The only trial hole with an unexpected subsoil was TP4, where a relict tufa deposit comprising porous, spongy calcium carbonate, and containing pods of organic material, was observed.

Location	Date	Depth (m)	Depth to bedrock	Subsoil sequence and description
TP1	10.2.2025	1.5	>1.5	gravelly SILT/CLAY to 0.7 m, over SAND and GRAVEL to 1.5 m
TP2	10.2.2025	2.2	>2.2	gravelly SILT/CLAY to 0.7 m, over SAND and GRAVEL to 2.2 m
TP3	10.2.2025	1.3	>1.3	Interbedded gravelly SAND and sandy GRAVEL to 1.3 m
TP4	10.2.2025	2.2	>2.2	Porous, spongy calcium carbonate (petrified tufa) to 2.2 m
TP5	10.2.2025	2.4	>2.4	Interbedded gravelly SAND and sandy GRAVEL to 2.4 m
TP6	10.2.2025	2.5	>2.5	Interbedded gravelly SAND and sandy GRAVEL to 2.5 m
TP7	10.2.2025	1.3	>1.3	Boulder and cobble GRAVEL to 1.3 m
TP8	10.2.2025	2.0	>2.0	gravelly SILT/CLAY to 1.2 m, over SAND and GRAVEL to 2.0 m
TP9	10.2.2025	1.5	>1.5	gravelly SILT/CLAY to 0.8 m, over SAND and GRAVEL to 1.5 m
TP10	10.2.2025	1.0	>1.0	Interbedded gravelly SAND and sandy GRAVEL to 1.0m
TP11	10.2.2025	1.3	>1.3	gravelly sandy SILT to 1.3 m
TP12	10.2.2025	2.4	>2.4	gravelly sandy SILT to 2.4 m
BH01	7.4, 8.4.2025	20.2	2.2	gravelly sandy SILT to 2.2 m
BH02	9.4.2025	20	4.5	Interbedded gravelly SAND and sandy GRAVEL to 4.5 m

Table 7 Summary depth to bedrock and subsoil data from trial pitting and drilling across the proposed LRD Site

Tufa is a rough, thick, rock-like calcium carbonate deposit that forms by the deposition or precipitation of calcium carbonate from bodies of water with a high dissolved calcium content. Where water is rich in dissolved calcium carbonate, when this emerges from a cavity into air the calcium carbonate comes out of solution and crystallises on whatever the water happens to be dripping over at the time. The lime deposit is the tufa, or dripstone, and is what makes up the spectacular stalactites and organ pipe sheets seen in some caves. It may form a thin, millimetres-scale layer, or drape rocks and other materials in thick, centimetres wide drapes.

In the past, localities with tufa forming (in the majority, at springs or seeps) were often termed dropping wells, and many were thought to have mystic significance because by placing an object (such as a leaf) under the drips, a stone replica could be produced, often within a couple of weeks with very lime-rich waters. Tufa therefore has a porous structure and often contains fragments of leaves, twigs and humus encrusted within it, and ranges in bulk density from very stiff to spongy.

As the proposed LRD Site is entirely underlain by mineral subsoil, no peat probing to determine peat thickness or morphology / composition was required to be carried out across the site.



Plate 6 The porous, spongy, humus-rich calcium carbonate containing pods of organic material (relict tufa) in trial pit 4, with a topsoil of partially-decomposed organic matter, towards the southern end of the proposed LRD site, February 2025. Pods of this material occur in pockets throughout the site (see also Plate 8).

6.4.1.3. Site Investigation - Bedrock

Bedrock was not met / confirmed in any of the 12 deep trial pits excavated on the site. Four of the pits was completed at a relatively shallow depths (TP3, 7, 10 and 11) owing to the predominance of boulder gravels in the subsoil, but the rest were finished at the respective longest extents of bucket reach on the excavator.

The depths to bedrock across the proposed LRD Site as a whole were thus found to be relatively deep, being a minimum of 1.0 m deep but a maximum of >2.5 m deep. The individual depths to bedrock at the trial pit point localities are shown in **Figure 6**. Bedrock was met in BH01 and BH02 at 2.2 m below ground level and 4.5 m below ground level respectively.



Figure 6: Point depths to bedrock at trial pit localities excavated and borehole localities drilled across the proposed LRD Site area (O.S. Licence EN 057926).

All depths to bedrock have been considered in the proposed finished floor levels, and associated cut and fill element for site preparation, across the site. The deepest areas of cut, in the west central portion of the site is approximately 0.4 m, and the vast majority of the proposed buildings on the site will be at current ground level or above current ground level (with the maximum rise of ground through filling approximately 2.4 m in the southeastern area of the site). Thus, any areas of cut have all been sited in localities with confirmed deep soil and subsoil above bedrock. It is therefore envisaged that minimal elements of excavation to and into the bedrock substrate will be completed during construction works

on the site, and it is only while boring the proposed pipeline at the southeastern end of the site that bedrock will actually be encountered during site works.

6.5. Bedrock Geology

The bedrock geology underlying the proposed LRD Site is discussed in the GSI publication “Geology of Meath” (McConnell et al., 2001), as well as on GSI’s web viewer (www.gsi.ie). The 1:100,000 scale bedrock geology map of the area (Sheet 13) indicates that the subject site is underlain entirely by rocks of the Lucan Formation (LU). These were deposited during the Lower Carboniferous Period (359 to 323 million years ago). The bedrock geology of the area around the proposed LRD Site is shown in Figure 7.

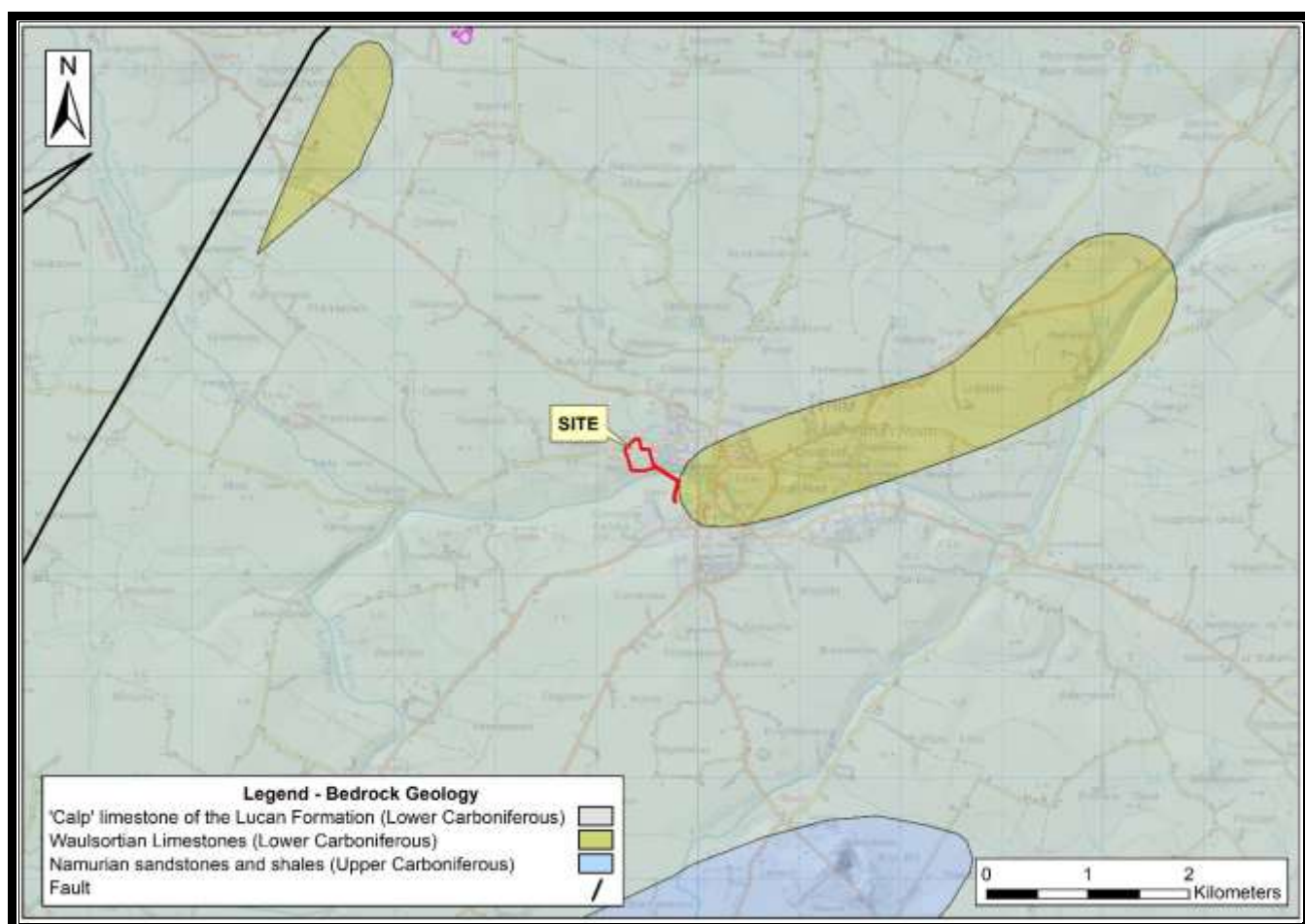


Figure 7: Bedrock geology of the proposed LRD Site and its environs (after www.gsi.ie, O.S. Licence EN 057926).

The Lucan Formation is a sedimentary rock and comprises dark grey to black limestones, which are in the majority conglomeratic, graded calciturbidites, and interbedded shales (McConnell et al., 2001). This is the same limestone unit that hosts much of the depth of Tara Mines in Navan, and is between 300 m and 800 m thick in the majority. In summary on the GSI Rock Unit Group map the Lucan Formation is synthesised as ‘Dinantian Upper Impure Limestones’ of ‘dark limestones and shales’.

The original manuscript maps of the Geological Survey of Ireland recorded 'hard, black, flaggy limestone' in the south central Meath area around Trim (**Figure 8**). Since then, further subdivision of the limestones in Ireland has been achieved by detailed geological mapping by GSI. In Dublin, south Meath and north Kildare, the limestones have historically been referred to as 'Calp' limestones, as they are muddy and impure, reflecting their deposition close to the shore at the base of a relatively deep sea during the Lower Carboniferous period (359 - 323 million years ago). Several formations within the Calp have been differentiated in the region, but it is often difficult to assign small exposures and drill cores to particular units.

To the immediate east of the site, but not beneath any portion of the site as the geological boundary is mapped by GSI as approximately east of its eastern extreme, Namurian (Upper Carboniferous, 323 to 299 million years ago) sandstones and shales are mapped. These overlie the rocks of the Lucan Formation stratigraphically, as they are younger in age. Further from this, to the south-southeast of the site by 3.4 kilometres and forming the high ridge at Bray Hill, pure, unbedded, Waulsortian limestone occurs, and crops out. As well as changes in bedrock type the only occasional geological differences are the presence of faults (**Figure 7**), but there are no faults mapped within 4.5 kilometres of the proposed LRD Site.

As Dinantian Upper Impure Limestones such as the Lucan Formation are alkaline (basic) rocks, they may be subject to dissolution and karstification.

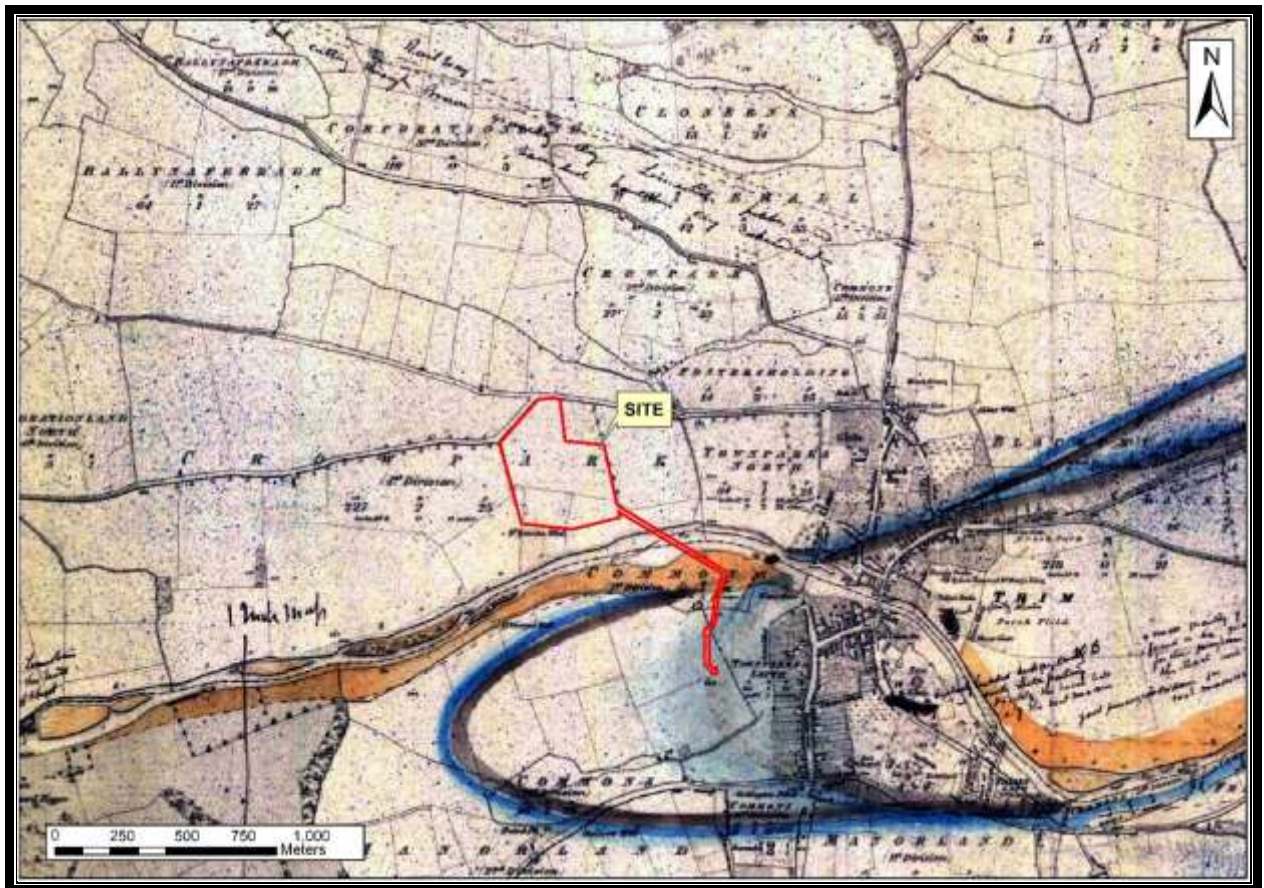


Figure 8: GSI six inch bedrock geology manuscript map of the proposed LRD Site and its environs (after www.gsi.ie, O.S. Licence EN 057926).



Plate 7 Bedrock outcrop at the base of Trim Castle in Trim Town.

Bedrock is not mapped as cropping out at or just below surface anywhere on the subject proposed LRD Site, on the GSI manuscript maps (1871, see **Figure 8**), with the closest outcrop approx. 465 m to the southeast where ‘dark platy slates’ are mapped adjacent to Trim Castle, in the scars around it’s base.

6.6. Applied Subsoils and Bedrock Geology

Applied geology is the practical application of geological principles to solve human-related problems, focusing on areas like resource exploration, engineering, and environmental management. It involves using geological knowledge for activities such as finding and utilizing mineral and energy resources (economic geology), designing structures such as buildings and tunnels (engineering geology), and assessing the impact of human activities on the environment (environmental geoscience).

6.6.1. Applied Geology - Geological Resource Importance

The ‘Calp’ limestone bedrock at the proposed LRD Site is classified as being of “Low” importance. The bedrock could be used on a “sub-economic” local scale for construction purposes only. Furthermore, the bedrock in the locality is poorly exposed due to the coverage of deep till subsoils.

The till subsoil deposits at the proposed LRD Site can also be classified as “Low” importance as the till is not designated as being a resource in this area and is also locally abundant in the general region.

The sands and gravels subsoil deposits at the proposed LRD Site are classified as of “Moderate” importance, but owing to the proximity of the River Boyne, this general classification is probable significantly reduced at site scale.

6.6.2. Applied Geology - Designated Sites

Under the Irish legal framework specified habitats and species, and areas which contribute surface water or groundwater resources to drinking water, are given various levels of protection to maintain both healthy and sustainable ecosystems and drinking water.

Protected areas or conservation areas are therefore locations which receive protection because of their recognized natural, ecological or cultural values. There are several kinds of protected areas in Ireland, which vary by level of protection depending on enabling laws or the regulations of the international organizations involved.

Natura 2000 is a network of protected areas established by the European Union across all Member States. It is made up of Special Areas of Conservation (SACs) and Special protection Areas (SPAs) designated respectively under the Habitats Directive and the Birds Directive. In Ireland, 7,155 km² are designated as terrestrial SAC sites, and 5,700 km² as SPA sites. SPAs and SACs aim to maintain or restore the favourable conservation status of habitats and species of community interest.

SPAs are designated based on the EU Birds Directive (2009/147/EC) which aims to protect all wild bird species which naturally occur in the European Union. Each of Ireland’s 154 SPA sites has been protected by individual Statutory Instruments. SAC sites are designated based on the EU Habitats Directive (92/43/EEC) which was transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The Habitats Directive ensures the conservation of a wide range of rare, threatened, or endemic animal and plant species.

Some rare and characteristic habitat types are also targeted for conservation in their own right, as Natural Heritage Areas (NHAs). The designation includes areas considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. Geological/geomorphological sites, such as karst pavement or early fossil sites, are also afforded protection through the NHA designation. In addition to NHAs, there are a number of proposed NHAs (pNHAs), which were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated as full NHAs. These sites are of significance for wildlife and habitats. Prior to statutory designation, pNHA sites are subject to limited protection.

The closest designated sites to the proposed LRD Site is the River Boyne and River Blackwater SAC (Site Code 002299) and the River Boyne and River Blackwater SPA (Site Code 004232), which is just outside the southern boundary of the site, and outside the area proposed to be developed (**Figure 9**).

A NIS accompanies this planning application under separate cover.



Figure 9: Designated sites in relation to the red line boundary of the proposed LRD Site. Datasets downloaded from www.npws.ie (O.S. Licence EN 057926).

6.6.3. Applied Geology - Geological Heritage Sites

The Irish Geological Heritage (IGH) Programme in GSI complements other nature conservation efforts of the last decade, by assessing Ireland's geodiversity. Geodiversity is the foundation of the biodiversity addressed under European Directives on habitats and species by the designations of SAC and more recently on a national scale by the introduction of NHAs as the national nature conservation method. As a targeted conservation measure to protect the very best of Irish geology and geomorphology the IGH Programme fills a void which has existed since the abandonment of the Areas of Scientific Interest scheme, listed by An Foras Forbartha in 1981.

The IGH Programme does this by identifying and selecting the most important geological sites nationally for designation as NHAs. It looks at the entire spectrum within Irish geology and geomorphology under 16 different themes:

IGH THEMES

1. Karst
2. Precambrian to Devonian Palaeontology
3. Carboniferous to Pliocene Palaeontology
4. Cambrian-Silurian
5. Precambrian

6. Mineralogy
7. Quaternary
8. Lower Carboniferous
9. Upper Carboniferous and Permian
10. Devonian
11. Igneous intrusions
12. Mesozoic and Cenozoic
13. Coastal geomorphology
14. Fluvial and lacustrine geomorphology
15. Economic geology
16. Hydrogeology

A fundamental approach is that only the minimum number of sites necessary to demonstrate the particular geological theme is selected. This means that the first criterion is to identify the best national representative example of each feature or major sequence, and the second is to identify any unique or exceptional sites. The third criterion, identifying any sites of International importance, is nearly always covered by the other two.

Designation of geological NHAs will be by the GSI's partners in the Programme, the National Parks and Wildlife Service (NPWS). Once designated, any geological NHAs will be subject to normal statutory process within Meath Council's Planning Departments and other relevant divisions. However, compared to many ecological sites, management issues for geological sites are generally fewer and somewhat different in nature.

From a national perspective, as a result of extensive comparison of similar sites to establish the best among them, there is now a good knowledge of many other sites, which are not the chosen best example, but which may still be of national importance. Others may be of more local importance or of particular value as educational sites or as a public amenity. All these various important sites are proposed for County Geological Site (CGS) listing in the County Development Plan.

Currently, in 2026, a Master List of candidate CGS and NHA sites is being used in GSI, originally compiled with the help of Expert Panels for all the 16 IGH themes, for the majority of counties. For several themes, the entire process has been largely completed and detailed site reports and boundary surveys have been completed along with a Theme Report.

But in 2007, twenty-eight County Geological Sites were formally identified in County Meath. Six, at Barley Hill, Bellewstown, Grangegeeth, Mullaghmore, Murrens and St. Gorman's Spring, are considered to be of national importance, whereby the sites would be put forward as a potential Geological Natural Heritage Areas (NHAs). This follows the comprehensive Irish Geological Heritage Audit of the county (Clarke et al., 2007).

The Trim Esker at Friarspark (1st Division), approximately 1.31 kilometres east-southeast of the proposed LRD Site, has been designated as a County Geological Site as part of this Irish Geological Heritage (IGH) Programme by the GSI. This is the closest County Geological Site to the proposed LRD Site.

Any potential hydrological/hydrogeological effects on the Trim Esker are discussed in the following section 7 following (Hydrology and Hydrogeology).

The NIS accompanying this planning application further assesses potential direct effects on Designated Sites. All geological heritage sites are screened out for further assessment with regard land, soils, geology, hydrology and hydrogeology due to lack of potential direct effects on them. Indirect hydrological and hydrogeological effects are assessed in the following section on Hydrology and Hydrogeology.

6.6.4. Applied Geology - Soil Contamination

There are no known areas of soil contamination on the proposed LRD Site. During the site walkovers or investigations, no areas of contamination concern were identified. This was also confirmed by a visual appraisal of the water quality in the River Boyne flowing west to east along the southern extremity of the site.

According to the EPA online mapping (<http://gis.epa.ie/Envision>), there are no licensed waste facilities or no historic (closed) landfills, or dump sites, on or within the immediate environs of the proposed LRD Site.

There are no historic mines at or in the immediate vicinity of the proposed LRD Site that could potentially have contaminated tailings.

6.6.5. Applied Geology - Economic Geology

The GSI online Aggregate Potential Mapping Database shows that the proposed LRD Site is located within an area mapped as being typically Low to High in terms of crushed rock aggregate potential and with Low potential for granular aggregate potential (i.e. potential for gravel reserves).

6.6.6. Applied Geology - Geohazards

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the proposed LRD Site or in the surrounding lands.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring at a given location. The probability of a landslide occurring at the proposed LRD Site is mapped as being Low.

As the proposed LRD Site is entirely underlain by mineral subsoil, and as there is no peat of any thickness, a site-specific, site scale Peat Stability Risk Assessment was not required on the site.

7.0 HYDROLOGY AND HYDROGEOLOGY

7.1. Water Balance

Long term Average Annual Rainfall (AAR) and evaporation data for the proposed LRD Site environs was sourced from Met Éireann.

The 10-year annual average rainfall (2010 - 2019) recorded at the nearest rainfall station, which is the synoptic¹ station at Dunsany, County Meath, located 12 kilometres east-southeast of the proposed LRD Site, are presented in **Table 7**. This is the closest weather station to the proposed LRD Site and the most appropriate station to use with respect to distance and elevation. The rainfall station at Dunsany has data available since 2006, and the average annual rainfall for the decade from 2010 to 2019 was 888 mm/year.

Station		X - Co-ordinate		Y - Co-ordinate		Elevation (mAOD)		From		To		
Dunsany		688720		752440		83		2006		present		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
72.4	56.68	69.4	51.63	63.78	66.92	85.43	85.86	70.93	83.61	98.24	83.12	888

Table 7 Local Average Long-Term Rainfall Data for Dunsany Weather Station (2010-2019)

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the proposed LRD Project site is 840 mm/year. This rainfall amount from the Met Eireann average annual rainfall grid was considered to be the most accurate estimate of average annual rainfall for the proposed PRD Site from the available sources.

The synoptic station at Dunsany collects potential evapotranspiration (PE) data. Daily rainfall and daily potential evapotranspiration data at the Dunsany synoptic station are available since 2011. The monthly average potential evapotranspiration here varies between less than 10 mm/mo in the winter months to more than 80 mm/mo in the summer months (see **Figure 10**). The long-term average PE for the Dunsany synoptic station is 507 mm/year. This value is used as a best estimate of the proposed LRD Site PE. Actual Evaporation (AE) at the proposed LRD Site is estimated as 481.65 mm/year (which is $0.95 \times PE$).

¹ Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

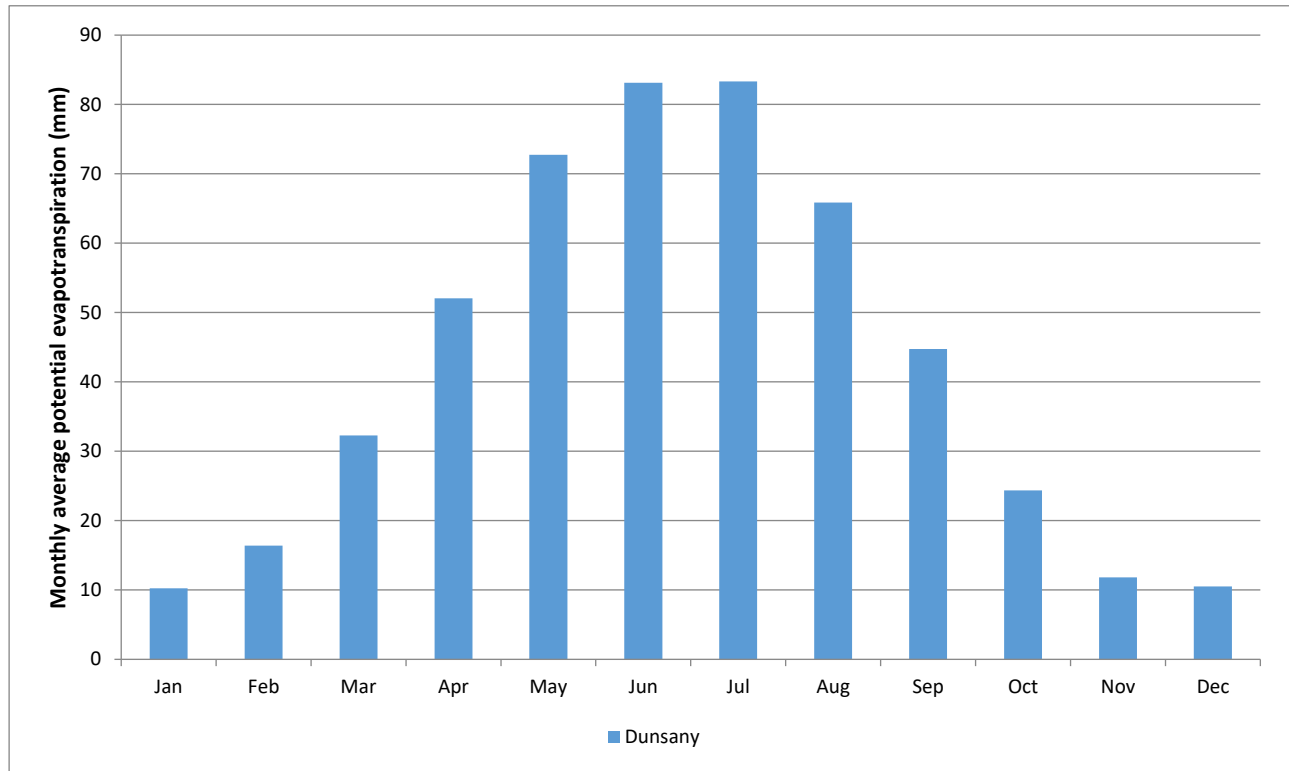


Figure 10: Monthly average potential evapotranspiration from Met Éireann's Dunsany synoptic station

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the proposed LRD Site is calculated as follows:

$$\begin{aligned} \text{Effective rainfall (ER)} &= \text{AAR} - \text{AE} \\ &= 840 \text{ mm/year} - 481.65 \text{ mm/year} \\ \text{ER} &= 358.35 \text{ mm/year} \end{aligned}$$

According to the GSI subsoil permeability mapping, the majority of the proposed LRD Site (74%) is mapped as being underlain by "Moderate" permeability subsoils, while the other 26% (in a central band which is underlain by sands and gravels) is mapped as being underlain by "High" permeability subsoils.

Based on recharge coefficient estimates from the GSI, an estimate of 60% recharge is assigned for a large proportion (74%) of the proposed LRD Site (mapped by GSI as "moderate permeability subsoil overlain by well drained soil"), while areas mapped as "high permeability subsoil" (26% of site area) are assigned a recharge coefficient of 85%.

The weighted average recharge coefficient for the proposed LRD Site is calculated to be 66.5%. The Site hydrology is therefore characterised by naturally (relatively) low surface water runoff rates (33.5%) and much higher groundwater recharge rates. The relatively low drainage density (see next Section) across the site is reflective of the relatively high groundwater recharge rates, and corroborates this.

Therefore, annual recharge and runoff rates for the proposed LRD Site are estimated to be 238.31 mm/year and 120.04 mm/year respectively.

Climate change projections for Ireland are provided by Regional Climate Models (RCM's) downscaled from larger Global Climate Models (GCM's). Projections for the period 2041-2060 (mid-century) are available from Met Éireann. The data indicates a projected decrease in summer rainfall from 0 to 13% under the medium-low emission range scenario and an increase in the frequency of heavy precipitation events of ~20%. In total the projected annual reduction in rainfall near the proposed LRD Project site is -10% under the medium-low emission scenario and -8% under the high emissions scenario.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. **Table 8** below presents return period rainfall depths for the area of the proposed LRD Site. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (1-year, 10-year, 30-year and 100-year). The 10-year rainfall depths are the basis of the proposed LRD Project drainage hydraulic design as described further below.

Storm Duration	Return Period (years)			
	1	10	30	100
5 minutes	3.5	7.0	9.5	13.0
15 minutes	5.7	11.5	15.5	21.3
30 minutes	7.5	14.4	19.1	25.6
1 hour	9.8	18.1	23.5	30.9
6 hours	19.6	32.3	40.0	50.0
12 hours	25.6	40.4	49.1	60.3
24 hours	33.5	50.6	60.4	72.7
2 days	39.8	58.8	69.4	82.6

Table 8 Return Period Rainfall Depths (mm) for the proposed LRD Project Site

7.2 Regional Hydrology

The Site is located in the regional River Boyne Catchment within Hydrometric Area 07 of the Eastern River Basin District (ERBD). A regional hydrology map is shown as **Figure 11**.

On a more local scale the proposed LRD Site is located in the majority in the Boyne_SC_070 surface water subcatchment, with the portion of the site crossing the river to host the proposed new foul sewer protruding in to the Boyne_SC_060 surface water subcatchment.

The proposed LRD Site in it's entirety drains to the River Boyne which flows through the site.

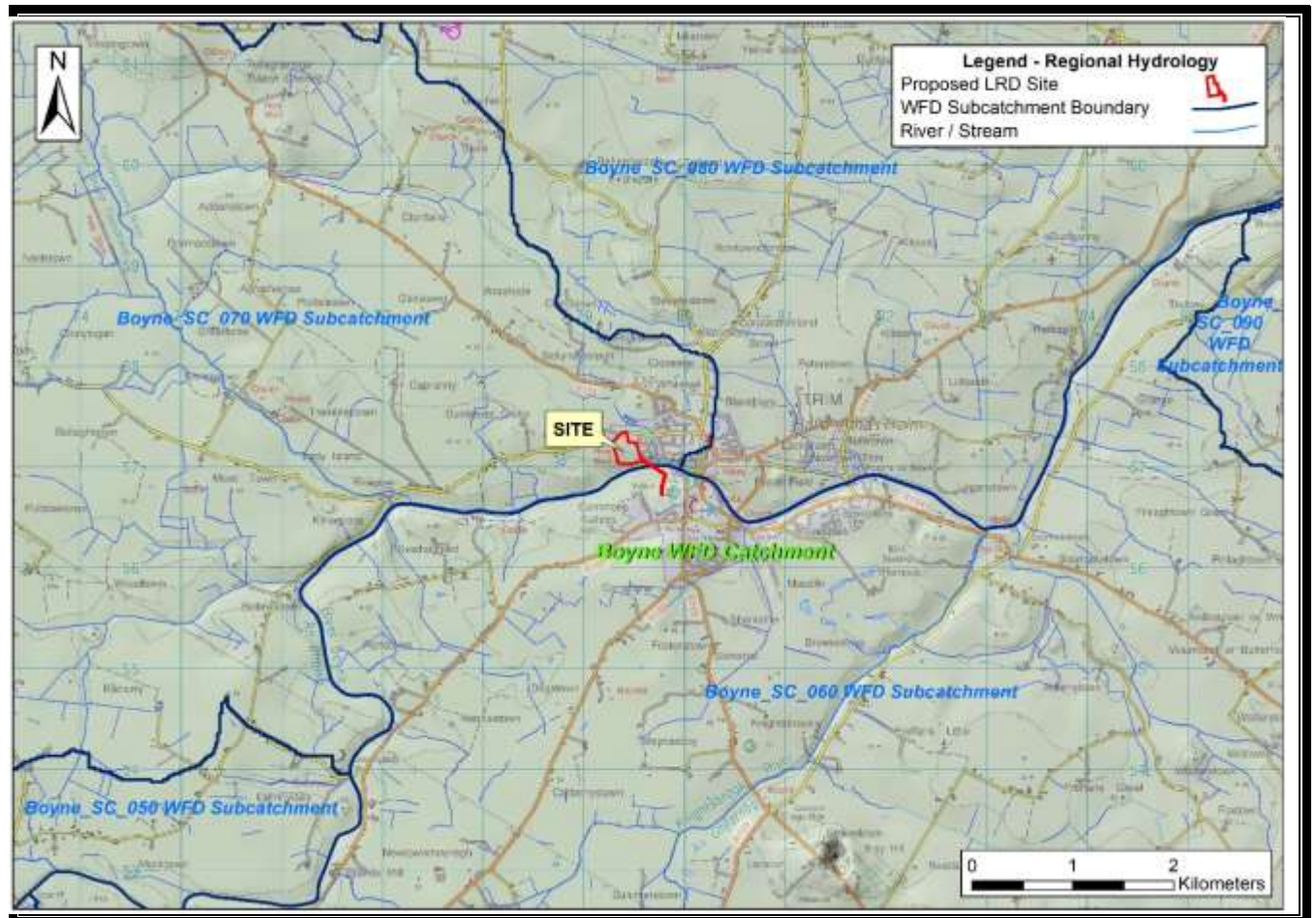


Figure 11: Regional Hydrology Map around the proposed LRD Site. Grid squares = 1 km distance (O.S. Licence EN 057926).

7.3 Project Site Existing Drainage

7.3.1 Drainage Regime

The proposed LRD Site is drained directly by the River Boyne which flows along the main portion of the site's southern boundary, and will also flow across the proposed rising main pipeline.

There is only 1 no. tributary stream within 500 m of the site (**Figure 12**). This first order stream ('Butterstream', EPA Code IE_EA_07B041200) flows southwards into the River Boyne approximately 125 m east of the southeastern corner of the proposed LRD Site. This stream rises in Corporationland (3rd Division) Townland as two discrete springs approximately 500 m northwest of the proposed LRD Site. The stream is culverted in the dip in the ground between Elder Grove and Cedar Grove Housing Estates before emerging at surface approximately 65 m north of the Boyne itself. This stream flows through a channel incised into glacial till subsoil.

Ponds are present in marked kettle hole hollows in the Boyne glaciofluvial sands and gravels terrace between 425 m and 525 m west of the proposed LRD Site boundary (**Figure 12**). These ponds have no inflow or outflow streams or streamlets. Some linear, non-natural ponds are also present to the north of the site, adjacent to the Butterstream watercourse.

A local hydrology / Site Drainage map illustrating all hydrological features in the vicinity of the site follows as **Figure 12**.



Figure 12: Local Hydrology Map around the proposed LRD Site, showing springs 1 - 6 where water flow monitoring took place (O.S. Licence EN 057926).

As can be seen on **Figure 12**, field mapping as part of the site investigation for this proposed LRD Project has led to the discovery of six previously undocumented springs just outside the southern boundary of the site, all within the area designated as SAC. These springs will be outside the area of all proposed works on the site, but require consideration nonetheless as they feed directly into the protected River Boyne. These springs are ephemeral, as detected during the occasional flow monitoring conducted at their outlets in the months leading up to the submission of this Planning Application. The details of each of the springs in terms of their exact location, elevation of outflows, and length of streamlet outflows into the River Boyne are shown following in **Table 9**.

Spring No.	Easting (ITM)	Northing (ITM)	Elevation (m AOD)	Length of streamlet into River Boyne
1(Holy Well)	679278	757056	54.876	93 m
2	679307	757014	53.827	53 m
3	679324	757049	54.193	34 m (joins with Spring 2) then 30 m
4	679433	757054	54.093	41 m
5	679469	757063	54.249	38 m
6	679527	757066	53.830	26 m

Table 9 Spring locations and elevations at the southern end of the proposed LRD Project Site

7.3.2 Surface Water Flow Measurements

In terms of hydrometric data for the site and its environs, the OPW, EPA and Local Authorities currently monitor the flow of the Boyne surface water network at 30 sites within the River Boyne Catchment. The closest of these 30 hydrometric stations is along the River Boyne itself approximately 275 m east-southeast of the site, between Watergate Bridge and Bridge Street in Trim itself (OPW Hydrometric Station 07005). This hydrometric station has been continually monitoring river flow data since August 1975, and has some historical records from before that date also.

Water level, flow and water temperature are recorded by the OPW at Trim Gauging Station, 275 m east-southeast of the proposed LRD Site and immediately downstream. Flows recorded by the OPW at Trim Weir between 20th November 2005 and 20th November 2025 are shown on **Figure 13** following.

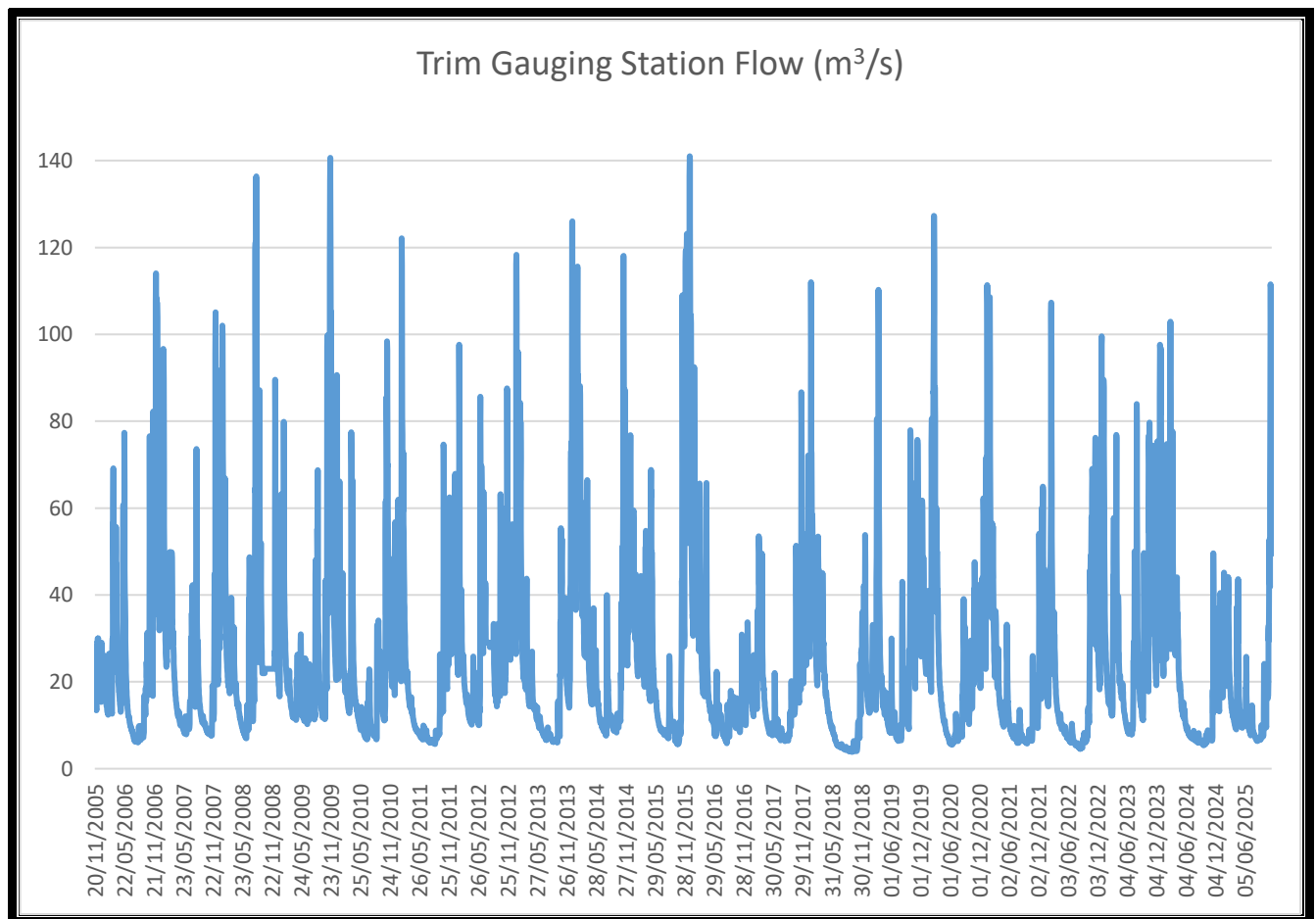


Figure 13: Flows at Trim Gauging Station on the River Boyne 275 m down-stream of the proposed LRD Site, November 2005 to November 2025 (Source: OPW).

At Trim, in that time over the last fifty years, the River Boyne's median flow (the daily mean flow which is equalled or exceeded 50% of the time) is 14.7 m³/s. The River Boyne's 95th percentile flow (the daily mean flow which is equalled or exceeded 95% of the time) is 3.69 m³/s at the same station.

The maximum, highest flow volume ever recorded in the River Boyne at Trim was 141.024 m³/s, on 31st December 2015, following three named storms within a week. The minimum, lowest flow volume was 1.818 m³/s, on 31st August 1995, at the end of an intense eight week drought period.

As the Butterstream stream (Stream 'A' on **Figure 12**) is outside the proposed LRD site confines, no monitoring of flows on this watercourse were conducted as part of this study.

Given that the site is underlain by relatively impure limestone bedrock of the Lucan Formation ('Calp' limestone, see Section 6.4 above), there is a low possibility of losing streams or reaches along the surface water courses in the locality.

Flow Monitoring measurement details of volumetric flow variations for the six streamlets emerging at the springs in the southern end of the site, and flowing in to the River Boyne, are shown following in **Table 10**.

Spring No.	Easting (ITM)	Northing (ITM)	Elevation (m AOD)	Flow (l/s) 28/01/2025	Flow (l/s) 02/04/2025	Flow (l/s) 07/07/2025	Flow (l/s) 02/09/2025	Flow (l/s) 13/10/2025
1(Holy Well)	679278	757056	54.876	6	2	Dry	Dry	0.5
2	679307	757014	53.827	0.7	0.3	0.2	Dry	0.2
3	679324	757049	54.193	0.5	Dry	Dry	Dry	Dry
4	679433	757054	54.093	2	0.8	0.2	Dry	0.1
5	679469	757063	54.249	1	0.5	Dry	Dry	Dry
6	679527	757066	53.830	2	1	Dry	Dry	0.2

Table 10 Spring water flow monitoring data at the southern end of the proposed LRD Project Site

Flows were measured on 5 no. occasions (dates and flows shown in **Table 10** above) and, as would be expected, the maximum flows were recorded in the winter month of January 2025. Flows at all spring outlets reduced markedly in April (one, Spring 3, was actually not flowing) and by July there was flow out of only two of the six springs (Springs 2 and 4). All were dry at start September, but flow had resumed at Springs 1, 2, 4 and 6 by October.

All of the springs flow across alluvial deposits resting on glacial till subsoil, with Spring 2 emerging through a locality with pockets of tufa deposits at surface also.



Plate 8 Tufa (cream material) exposed in the base of the outflow locality of Spring 2, January 2025. See also the organic, humus-rich material around the spring, as observed in trial pit 4 (Plate 6).

7.4 Spring volumetric flows, Boyne volumetric flows and dilution

The combined volumetric flows of the springs on each of the dates they were monitored is shown following in **Table 11**. The flow rate in the River Boyne at Trim Gauging Station, 275 m east-southeast of the spring streamlet inputs, shown on each day is the minimum flow rate recorded / measured on each of the respective days.

Spring No.	Flow (l/s) 28/01/2025	Flow (l/s) 02/04/2025	Flow (l/s) 07/07/2025	Flow (l/s) 02/09/2025	Flow (l/s) 13/10/2025
1(Holy Well)	6	2	Dry	Dry	0.5
2	0.7	0.3	0.2	Dry	0.2
3	0.5	Dry	Dry	Dry	Dry
4	2	0.8	0.2	Dry	0.1
5	1	0.5	Dry	Dry	Dry
6	2	1	Dry	Dry	0.2
Combined spring flows	12.2	4.6	0.4	No flow	1.2
Flow rate of River Boyne (Sourced from OPW)	34,642	10,583	8,197	6,642	10,412
Dilution factor	2,839	2,301	20,492	n/a	8,767

Table 11 Combined spring water flows and flow volumes in the River Boyne on dates of monitoring at the proposed LRD Project Site

This means that when the springs at the southern end of the site are flowing, there is an approximate minimum dilution factor of between 2,301 and 20,492 on the spring flows once they meet the River Boyne, depending on the time of year and the antecedent weather conditions.

7.5 Flood Risk Assessment

This section is a summary of a site-specific flood risk assessment (FRA) undertaken for the Site. The full FRA report, completed by JBA Consulting, is enclosed with this application, and only a summary is included here.

The FRA was carried out at the early design stage of the proposed LRD Project design in order to ensure as much of the proposed infrastructure was placed outside of any potential mapped flood zones.

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (<https://www.floodinfo.ie/map/floodmaps/>), historical mapping (i.e. 6" and 25" base maps) and GSI Groundwater/Surface Water Flood Maps were consulted to identify those areas of the Site as being potentially at risk of fluvial, pluvial and surface water flooding. A number of walkover surveys were also conducted as part of the site-specific FRA.

No recurring flood incidents within the Site boundary were identified from OPW's Past Flood Event Mapping (see **Figure 14**), though some are recorded as occurring historically on the Kildalkey Road just northeast of the proposed LRD Site boundary, as well as on the River Boyne floodplain beneath which the proposed foul sewer pipeline is proposed to run.

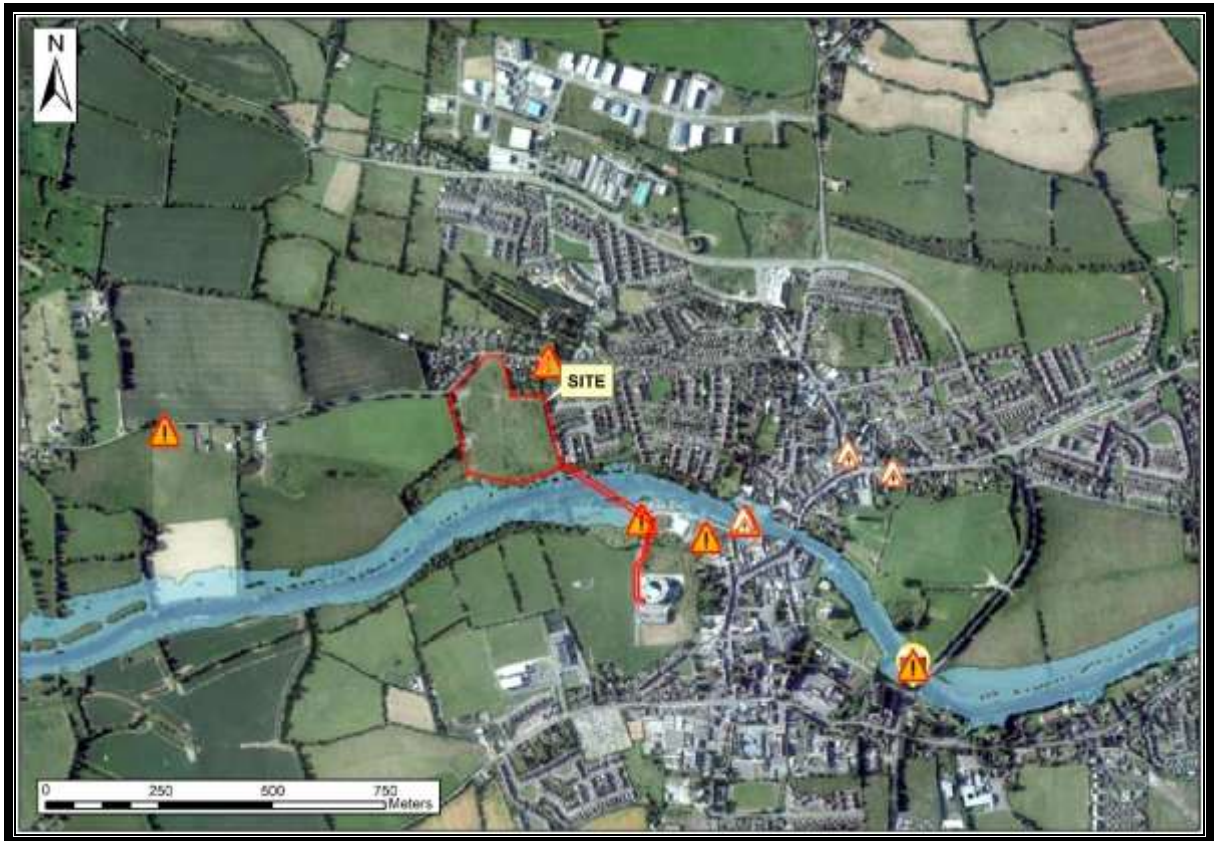


Figure 14: OPW Past Flood Event Mapping around the proposed LRD Site (O.S. Licence EN 057926).

This is as would be expected, given that the southern portion of the site lies on a river floodplain, and that closest mapped flood event is a Single Flood Event, along the River Boyne at Trim Pitch and Putt Course, from 16th August 2008. This is adjacent to where the foul sewer pipeline is proposed to run (Figure 14).



Figure 15: OPW National Indicative Flood Mapping for the region around the proposed LRD Site (O.S. Licence EN 057926).

Identifiable map text on local available historical 6" or 25" mapping for the proposed LRD Site area do not identify any lands that are "Liable to Floods", though the stippled symbol on the Ordnance Survey Cassini' six inch to one mile sheet (1882 - 1884) suggests marshy ground adjacent to the river (see also **Figure 3** previously).

There is no OPW River Flood Extents Mapping available for the area of the Site and therefore the National Indicative Fluvial Mapping (NIFM) was consulted which has estimated current and future scenario 100-year and 1000-year fluvial flood zones for the streams adjacent to the proposed LRD Site. Based on this National Indicative Fluvial Mapping (NIFM) as shown in **Figure 15** above, there are 100-year or 1000-year flood zones associated with the environs of the site. The nearest most extensive mapped fluvial flooding zone runs through the southern portion of the site, again expected given that this is known as part of the River Boyne floodplain.

The design of the proposed development has ensured that none of the proposed building structures to be constructed on the site will be located inside an NIFM flood zone. The only work that will traverse the NIFM flood zone is the horizontal directional drilling beneath the River Boyne associated with the installation of the 125 mm rising main beneath the river. The Method Statement for this directional drilling has been completed by Dunnes Drilling Limited of Clonmore, Togher, County Louth, and has been included with this application (Dunnes, 2025). Further reference to this report is included following in Section 9 of this report "Likely and Significant Impacts".

The GSI Groundwater Flood Maps and Winter 2015/2016 Surface Water Flooding Maps have no groundwater flood zones mapped within the confines of or adjacent to the proposed LRD Site either.

All potential vulnerable LRD infrastructure, including all dwelling houses and apartments, all roadways, and all ancillary site works are located above the mapped 1000-year flood level and therefore all this infrastructure is located outside any potential flood zones. This is also expected given the site elevation and topography, and again recognition of this aspect has been considered and inherent in the design of the proposed LRD Project.

7.6 Surface Water Quality

In the presence of pollution, characteristic and well-documented changes are induced in the flora and fauna of surface waters. Particularly well documented are the changes brought about by organic pollution in the macroinvertebrate community i.e., the immature aquatic stages of aerial insects (mayflies, stoneflies, etc.) together with *Crustacea* (e.g., shrimps), *Mollusca* (e.g. snails and bivalves), *Oligochaeta* (worms) and *Hirudinea* (leeches) (EPA, 2005). The changes are due to the varying sensitivities of the different components of the community to the stresses caused by pollution. The EPA scheme of Biotic Indices or Quality (Q) Values uses the macroinvertebrate community structure to rank water quality. The relationship between the Q value, water quality and WFD Status is outlined in **Table 12** following.

The EPA monitors Q values within the Boyne Catchment at 104 surface water monitoring stations. The River Boyne itself has 27 surface water monitoring stations along its course, from its rising at Trinity Well near Carbury in County Kildare, until it meets the sea at Drogheda. Of these monitoring stations,

13 are upstream of the proposed LRD Site, and 14 are downstream, with the closest downstream monitoring station just west of Watergate Bridge in Trim, approximately 350 m downstream of the proposed LRD Site. This point was last monitored in 2024, when it had a ‘Moderate’ status (*i.e.* Q3-4, slightly polluted).

Biotic index	Water quality	WFD status
Q2, Q1-2, Q1	Seriously Polluted	Bad status
Q3, Q2-3	Moderately Polluted	Poor status
Q3-4	Slightly Polluted	Moderate status
Q4	Unpolluted	Good status
Q5, Q4-5	Unpolluted	High status

Table 12 Relationship between the Q value, water quality and WFD Status (after EPA, 2005, 2011)

Along the River Boyne each side of the site, EPA Q-rating data (<https://www.catchments.ie/data>) shows that the river consistently has ‘Moderate’ status river waters either side of Trim (see **Figure 16**). River water of ‘Moderate’ status generally flows into the river as well, *via* its tributaries, but ‘Poor’ status waters do flow in to The Boyne at Scurlockstown, downstream of Trim, *via* both the Knightsbrook and Boycetown Rivers (**Figure 16**). This ‘Poor’ status water is quickly diluted by the ‘Moderate’ status water to read ‘Moderate’ at the next downstream sampling point, at Bective Bridge. The ‘Moderate’ quality waters then become of ‘Good’ Status downstream of Navan, at both Stackallen and Slane.

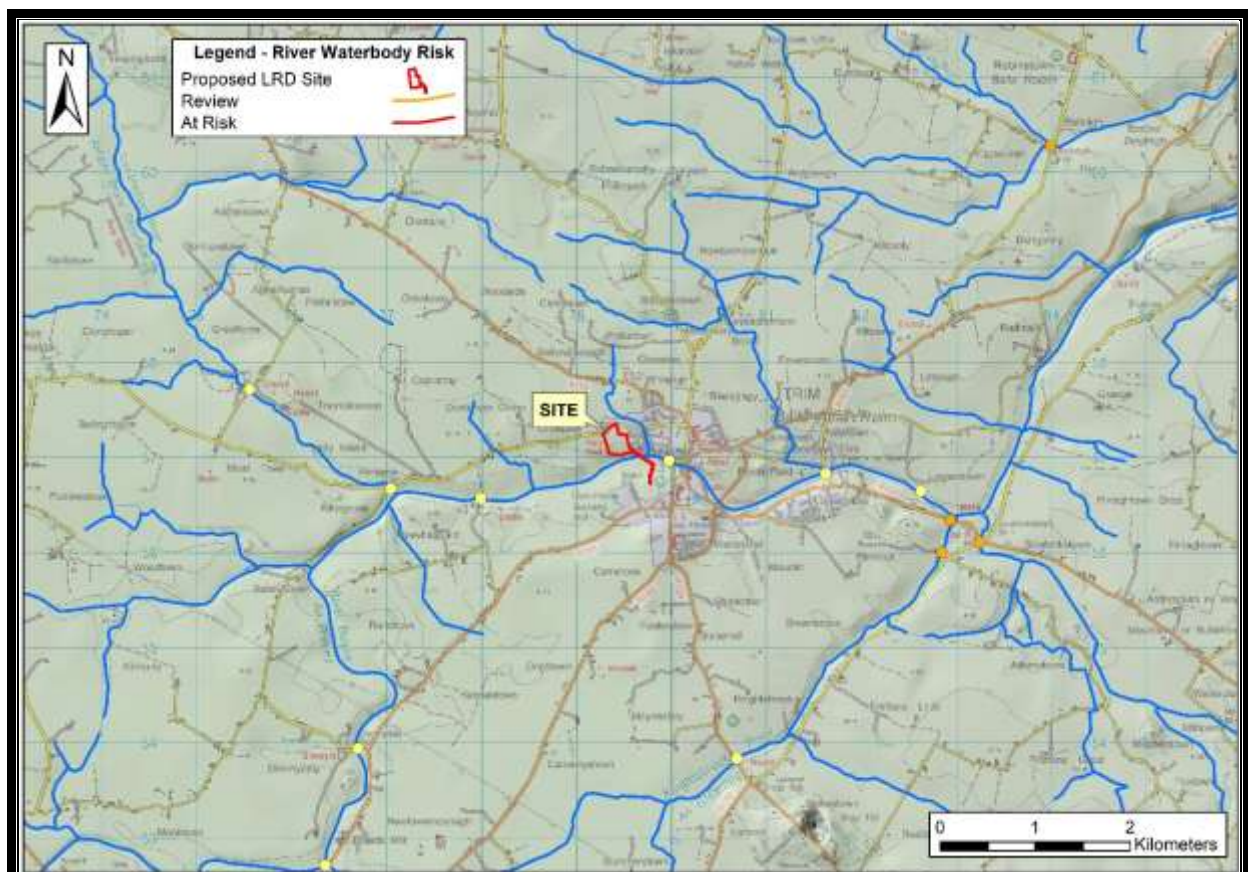


Figure 16: Surface water monitoring stations and Q values last recorded (1991 to 2024, depending on station; 2024 for ‘Moderate’ status site just downstream of the site) in the vicinity of the proposed LRD Site (O.S. Licence EN 057926).

7.7 Regional Hydrogeology

Groundwater is defined as water that moves through and is stored within sub-terrain geological strata. The aquifer potential of a bedrock unit is determined by the groundwater productivity, and the productivity is determined based on hydraulic characteristics compiled from borehole data throughout the country. These impure slate rocks are generally devoid of intergranular permeability. Groundwater in Ireland does not flow intergranularly within the rock particles themselves, but has secondary porosity only and flows through fissures, faults, joints and bedding planes.

An aquifer map was published by the GSI as part of the characterisation of the Eastern River Basin District for the EU Water Framework Directive. The dark limestones and shales of the Lucan Formation bedrock are poorly permeable and relatively unproductive. The aquifer map therefore indicates that the Lucan Formation is classified as a Locally Important Bedrock Aquifer - Bedrock that is Moderately Productive, which is generally moderately productive (Lm, see **Figure 17**), where the network of fractures, fissures and joints, through which groundwater flows, is reasonably well connected and dispersed throughout the bedrock, giving a *moderate* permeability and groundwater throughput. Aquifer storage is moderate and groundwater flow paths can be up to several kilometres in length. There is likely to be a substantial groundwater contribution to surface waters ('baseflow') and large (>2,000 m³/d), dependable springs may be associated with these aquifers. Although the aquifer may supply '*excellent*' yields, the small size often limits the amount of recharge available to meet abstractions.

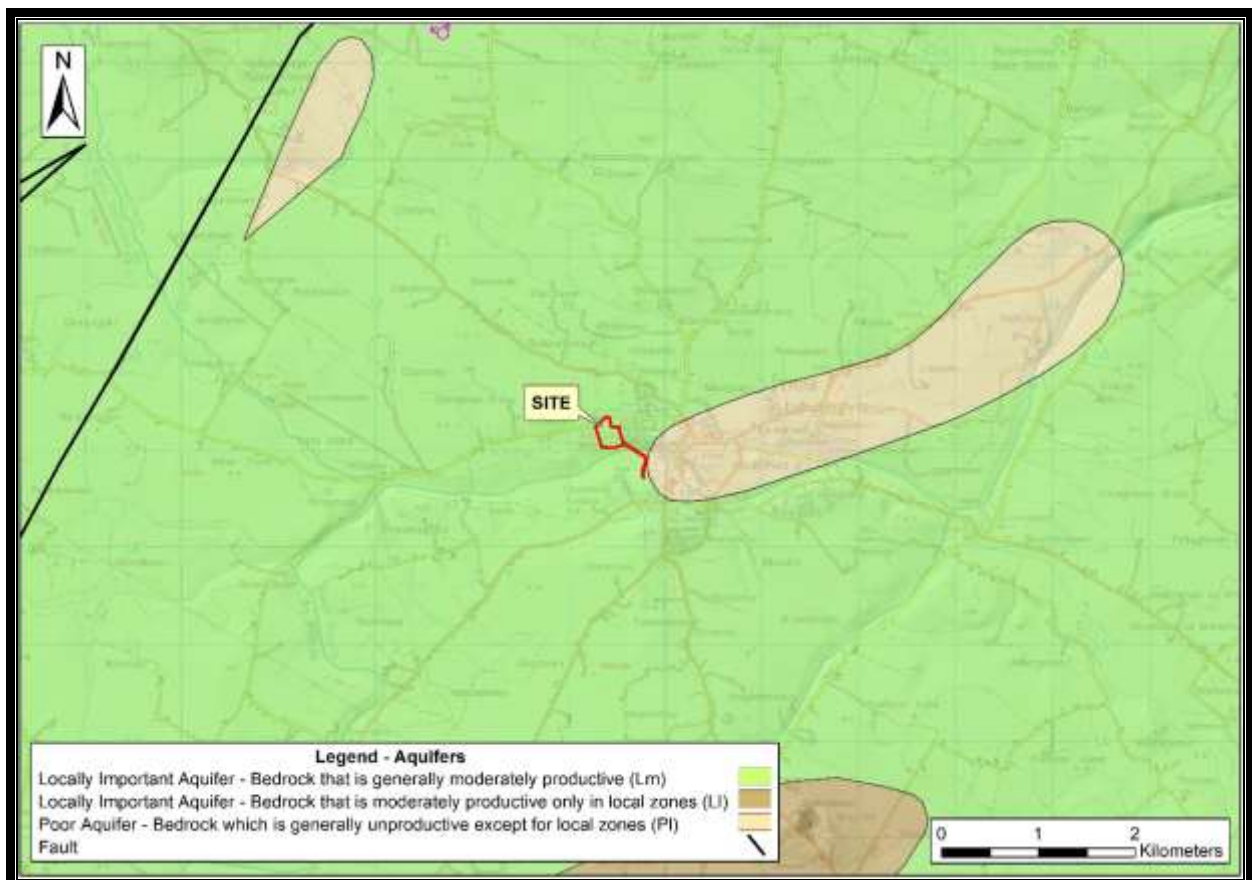


Figure 17: Aquifer map of the proposed LRD Site and its environs (O.S. Licence EN 057926).

The proposed LRD Site is also located in the Trim Groundwater Body (IE_EA_G_002) which has a mapped surface area of 703.77 km² (see **Figure 18** following).

The bedrock type of the Trim GWB is predominantly (over 90% of it's area) Dinantian Upper Impure Limestones ('Calp' limestone of the Lucan Formation), as exists beneath the proposed LRD Site. Smaller pockets of purer limestone or shale also exist.

Diffuse recharge occurs over the GWB via rainfall percolating through the permeable subsoil, and this type of recharge is dominant in this GWB.

The Groundwater body summary sheet, produced by the GSI for the Trim Groundwater Body, of which the Kildalkey Road proposed LRD Site forms part, states that numerous large scale borehole water supply abstractions occur in the area around the site. The most important of these are at

- Trim itself (375 m³/d, with a separate water source being the water abstracted from the River Boyne there),
- Dunshaughlin (7 no. individual boreholes, providing up to 3,000 m³/d),
- Kilmessan (500 m³/d), and
- Trim Golf Club (50 m³/d).

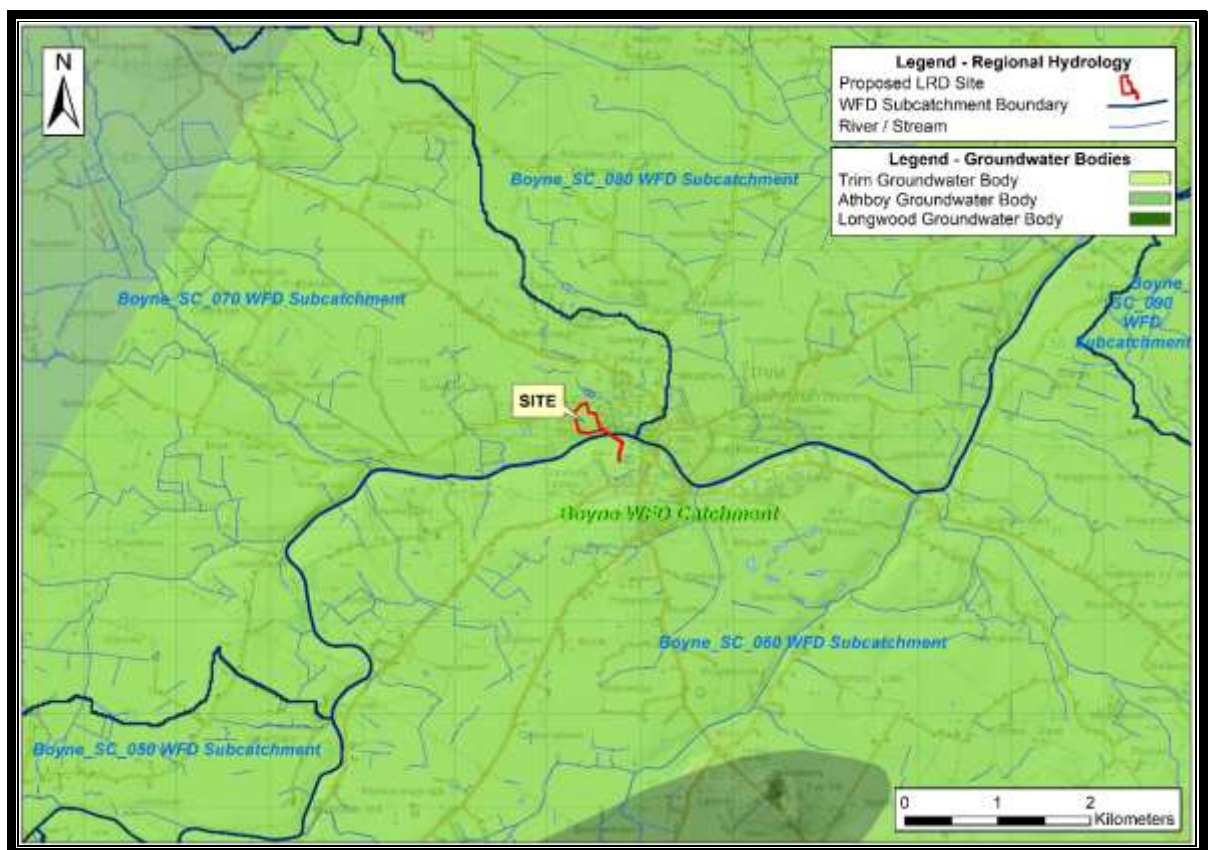


Figure 18: Groundwater Bodies (GWBs) around the proposed LRD Site, with surface water catchments and subcatchments also shown (O.S. Licence EN 057926).

It should be noted that none of the Zone of Contribution areas to any of these groundwater borehole supplies are within 3 kilometres of the proposed LRD Site (see **Figure 23** following), and there are no

GSI mapped groundwater Source Protection Areas (SPAs) within 3 kilometres of the Site relating to either Group Water Scheme (GWS) or Public Water Supply (PWS) sources.

The majority of groundwater flow in this aquifer will thus take place in the upper 3 m of the bedrock. This will be lateral flow towards discharge point such rivers and streams. Deeper groundwater flow is possible and deep-water strikes are often encountered (between 10 and 40 m bgl) but they are more isolated features located along open fractures, which allow groundwater flow. Regional groundwater flow paths are not considered to develop, as the rocks do not have sufficient transmissivity to transport water over long distances. Typical groundwater flow paths will be in the order of a couple of hundred metres, with discharge occurring to the closest surface water feature.

In areas underlain by 'Locally Important' aquifers, groundwater flow directions broadly follow topography. Thus, in the area of the proposed LRD Site, groundwater would be expected to flow generally southwards, discharging to the River Boyne along the site's southern boundary.

7.7.1 Potential for karstification in Lucan Formation bedrock

'Karstification' is the process whereby limestone is slowly dissolved away by percolating waters. It most often occurs in the upper bedrock layers and along certain fractures, fissures and joints, at the expense of others. Karstification frequently results in the uneven distribution of permeability through the rock, and the development of distinctive karst landforms at the surface (*e.g.* swallow holes, caves, dry valleys), some of which provide direct access for recharge/surface water to enter the aquifer. The landscape is characterised by largely underground drainage, with most flow occurring through the more permeable, solutionally-enlarged, interconnected fissure/conduit zones, which may be several kilometres long. Groundwater velocities through fissures/conduits may be high and aquifer storage is frequently low. Groundwater often discharges as large springs (>2,000 m³/d), which range from regular and dependable to highly variable ('flashy'). There is strong interconnection between surface water and groundwater. The degree of karstification ranges from slight to intense. GSI recognises two types of karst aquifer: those dominated by diffuse flow (Rkd) and those dominated by conduit flow (Rkc). As above, the bedrock aquifer beneath the proposed LRD Site locality is dominated by a poorly developed fracture flow system, and as the Lucan Formation bedrock is poorly calcareous, there are no karst features mapped by GSI anywhere within several kilometres of the site.

According to the GSI Groundwater Body Characterisation Report for the Trim GWB, evidence suggests that the degree of karstification throughout the area underlain by Lucan Formation bedrock is highly variable, as is the degree of structural deformation, the occurrence of open fractures in a connected network which will allow groundwater flow, the degree of confinement by impermeable tills, and the additional storage provided by the many gravel deposits overlying the aquifer. All these factors have the potential to alter the nature of groundwater flow within the aquifer.

On the 20 November 2021, a return air raise vent (RAR) pilot hole at Boliden Tara Mines in Navan, drilling through the Lucan Formation, broke through as planned into the Tara Deep Exploration Drive (TRDEX), an exploration tunnel driven from the South West Extension (SWEX) area of Tara Boliden's Navan mine which connects to the Tara Deep exploration area. The pilot hole immediately began discharging water which over the course of the next few days dramatically increased in flow rate and

began flooding the tunnel and underground workings. The hole was eventually plugged on 2nd December 2021 by which time an estimated 412,000 m³ of groundwater had accumulated in underground relief storage ponds in the Navan mine and had inundated a number of pumps and working areas. The ‘Inrush event’ was unexpected and caused a shut-down of operations and initiated an incident inquiry.

Therefore though not widespread at a regional scale, there is thus the potential for significant karstification locally within the Lucan Formation bedrock.

7.8 Site Hydrogeology

7.8.1. Introduction

Refer to Existing Environment (Section 6, specifically Section 6.3.1 “Site Investigations: Drilling and Trial Pitting”) for more comprehensive information relating to the intrusive site investigations conducted at the Site.

In order to determine the full geological profile (soil, subsoil and bedrock) at the proposed LRD Site, extensive ground investigations were carried out in February, April and September 2025 to determine the geological and hydrogeological setting of the proposed LRD Site.

A total of 12 no. deep trial pits were excavated inside the proposed LRD Site boundary, 20 dynamic probe tests were completed, and 2 no. boreholes were drilled inside the proposed LRD Site boundary. As well as this, 14 no. shallow archaeological trenches were opened, 7 no. in December 2016 and 7 no. in September 2025. The locations of these investigation point localities are shown previously on **Figure 5**, which also shows the GSI mapped subsoils as a backdrop (see Section 6.3 above).

Trial pit logs are included as a separate report with this application “Ground Investigations Ireland: Kildalkey Road, Trim, Ground Investigation Trial Pitting Report” from February 2025, and borehole logs are included as a second separate report “Ground Investigations Ireland: Kildalkey Road, Trim, Ground Investigation Borehole Report” from May 2025. Refer also to **Tables 6** and **7** following for a summary of the ground investigation deep trial pitting and drilling. The archaeological investigations are summarised as another separate report “Kildalkey Road, Trim, County Meath: Archaeological Impact Assessment” by Archer Heritage Planning, from September 2025.

7.8.2. Hydrogeological Aspects of Site Investigation - Summary

Bedrock was confirmed in both deep boreholes (BH01 and BH02) drilled on the site (**Figure 6** previously); at 2.2m below ground level in BH01 and 4.5 m below ground level in BH02.

Bedrock was not met in any of the Ground Investigation trial pits excavated on the site, nor in any of the archaeological trenches, nor at the localities of any of the dynamic probes.

The water table was not met during drilling in either borehole on the site (Ground Investigations Ireland, 2025b), but was recorded at 2.54 m below ground level in BH01 on 13th October 2025.

The water table was met in only one of the Ground Investigation trial pits excavated on the site; at 2.01 m below ground level in TP4. As this locality is relatively low-lying (see **Figures 5** and **6**) and close to

the expected discharge zone near the River Boyne, this is expected. The water table was not met in any of the archaeological trenches, nor at the localities of any of the dynamic probes.

Given that all trial pits on the site were backfilled following excavation for Ground Investigation in February 2025 and Archaeological Investigation in September 2025, the only medium or long-term groundwater level monitoring that can be carried out on-site is at BH01.

7.8.3 Groundwater Levels and Flows

Given that the depths to groundwater table across the site are all well below the level of foundations / cuttings / incisions in to the subsurface on the site, and as the potential impacts of the proposed LRD development on the groundwater in the locality will be low as no works will take place in the vicinity of the spring emergences, no groundwater level monitoring network is required at the site. BH01 will however be kept *in situ* should any monitoring be needed as part of academic studies of the springs hydrology and / or hydrogeology in the future.

The exact groundwater flow direction on the site can be determined by triangulation of groundwater and surface water levels, where known, across the site (see **Figure 19** following).



Figure 19: Water levels at springs, in the River Boyne and in BH01 and Trial Pit 04 on the proposed LRD Site, as well as interpolated groundwater contours from this, and groundwater flow directions. (O.S. Licence EN 057926).

As would be expected with a locally important bedrock aquifer beneath the site, the River Boyne forms the hydrological base level, with the water table present beneath the site in the subsoils (and by extension the bedrock in the southeastern corner) and groundwater emerging at the springs and flowing off via the streamlets into the hydrological base nadir.

As well as this, information determined by the intrusive investigations on groundwater levels and flows across the site, and from known water emergence elevations at the springs and in the River Boyne following the detailed site survey of the site, can be summarised as follows:

- No perched water levels were encountered within the till or sand and gravel subsoils encountered in any of the trial pits or trenches;
- Notwithstanding the presence of the River Boyne at the southern end of the site, and the spring localities and short streamlets flowing in to this, there is a low density of natural watercourses and manmade drains draining the ground surface of the proposed LRD Site (see also **Figure 11** previously);
- There are significant depths of overburden (glacial tills) recorded above the bedrock across the vast majority of the proposed LRD site;
- The groundwater table is largely hosted within these subsoils, and the springs seem to emerge where preferential flowpaths exist in these (i.e. beds of GRAVEL);
- These GRAVELS are in no way connected to the GRAVEL associated with the Trim Esker Geological Heritage Site, which is 1.31 km to the southeast, and across the hydrological divide of the River Boyne;
- Groundwater levels below the subsoils in the area on-site to be developed remain at depth throughout the year; and,
- There is no significant deep underground drainage occurring because of the likely absence of karstified bedrock, and the water table and River Boyne form the hydrological base level.

In addition, this indicates that there is substantive recharge/vertical groundwater flow from the glacial deposits down into the underlying bedrock aquifer at the proposed LRD site. This is also confirmed by the low stream density and man-made drainage density at the Site. The general absence of these implies there is no need to drain surface water, as it can recharge/drain readily to the underlying locally important groundwater system, and more importantly can continue to feed groundwater in a diffuse manner to the springs.

Therefore, the majority (66.5% based on the site locality water balance, see Section 7.1) of the rainfall that infiltrates into the glacial tills and glaciofluvial sands and gravels at the site is more likely to move laterally at depth and discharge at the springs than emerge in the upper or central portions of the site, having recharged vertically into the deep, permeable subsoils and / or underlying bedrock aquifer.

7.8.4. Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The vulnerability category is based on the relative ease with which infiltrating water and potential contaminants may reach groundwater in a vertical or sub-vertical direction. The permeability

and thickness of the subsoil, which influence the attenuation capacity of subsoil, are important aspects in determining the vulnerability of groundwater.

A groundwater protection scheme has been completed at a scale of 1:40,000 for County Meath by GSI, and the groundwater vulnerability of the area around the proposed LRD Site has been determined on a precise empirical basis (**Figure 20**).

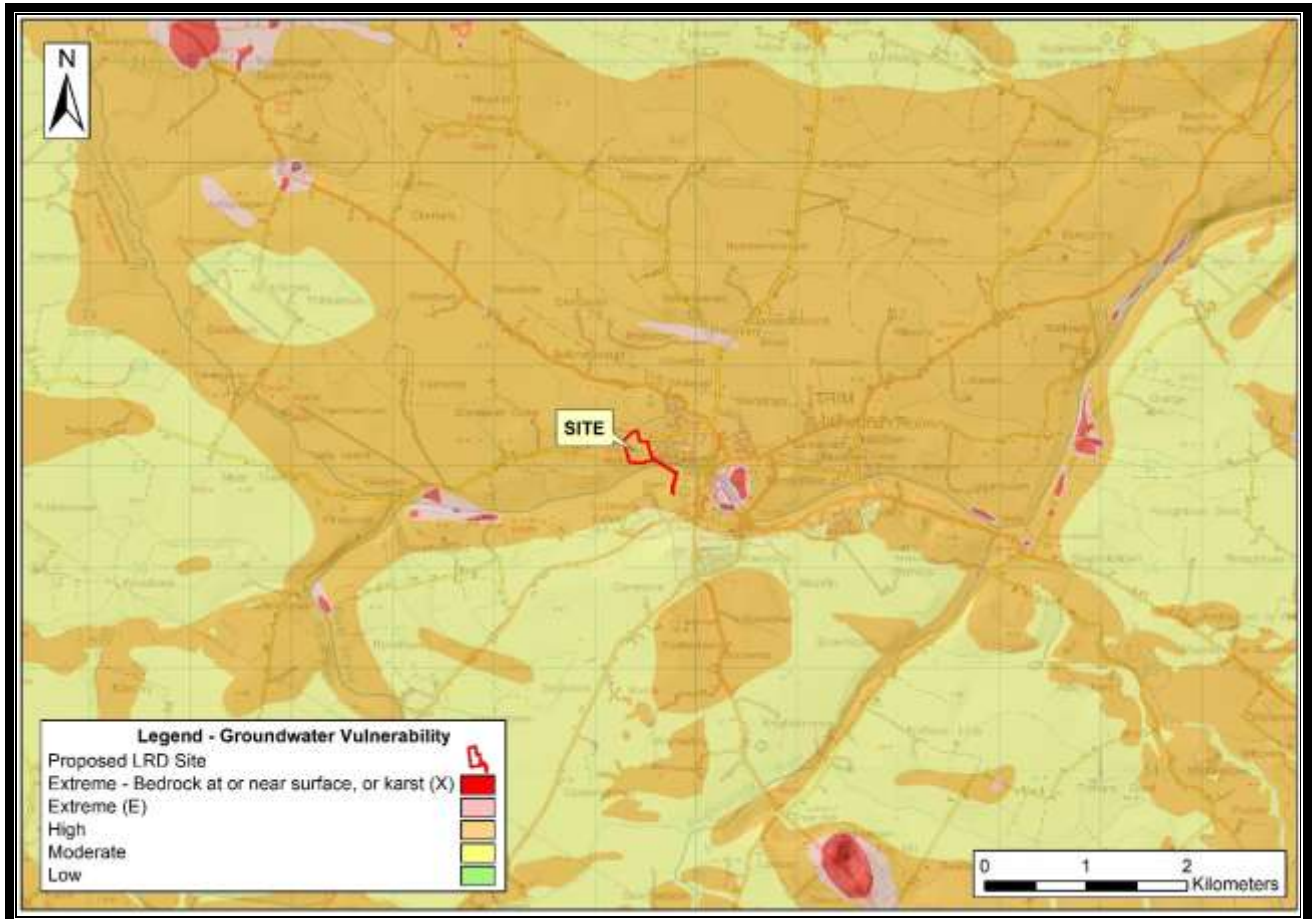


Figure 20: Groundwater Vulnerability map of the site and its environs (after www.gsi.ie, O.S. Licence EN 057926).

With respect to depth-to-bedrock, the proposed LRD Site is situated in an area where bedrock is mapped as being greater than 3 m and less than 5 m from the land surface, while the depth to bedrock is interpreted to increase towards the north into mid-Meath. Thus, the depth-to-bedrock at the proposed LRD Site is interpreted to be at least 3 m thick by the GSI, increasing to 5 m and eventually to 10 m at the northern extremity of the site. With such a depth-to-bedrock, the groundwater vulnerability is interpreted as consistently 'High' (see **Figure 20**), owing to the high to moderate permeability of the subsoil materials. Given the depths to bedrock encountered across the site during the Site Investigations (Ground Investigations Ireland, 2025a, b), this vulnerability rises to 'Extreme' at a site-specific scale in the southeastern corner of the site only, where bedrock was encountered in a borehole at 2.2 m bgl. Hence the design of the proposed LRD ensures no deep excavations into the bedrock across the site where any structures are being constructed, and the only element of the scheme that

will encounter bedrock is the boring of the rising main beneath the River Boyne, where boring through bedrock is crucial in the integrity of same in any case.

7.8.5. *Groundwater Quality Hydrochemistry*

Sampling of groundwater emerging from some of the springs on-site was carried out by Denyer Ecology, who are Ireland's premier environmental consultancy specialising in tufa springs (see Denyer 2025), on 11th June and 20th October 2025. Springs 1, 2 and 4 were sampled on each occasion. Hydrochemical analysis on the groundwater samples was completed by Eurofins Environment Testing Ireland, Hoffman Park, Inchera, Cork, County Cork, T45 PC80. Summary results of this analysis follow in **Table 13**, with a comparison of resultant concentrations in relation to the maximum admissible concentrations (MAC) of the Groundwater Regulations (S.I. No. 9 of 2010), the Drinking Water Regulations (S.I. No. 99 of 2023) or the European Union Maximum Admissible Concentration Limits (2008 / 2010). A separate report by Denyer Ecology on the petrifying (tufa) springs and their associated hydrochemical analyses accompanies this application (Denyer, 2026) and compares water quality results to those relevant to petrifying (tufa) springs.

	Spring 1 - July	Spring 1 - October	Spring 2 - July	Spring 2 - October	Spring 4 - July	Spring 4 - October	MAC
Alkalinity (mg CaCO ₃ /l)	353	353	347	345	351	343	n/a
Alkalinity (mg HCO ₃ /l)	431	431	423	421	428	418	n/a
Ammonia (mg /l)	0.0130	0.031	0.0500	<0.01	0.727	0.01	0.233
Ammonium (mg /l)	0.0140	0.033	0.0520	<0.01	0.770	0.011	0.3*
Calcium (mg/l)	151	118	149.0	151.0	146.0	148	200#
Chloride (mg/l)	25.2	24.7	27.4	25.9	29.6	28.4	250*
Conductivity @25°C (µS/cm)	740	754	758	753	754	751	n/a
Magnesium (mg/l)	15.3	16.3	15.8	15.9	16.8	16.8	50#
Nitrate (mg N/l)	19.8	17.8	6.42	<4.4	7.240	5.91	37.5~
pH	7.2	7.1	7.4	7.6	7.20	7.2	6.5-9.5*
Phosphate Ortho-P (mg P/l)	<0.03	<0.03	<0.03	<0.03	0.384	<0.03	0.03#
Potassium (mg/l)	1.47	1.79	1.54	1.84	1.7	1.76	4#
Sodium (mg/l)	9.76	9.72	10.3	10.1	12.1	11.9	150*
Sulphate (mg/l)	47.8	55.0	66.8	71.6	60.0	65.3	187.5~
Temperature	n/a	n/a	n/a	n/a	n/a	n/a	n/a
K/Na ratio	0.15	0.18	0.15	0.18	0.14	0.15	n/a

* *Drinking Water Regulations, S.I. No. 99 (2023)*

~ *Groundwater Regulations, S.I. No. 9 (2010)*

Interim Guideline Values 2010 / EU MAC

Table 13 Hydrochemical analysis of springs sampled on the proposed LRD Project Site

The water quality of the groundwater emerging at Springs 1, 2 and 4 is generally good, but despite being well below the groundwater regulations limit of 37.5 mg/l, there are relatively high levels of nitrate in all springs sampled. This would be expected given the permeable nature of the soils and subsoils in the area around the proposed LRD Site locality, and the preponderance of tillage land to the north / northwest. Nitrate has natural background levels of approx. 1 to 8 mg / l (Tedd et al., 2016), and the values for spring 2 are within that range, suggesting it has a very localised zone of contribution (potentially solely beneath the site itself).

A relatively high level of orthophosphate was recorded at Spring 4, but only in July 2025. All other recorded values were below the relevant limits required. Phosphate is relatively immobile and is attenuated in mineral soils and subsoils, and is only mobile in localities with either organic soils or bedrock at surface. Given that organic soils have been recorded on the site in numerous localities both where springs emerge today or have emerged historically (see Plates 6 and 8, and Appendix A) the potential for occasional, natural spikes in orthophosphate exists on the site.

With ammonia, this also has low mobility too and is attenuated in soil and subsoil. As with phosphate, the main pathways are overland and near-surface drainage. But ammonia usually converts to nitrate readily over short distances, and the fact that it was also high in Spring 4 in July might again suggest that the organic soils have had an impact on these levels when flows were low. Both the ammonia and orthophosphate seem to have been hugely diluted by October when Spring 4 had a higher volumetric flow rate.

7.8.6. Groundwater Body and Status

The descriptions of groundwater bodies throughout Ireland are available from the GSI website: www.gsi.ie and the 'status' is obtained from the EPA Catchments / Water Framework Directive website: www.catchments.ie.

As outlined above, the subject site and the surrounding localities are located within the Trim Groundwater Body. This is categorised at 'Good Status' by the EPA, which is defined based on the quantitative status and chemical status of the GWB. The assigned risk status (WFD 3rd Cycle) is 'At Risk'. The main groundwater pressures are reportedly due to agriculture and other anthropogenic pressures.

7.8.7. River Water Body Status and Risk

As outlined above in Section 7.2, the majority of the proposed LRD Site is wholly located within the Boyne_SC_070 subcatchment, with the portion of the site crossing the river to host the proposed new foul sewer protruding in to the Boyne_SC_060 surface water subcatchment.

The Local River and Stream Waterbody status and WFD risk classification are available from (www.catchments.ie) and are summarised in **Table 14** below. These status and risk classifications are also shown on **Figures 21** and **22** following.

European Code	SWB Name	Ecological Status	Overall Status	Risk Status	Pressure Category
IE_EA_07B041200	Boyne_SC_060	Moderate	Moderate	At Risk	Urban Run Off Agriculture Domestic Waste Water Hydromorphology
IE_EA_07B041200	Boyne_SC_070	Moderate	Moderate	At Risk	Agriculture Domestic Waste Water Hydromorphology

Table 14 River Waterbody Status and Risk near the proposed LRD Site

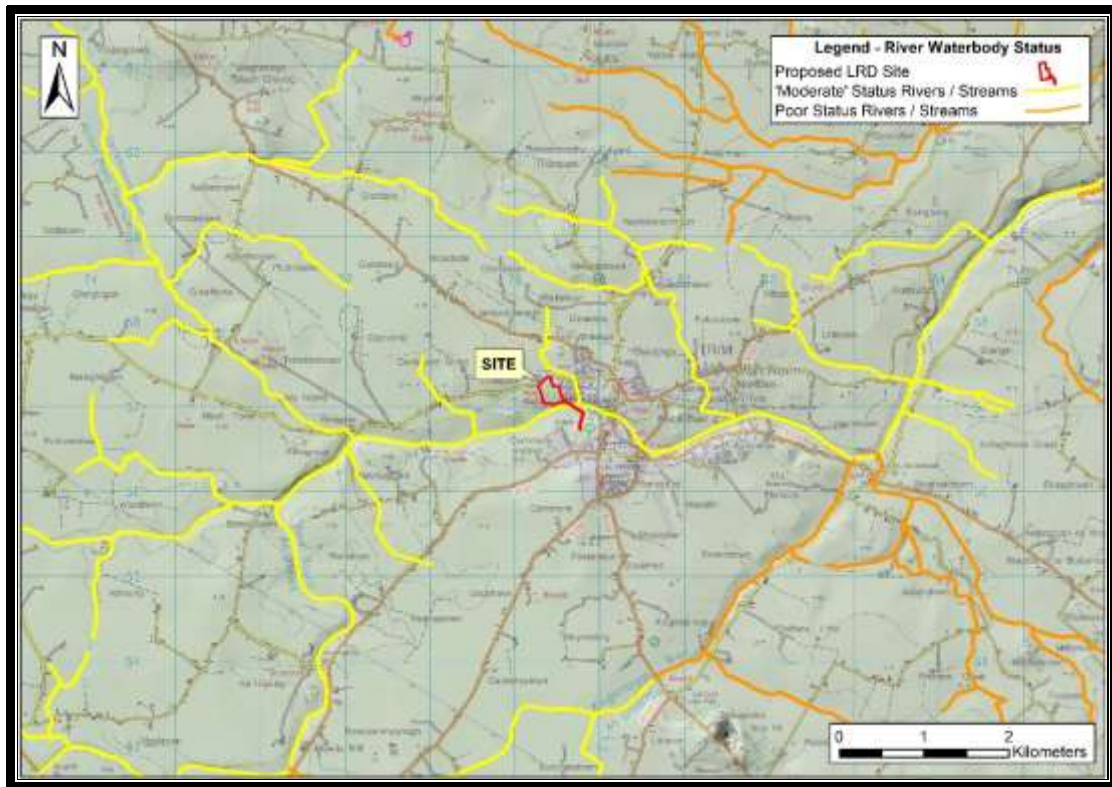


Figure 21: River Waterbody Status around the proposed LRD Site, 2019 - 2024 (after www.epa.ie). Note that only the River Boyne at the southern end of the site, as well as the stream flowing between Elder Grove and Cedar Grove approx. 165 m - 185 m to the east of the site (IE_EA_07B041200), are included in the EPA's Monitoring Programme for the locality / area, and the springs rising at the southern end of the site are not monitored by the EPA (O.S. Licence EN 057926).

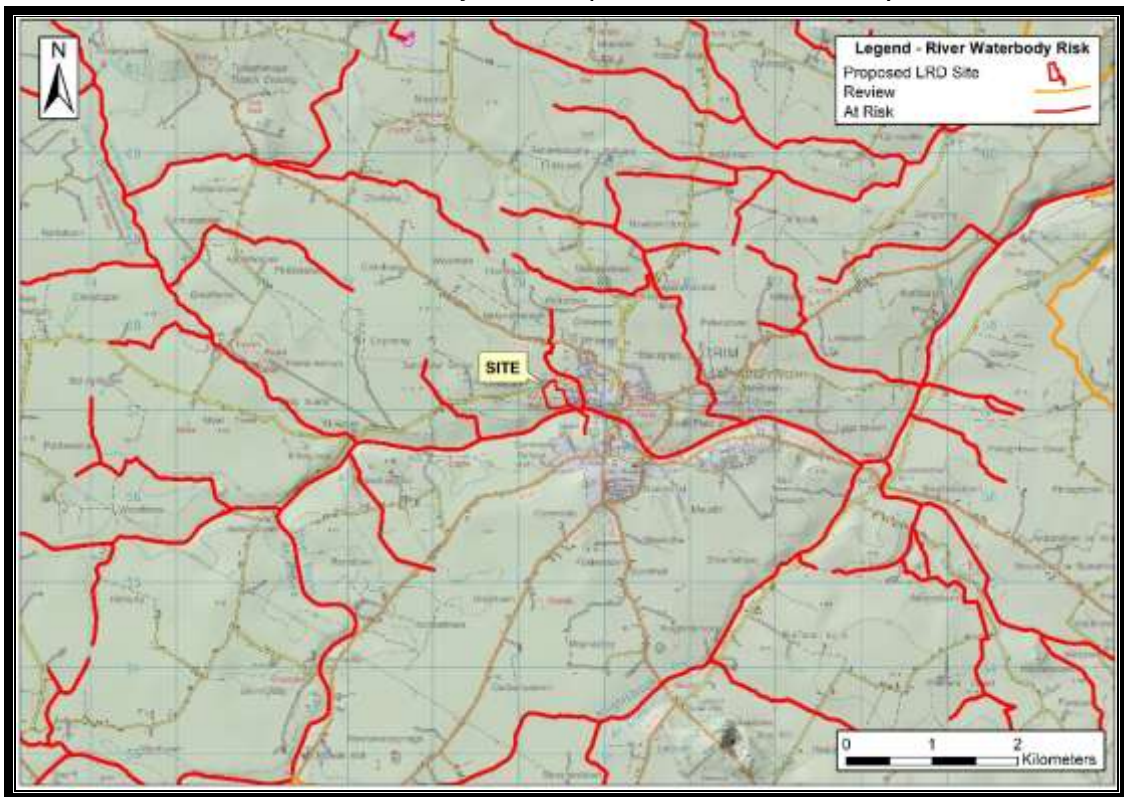


Figure 22: River Waterbody Risk around the proposed LRD Site (after www.epa.ie, (O.S. Licence EN 057926).

In terms of Surface Waterbody River Risk Status, the majority of the rivers and streams around the site are 'At Risk', with only some of the Boyne stream tributaries around Bective to the east and to the southwest around Newtownmoynagh under 'Review' (see **Figure 22** above).

7.8.8. Water Resources

7.8.8.1. Public / Group Water Schemes

Public supply mains water supplies all of the area around the proposed LRD Site (see **Figure 23** following) and will also supply water to the Site.

There are no GSI mapped groundwater Source Protection Areas (SPAs) within 3 kilometres of the proposed LRD site relating to Group Water Scheme (GWS) or Public Water Supply (PWS) sources. The closest Public Water Supply is that southeast of Trim (**Figure 23**).

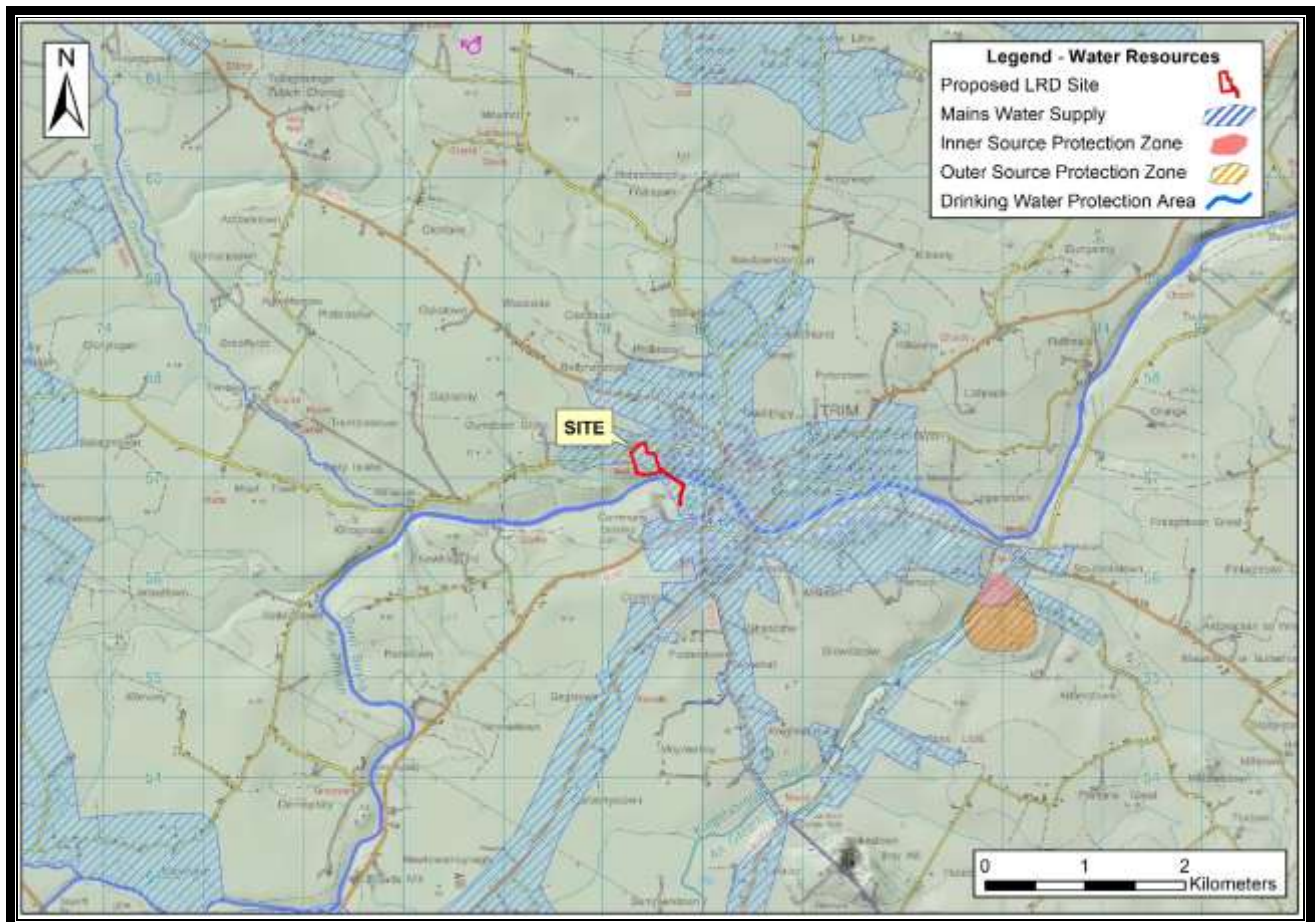


Figure 23: Areas supplied by Public Supply Mains water in the vicinity of the proposed LRD Site. Source Protection Zones / Zones of Contribution to groundwater wells and springs are also shown, as is the River Boyne, which has a drinking water abstraction for Trim down-gradient of the site (O.S. Licence EN 057926).

7.8.8.2. Private / Domestic Wells

A search of private well locations on GSI well database (www.gsi.ie) reveal no mapped private wells within 3 km of the Site.

In order to be conservative and following the worst case assumptions, it has been assumed that all dwellings in the surrounding lands not supplied by Mains Water have a private groundwater well. A number of private dwelling houses were identified along the local roads to the west and southwest of the proposed LRD Site (generally in the areas to the west and southwest that are

outside the area identified in **Figure 23** as being supplied by Public Supply Mains water, and are also alongside to up-gradient with respect to groundwater flow).

A field-scale assessment of private wells in the lands surrounding the Site has been completed and the closest well is approx. 700 m west of (and alongside of) the proposed LRD Site. A disused public supply hand pump occurs across the road at the entrance to Crowpark Lane, but has been disconnected a number of years ago, and no manhole providing access to the well even exists.

7.8.8.3. Surface Water Resources

The River Boyne, as it has a surface water-fed drinking water supply approximately 3.5 km downstream the proposed LRD Site, is identified as a Drinking Water Protected Areas (see also **Figure 23**).

7.8.9. Receptor Sensitivity and conceptual model

Due to the nature of proposed LRD developments being near-surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the Site would be from hydrocarbon spillage and leakages into excavations.

These are common potential impacts to all construction sites (such as road works, industrial sites and LRD Sites). These potential contamination sources are to be carefully managed at the Site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.

It is acknowledged that the Site is underlain by a Locally Important Aquifer, and the groundwater vulnerability rating of the Site ranges High to Extreme (in the small area at the southeastern end of the site where bedrock was encountered at 2.2 m depth in BH01). The 'High' vulnerability rating is because the majority of the Site is covered by high to moderate permeability subsoil which is at least 3m thick. Thus, the relatively deep glacial and glaciofluvial deposits act as a protective cover to the underlying bedrock aquifer.

Any contaminants which may be accidentally released on-site are more likely to travel to the nearby springs / streamlets at a shallow depth. The deep and high to moderate permeability of the glacial and glaciofluvial deposits means contaminants are unlikely to reach the bedrock and will instead disperse with the glacial deposits and would remain localised to the source. These could potentially reach the River Boyne in wet periods though, if contaminants escape.

This report acknowledges that there is a sensitive water supply source within the vicinity of the proposed LRD Site (the River Boyne as a Drinking Water Protected Area) as well as the River Boyne SAC itself. But there are no subsurface or surface hydraulic pathways between the proposed LRD Site and any Public Water Supply or Group Scheme Sources, or domestic wells (none occur down-gradient).

Mitigation measures will ensure that surface runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the Site, including all SUDS measures, will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the Site.

Providing as large a setback distance as possible from sensitive hydrological features means they will not be impacted by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features. This will allow attenuation of any surface runoff to be more effective.

A cross section of the conceptual model illustrating the geological and hydrogeological framework of the site follows in **Figure 24**.

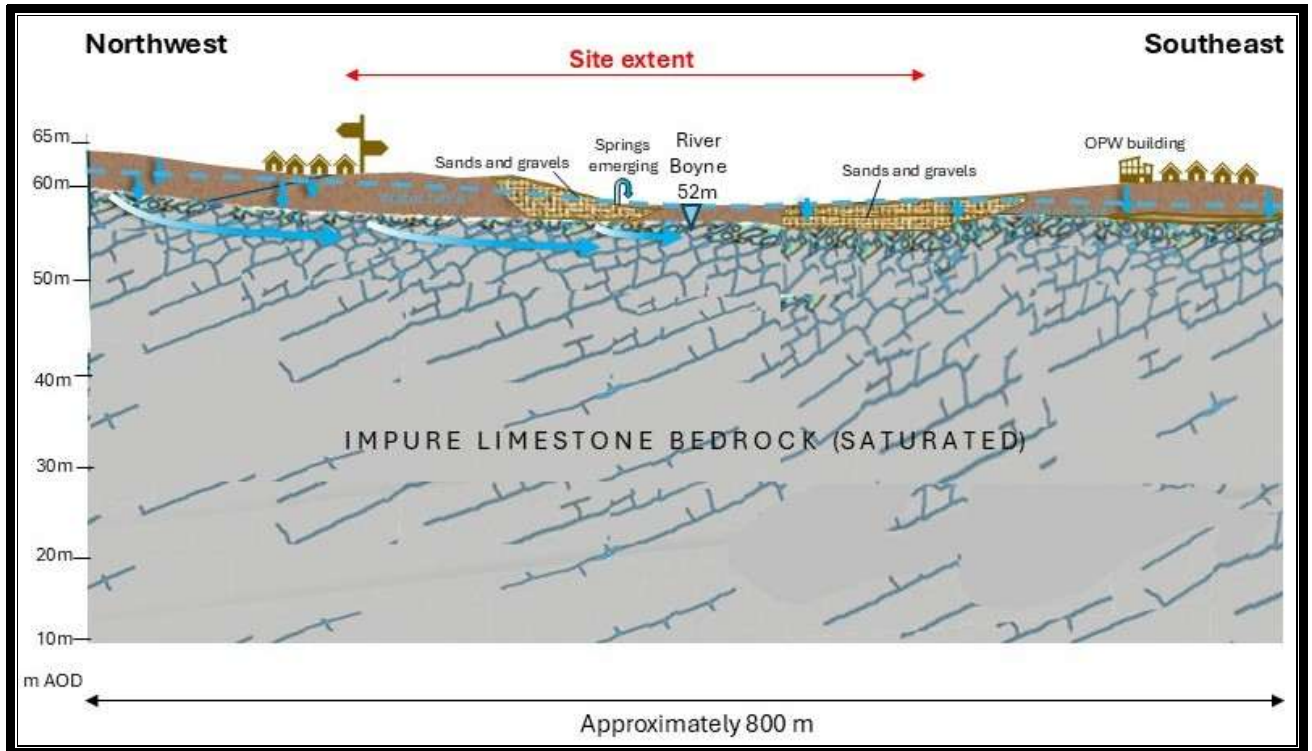


Figure 24: Conceptual geological and hydrogeological model of the proposed LRD Site.

8.0 CHARACTERISTICS OF THE PROPOSED PROJECT

The proposed LRD Project construction will mainly involve removal of soils and mineral subsoils for access roads, underground cabling and pipework, hardstanding areas, house, apartment and creche foundations, a construction compound and drainage works. Some crushed rock for construction purposes will be sourced off-site from nearby commercial quarries. Horizontal directional drilling will be completed beneath the River Boyne associated with the installation of a 125 mm rising main beneath the river for foul sewerage.

The main characteristics of the proposed LRD Site could impact on hydrology and hydrogeology are the excavation of foundations and the 'cut and fill' sequence across the site, as well as the boring of the directional drilling borehole beneath the River Boyne.

Welfare facilities will be provided at the proposed LRD Site, along with a temporary construction compound.

There will be no requirement for the importation of any soil or subsoil / landscaping material from licenced quarries or gravel pits.

Generally during house construction, gravity foundations depths are expected to be between 0.3 m and 0.6 m deep, depending on ground conditions at each house locality.

All house hardstands will be founded on a suitable bearing material requiring the excavation of any encountered 'soft' ground materials, if present.

8.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the proposed LRD Site. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around the spring drainage features at the southern end of the site, and diverting clean surface water flow around excavations, construction areas and temporary storage areas.

The second method involves collecting any drainage waters from works areas within the proposed LRD Site that might carry silt or sediment, and nutrients, to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to any surface waters in or around the springs on the site, or the River Boyne.

During the construction phase all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released.

Due to the high groundwater vulnerability rating of the Site, and the absence of extensive areas of 'Extreme' groundwater vulnerability, and the poor surface water and bedrock aquifer interaction, no special design requirements are needed to prevent the ingress of surface water drainage into the groundwater system.

It is vital that there is no deterioration in water quality in the springs that occur within the application site, or in the River Boyne. This will protect both habitats and species that are sensitive to pollution. Therefore, strict controls of erosion, sediment generation and other pollutants associated with the construction process should be implemented, including the provision of attenuation measures, silt traps or geotextile curtains to reduce and intercept sediment release into any local watercourses. Guidelines in the following best practice documents should be adhered to:

- Construction Industry Research and Information Association (CIRIA) (2005) Environmental Good Practice on Site (C692)
- Construction Industry Research and Information Association (2001) Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (C532)
- Construction Industry Research and Information Association (2000) Environmental Handbook for Building and Civil Engineering Projects (C512)
- Environmental Protection Agency (2015) List of Waste and Determining if Waste is Hazardous or Non-Hazardous

- Environment Agency et al. (2015) Guidance on the Classification and Assessment of Waste, Technical Guidance
- Environmental Protection Agency (2013) Guidance (and Templates) on the Management of Contaminated Land and Groundwater at EPA Licensed Site
- Environment Agency (2004) Model Procedures for the Management of Land Contamination (CLR11).

All relevant guidelines within the document Inland Fisheries Ireland Requirements for the Protection of Fisheries Habitats during Construction and Development Works and River Sites (www.fisheriesireland.ie) and the updated guidelines entitled Guidelines on Protection of Fisheries During Construction Works in And Adjacent to Waters (2016) should also be adhered to and they include.

- The construction team must implement the following specific mitigation measures, and these measures should be incorporated into a Construction and Environment Management Plan. This CEMP must include measures to prevent the release of hydrocarbons, aggregates, polluting chemicals, sediment and silt and contaminated waters into water course on-site.
- In this plan, the conceptual model of the site, whereby rainwater infiltrates to ground diffusely across the site and there are no surface channels except the streamlets issuing from the springs at the southern end of the site, must be allowed maintain in as much as possible.
- Surface waters from the construction site should therefore be managed only using a system of temporary on-site attenuation features including straw bales and silt fencing (a silt barrier device).
- No settlement ponds or diversion drains will be used during construction, to maintain the current hydrological and hydrogeological regime in as much as possible.
- Silt fences and berms should be installed prior to the commencement of construction on site. These should be set back at a minimum of 25 m from all of the springs and streamlets on the site. As the streamlets within the application site are associated with existing trees and woodland habitats, the silt fences will serve as protective fencing for the woodland habitats also. The silt fences should be sturdy and constructed of a suitable geotextile membrane to ensure that water can pass through, but that silt will be retained. The silt fence must be capable of preventing particles of 425 μm from passing through.
- The silt fences should be monitored daily to ensure that they remain functional throughout the construction of the proposed development. Maintenance of the fences should be carried out regularly.
- Any temporary fences emplaced across the site during construction should be inspected thoroughly after periods of heavy rainfall.

Discharge water generated during laying of concrete should be removed off site for treatment and disposal.

The following pollution control measures must also be employed on site:

- A dedicated re-fuelling location must be established on site, and this must be situated away from the River Boyne and any of the springs and streamlet watercourses on site.
- Spill kits stations must be provided at the fuelling location for the duration of the works.
- Staff must be provided with training on spill control and the use of spill kits.
- All fuel storage containers must be appropriately bunded, roofed and protected from vehicle movements.
- These bunds will provide added protection in the event of a flood event on site.
- All chemicals must be stored as per manufacturer's instructions. A dedicated chemical bund will be provided on site.
- Storage of fuel, and servicing and refuelling of equipment or machinery must be at least 25 m from ground clearance activities.
- The dedicated refuelling area must be underlain by concrete hard standing. All fuel and oil tank should be inspected on a regular basis for signs of spillages, leaks and damage during use. A record of these inspections must be kept, and any improvements needed be carried out immediately.
- The risk of fuel spillages on a construction site is at its greatest when refuelling plant. Therefore, only designated trained and competent operatives should be authorised to refuel plant on site. Plant and equipment should be brought to a designated refuelling area rather than refuelling at numerous locations about the site.
- Chemicals used on site must be returned to the site compound and secured in a lockable and sealed container overnight in proximity to the fuel storage area.
- Drip trays must be utilised on site for all pumps situated within 25 m away from ground clearance areas.
- Procedures and contingency plans must be established on site to address cleaning up small spillages as well as dealing with an emergency incident. A stock of absorbent materials such as sand, spill granules, absorbent pads and booms must be kept on site, on plant working near streams and at the refuelling area.
- Daily plant inspections must be completed by all plant operators on site to ensure that all plant is maintained in good working order. Where leaks are noted on these inspection sheets, the plant must be removed from operations for repairs.
- All personnel should observe standard precautions for handling of materials as outlined in the Safety Data Sheets (SDS) for each material, including the use of PPE. Where conditions warrant, emergency spill containment supplies should be available for immediate use.

Best practice concrete / aggregate management measures must be employed on site. These will include:

- A designated concrete wash out area should be set up on site; typically, this will involve washing the chutes, pumps into a designated IBC before removing the wastewater off site for disposal. These procedures should be covered during a Site Safety and Environmental Induction session.
- Best practice in bulk-liquid concrete management should be employed on site addressing pouring and handling, secure shuttering, adequate curing times etc.

- Stockpile areas for sands and gravel must be kept to a minimum size, well away from the River Boyne, springs and streamlet watercourses (minimum 50 m).
- Where concrete shuttering is used, measures must be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils.
- Activities which result in the creation of cement dust must be controlled by dampening down the areas.
- Raw and uncured waste concrete must be disposed of by removal from the site.
- Stockpile areas for sands and gravel will be kept to a minimum size, well away from the River Boyne and the springs and streamlet watercourses on site.

There should be no disturbances of the habitats along the River Boyne and adjacent to the springs / streamlet watercourses within the application site. All vegetation within the buffer zone of springs must be protected. Vegetation within this buffer zone should be retained and enhanced using suitable species and in accordance with any landscaping plan that has been produced for the site.

A separate rising main pipe will eventually cross beneath the southeastern area of alluvial woodland, and beneath the River Boyne. This will be situated in a tunnel to be bored under the River Boyne.

9.0 LIKELY AND SIGNIFICANT IMPACTS ON LAND, SOILS, GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

The potential impacts of the proposed LRD Project and mitigation measures that will be put in place to eliminate or reduce them are set out below.

The proposed LRD Site is situated adjacent to the River Boyne SAC, as well as a Drinking Water Protected Area abstracting from surface water as the River Boyne is used as a water supply source downstream of Trim Town.

The site is not within a Source Protection Zone for a Public Drinking Water Supply, a Zone of Contribution to a Group Scheme.

Potential effects on groundwater quality with regard to contaminants such oils, fuels, cement and sediments (i.e. from drilling, compaction of foundations, and excavation works).

The not-insignificant depth of overburden at the proposed LRD site will also ensure that access road construction, trenching for electrical cabling, temporary construction compounds and routeway drainage and attenuation (i.e. straw bales and silt fencing / barriers) would have no potential to disrupt groundwater flowpaths downslope. Locally, trenching or drains will typically extend no more than 0.6 m below ground level.

No point recharge features such as swallow holes, dolines etc are present at the ground surface on the proposed LRD Site, as the setting is within an aquifer that does not illustrate any karst features anywhere in the vicinity of Trim.

9.1 Do Nothing Scenario

If the proposed development does not go ahead, there would be no potential impacts on the soil, subsoil and bedrock geology underlying the subject site, nor on the hydrology and hydrogeology.

The area of the site, including the fields and hedgerows within, would continue as is on the site, with rainfall infiltrating to ground. Some of the groundwater beneath the site would continue to emerge at the springs, and then flow to the River Boyne, while surface water at the lower end of the site would also continue to flow into the River Boyne. The hedgerows would not be encroached upon, and agricultural practices would continue. This would have no impact on the underlying substrate, and there would be no change to the environmental profile of the site in relating to Land, Soils, Geology, or to Hydrology and Hydrogeology.

9.2 Potential Impacts and Mitigation Measures - Construction Phase

The proposed development will include the following accommodation as part of 183 individual residential units;

- 127 no. houses (ranging from two to two and a half storeys in height); 19 no. detached 4-bedroom houses, 9 no. semi-detached / end-terrace 4-bedroom houses, 4 no. detached 3-bedroom houses, 43 no. semi-detached/end-terrace 3-bedroom houses, and 52 no. mid-terrace 3-bedroom houses,
- 56 apartments within two blocks (ranging up to four storeys in height); 16 no. one-bedroom and 40 no. two-bedroom apartments,
- a creche facility

and all ancillary site works.

The scheme also includes the provision of new vehicular and pedestrian accesses from Kildalkey Road.

The proposal provides for associated infrastructure and site works, including landscaping, public and communal open space, internal streets and footpaths, car and bicycle parking, bin stores, private open space, boundary treatments, plant and waste management areas, utility infrastructure and a foul sewer connection to the existing network adjoining the OPW offices on Jonathan Swift Street, to be delivered beneath the River Boyne and Trim Pitch & Putt. Important in terms of geology and hydrogeology is the proposed new foul sewer connection to the existing foul water network adjoining OPW offices on Jonathan Swift Street (to be delivered underneath the River Boyne and Trim Pitch & Putt).

The site is located in the central area of the Plains of Meath, in the townland of Crowpark (1st Division), approximately 600 m west-northwest of the centre of the town of Trim, at ground surface elevations between approximately 52 m - 66mAOD.

There will be no basements in any of the houses on the site, and the foundation levels will be set just below existing ground levels in the majority, largely on the pre-existing, *in situ* subsoil. In only a few cases will cut-and-fill happen where split level houses are proposed to be constructed.

Detailed desk study review of available soils, subsoils and bedrock geological maps for the site show the presence of deep soil and subsoil beneath the majority of the site, with bedrock close to (within 1 metre of) the surface in a restricted locality in the southeastern portion of the site. The construction activity at the site will comprise the extraction and movement of relatively small portions of soil and subsoil material. It is envisaged that no rock-breaking will be required across the site area during construction, as the proposed alteration of site levels where required will require removal of glacial till material for the most part, as ensured by the design of the geometry of the proposed cut and fill and the related proposed floor levels for the site. Bedrock will only be encountered while boring the proposed tunnel for the proposed 125 mm rising main beneath the River Boyne at the southeastern extremity of the site.

As the proposed development will not involve major excavations as no subterranean car parks or basements are proposed, the construction works will not impact on groundwater resources local to any of the proposed structures on the site. The proposed 125 mm rising main borehole will not pump or dewater the area within and around it, and will drill in the saturated zone, in and beneath the water table. The full procedural and Method Statement for the directional drilling is included in the report by Dunnes Drilling Limited (Dunnes, 2025).

A significant amount of the extracted topsoil will be retained on the site for use in landscaping and remediation of the site following completion of the construction phase. This is described in more detail in the enclosed Construction and Environmental Management Plan.

In the course of the works it is estimated that there will be an approximate 5% loss of the usable topsoil, subsoil and rock material due to the nature of handling such material.

In extraction, any existing topsoil layer that require removal (approx. 300 mm - 500 mm) will be removed from phased working areas. Any subsoil material from the phased working areas will then be removed from the ground using a mechanical excavator; this will be to a maximum depth of approximately 0.75 m where required. No blasting shall be employed in the removal of topsoil or subsoil.

Any topsoil or subsoil stockpiles will likely only store a maximum of 100m³ of topsoil at any one time (depending on the exact sequence of works).

The maximum dimensions of any stockpiles shall be 2 m in height, approximately 5 m deep and approx. 10 m long. On this basis, it is estimated that there should be no more than 2 no. stockpiles of topsoil required.

The stockpiles will be formed so that they do not hold ponds of water on the surface and the stockpiles will be rolled or tamped smooth such that the upper layer will resist water ingress into the material below. Where the spoil is wet, it may be spread to allow air drying during periods of dry weather.

All works will be carried out under the supervision of suitably experienced and competent overseers. All personnel on site will be informed of all ground conditions to be expected on site and made aware of any mitigation measure necessary to successfully complete the construction of the project.

During the initial site preparation and construction stage, there will be a significant volume of machinery and equipment at the subject site, including trucks, excavators and screeners. There will be potential for leakage of fuel and oil from these vehicles into the surrounding groundmass, particularly during refuelling operations. The storage of large quantities of fuel or oils on site is not anticipated.

A Construction Management Programme will be implemented by the Principal Contractor for the duration of the construction phase, which will also cover associated and related environmental issues. This will require all potentially polluting material *e.g.* fuel and oil, be stored in appropriate, bunded containment; that all spills are cleaned promptly; and spill cleanup waste disposed of appropriately, and that all spills are notified to the site manager. Given the site topography, with a gently sloping gradient down-hill towards the springs and the River Boyne, and given the results from trial pitting on the site, it is not expected that any significant volumes of shallow, 'perched' groundwater will be encountered during excavation work. Surface water, which may collect in shallow excavations, has the potential to be contaminated with silt or other contaminants and would not be considered suitable for the discharge to any local surface water bodies without appropriate treatment. Hence, surface water will infiltrate to ground during construction, as happens currently on the site, and will be managed by the straw bales and silt fences as described above.

Though the above outlines a significant work package to be carried out on-site, there will be little impact to the site as the bedrock substrate and any associated landscaping of soil and subsoil will not be over-compacted when restoring the site.

9.2.1. Effects on Land and Land Use of the proposed LRD Site Construction

There will be loss of land as a result of the proposed LRD Site (Proposed Project).

The loss of agricultural land amounts to approx. 6 ha and there is no loss of forestry as it is proposed to retain the alluvial woodland and hedgerows along the southern end of the site, flanking the River Boyne.

There will be no effects on the lands adjoining the proposed LRD Site. Agriculture will continue north and west of the site during the construction of the proposed LRD Project.

Pathway: Land take

Receptor: Land and Landuse (i.e. the land upon which the proposed LRD Project will occur)

Potential Pre-mitigation Impact: Negative, slight, direct, likely, permanent impact on land and land use.

Impact Assessment: The loss of agricultural land resulting from the proposed LRD Project on a local or regional scale is minimal and therefore the effects of actual agricultural land loss are imperceptible.

Mitigation Measures: No mitigation is proposed with regard agricultural or forestry loss of land.

Residual Impact Assessment: Due to the small footprint of the proposed LRD Project on a local scale the residual effect is negative, direct, slight, likely, permanent impact on land and land use.

Significance of Effects: For the reasons outlined above, no significant effects on land or land use will occur as a result of the proposed LRD Project.

9.2.2. Effects on Soil and Subsoil Excavation of the proposed LRD Site Construction

There will be excavations required for the proposed LRD Site (Proposed Project).

Excavation of soil, subsoil and a very small portion of bedrock will be required for construction of works and for the installation of access roads, site drainage network, as well as all ancillary site works.

This will result in a permanent removal and relocation of *in-situ* soil and subsoil at most excavation locations. There is proposed to be no net loss of soil and subsoil, but much of the removed soil and subsoil will be relocated within the Site.

Pathway: Extraction/excavation.

Receptor: Soil and subsoil.

Potential Pre-Mitigation Potential Effect: Negative, slight/moderate, direct, likely, permanent effect on soil, subsoil and bedrock due to excavation and relocation within the proposed LRD Project Site.

Proposed Mitigation Measures by Design:

- Much of the soil and subsoil which will be removed during the construction phase will be very localised to the proposed LRD Site infrastructure, compounds and access roads;
- The areas of construction on the proposed LRD Project have been designed to avoid sensitive habitats within the proposed LRD Site boundary; and,
- No construction of settlement ponds will take place, and only excess soil / subsoil material from locally on-site will be used locally to form silt fencing / barriers.

Residual Impact Assessment: The mineral soil and subsoil at the Site can be classified as of “Low” importance.

The design measures incorporated into the proposed LRD Project as described above in particular the practice of avoidance areas of bedrock subcrop as much as possible combined with the ‘low’ importance of the deposits means that the residual effect will be a negative, slight, direct, likely, and permanent effect on soil and subsoil due to disturbance and relocation within the Site.

Significance of Effects: For the reasons outlined above, no significant effects on soils and subsoils will occur as a result of the proposed LRD Project.

9.2.3. Effects on Bedrock from drilling the proposed 125 mm rising main construction

There will be directional drilling required for the proposed 125 mm rising main beneath the River Boyne in the proposed LRD Site (Proposed Project).

Drilling through a very small portion of bedrock will be required for construction of the rising main which is the ultimate outlet from the site foul drainage networks.

This will result in a permanent removal and relocation of *in situ* bedrock within the conduit hosting the proposed 125 mm bore location. There is proposed to be a minimal net loss of bedrock from this procedure.

Pathway: Tunnel boring.

Receptor: Bedrock.

Potential Pre-Mitigation Potential Effect: Negative, slight/moderate, direct, likely, permanent effect on bedrock due to boring 125 mm rising main tunnel borehole within the proposed LRD Project Site.

Proposed Mitigation Measures by Design:

- Much of the bedrock which will be removed during the construction phase will be very localised to the proposed rising main locality at the downstream end of the proposed LRD Site foul infrastructure, and;
- The locality for boring beneath the River Boyne has been designed to avoid sensitive habitats within the proposed LRD Site boundary.

Residual Impact Assessment: The bedrock beneath this portion of the Site can be classified as of “Low” importance.

The design measures incorporated into the proposed LRD Project as described above in particular the practice of boring the tunnel within the saturated zone beneath the water table, as well as the absence of pumping and / or dewatering, combined with the ‘low’ importance of the rock itself means that the residual effect will be a negative, slight, direct, likely, and permanent effect on bedrock due to disturbance and removal from the 125 mm bore within the Site.

Significance of Effects: For the reasons outlined above, no significant effects on bedrock will occur as a result of the proposed LRD Project.

9.2.4 Contamination of Soil, Subsoil and Bedrock by Leakages and Spillages of Hydrocarbons or Chemicals in the proposed LRD Site Construction

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk at the proposed LRD Project Site and this is assessed herein.

The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of soils and subsoils and pollution of the underlying bedrock aquifer) on the geological and water environment.

Pathway: Soil and subsoil and underlying bedrock pore spaces.

Receptor: Soil and subsoil, bedrock.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, unlikely effect on soil, subsoils and bedrock.

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- All fuel storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel, oil and chemical stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- Safety data sheets for all chemicals used will be kept on-site; and,
- An emergency response plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan.

Residual Effect Assessment: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect for the proposed LRD Project will be negative, imperceptible, direct, short-term, unlikely effect on soil, subsoils and bedrock.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation, no significant effects on soil, subsoils and bedrock will occur as a result of the proposed LRD Project.

9.2.5 Erosion of Exposed Soils and Subsoils during the proposed LRD Site Construction

Soils and subsoils are at risk of erosion at the proposed LRD Project Site during the construction phase.

There is a high likelihood of erosion of spoil during its excavation and during landscaping works at the Proposed Project site. The main impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in the following sections.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Soil and subsoil.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, likely effect on soils and subsoils by erosion and wind action.

Proposed Mitigation Measures:

- The upper vegetative layer (where still present) of excavated soil will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the soil within the spoil repository areas;
- Re-seeding and spreading/planting will also be carried out in these areas;
- Brush mats will be put in place to support vehicles on soft ground, reducing mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur.

Residual Effect Assessment: Soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this, all excavation works will be completed in accordance with a detailed Spoil Management Plan, material will remain within the proposed LRD Project Site and reseeding and planting will be completed to bind landscaped spoil. Following implementation of these measures the residual effects will be negative, slight, direct, short-term, likely effect on soils and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, no significant effects on soils or subsoils in terms of erosional processes will occur as a result of the proposed LRD Project.

9.2.6. Earthworks (Removal of Vegetation Cover, Excavations and 'Cut-and-Fill') Resulting in Suspended Solids Entrainment in Surface Waters (Proposed Project)

There will be earthworks required for the proposed LRD Site and these are assessed herein.

The Proposed Project construction phase activities that will require earthworks result in the removal of vegetation cover and excavation of mineral topsoil and subsoil. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the subsurface rising main resulting in the entrainment of sediment from any excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies, as well as potentially the drinking water supply sourced from the River Boyne. Potential impacts could be significant if not mitigated.

Pathway: Drainage and surface water discharge routes.

Receptor: Down-gradient rivers (River Boyne and it's tributaries) and dependent ecosystems.

Pre-Mitigation Potential Effect: Indirect, negative, significant, long-term, likely effect on surface water quality.

Mitigation by Avoidance:

The key mitigation measure during the construction phase of the Proposed Project is the avoidance of sensitive aquatic areas. From **Figure 2** it can be seen that all of the key areas of the Proposed Project

infrastructure are actually significantly away from any required, delineated buffer zones. Additional control measures, which are outlined further on in this section, will be undertaken where proposed new roads, and proposed stream crossings, will be emplaced.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operated effectively. The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface water courses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase surface system into watercourses, achieved in part by utilising sediment control systems such as straw bales and silt fences, and not implementing any alteration to the infiltration regime by avoiding the use of settlement ponds and drainage channels, and allowing percolation across the entire site towards the vegetation of the buffer zone.

Mitigation by Design:

- Source controls:
 - Straw bales and silt fences / barriers, erosion and velocity control measures such as use of sand bags, filter fabrics, and other similar/equivalent or appropriate systems.
 - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
 - Erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, non-channel baffles, silt bags, silt fences, sedimats, filter fabrics, sediment traps, or other similar/equivalent or appropriate systems. **Full avoidance of** treatment systems such as temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems.
- Monitoring:
 - An inspection and maintenance plan for the on-site construction sediment control system will be prepared in advance of commencement of any works. Regular inspections of all installed structures will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.
 - Any excess build-up of silt levels at dams, or any other sediment control features that may decrease the effectiveness of the feature, will be removed. Checks will be carried out on a daily basis.
 - During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for the River Boyne and the springs / streamlets on the site, and specifically following heavy rainfall events (as per the CEMP included with this LRD application).

Residual Effect: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between potential sources and the receptor. The mitigation measures will ensure that surface water runoff from the site will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. The residual effects of the Proposed Project will be negative, imperceptible, indirect, short-term, likely effect on down-gradient rivers, water quality, and dependent ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

9.2.7. Potential Impacts on Groundwater Levels and Flows During Excavations and Drilling (Proposed Project)

Quantity effects (i.e. flows/spring discharge volumes) are unlikely to arise as any excavations and shallow cut-and-fill will all be well above the groundwater table on the area of the site to be developed. As well as this, the proposed SUDS measures ensure rainfall will continue to infiltrate in as diffuse a manner as possible into the soils and subsoils before meeting the water table and eventually emerging at the spring / streamlets at the southern end of the site, as it does now.

There will be excavations required for the proposed LRD Site (Proposed Project).

But groundwater level impacts will not be significant due to the local geological and hydrogeological regime as outlined previously and following. None of the groundworks proposed (including the directional drilling of the proposed rising main tunnel borehole) do not require active dewatering (albeit some temporary displacement of local groundwater in the saturated zone is likely to occur) and therefore none of the activities proposed on site have any potential to significantly affect groundwater levels during construction.

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels (Trim GWB and local bedrock aquifers), the springs / streamlets on-site.

Pre-Mitigation Potential Effect: Direct, negative, slight, brief, likely effect on local bedrock aquifers. No significant effects on the Trim GWB will occur due to the absence of dewatering requirements. The potential for water levels to fall or be affected is absent given the proposed drilling methodology.

Impact Assessment:

No groundwater level of flow regime impacts are predicted from the construction of the proposed LRD due to the shallow nature of the excavations (i.e. mostly 0 - ~0.75 m), and the design of the proposed SUDS system for the site in the topsoil zone. The deepest excavations on the area of the site to host housing structures will be required in the east central portion of the site, ~0.75m, but these excavations will progress in a more horizontal manner rather than vertical deepening. The proposed rising main will be bored through bedrock deep beneath the River Boyne and in the saturated zone, with no pumping to dewater or alter existing groundwater levels.

Residual Impact: Due to the prevailing soils and subsoils geology at the Site, the local and temporary nature of the proposed works, the residual effects of the proposed LRD Project on groundwater levels and flows at springs /streamlets will be negative, imperceptible, direct, brief and reversible.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels and / or flows will occur.

9.2.8. Potential Release of Hydrocarbons During Construction and Storage (Proposed Project)

Hydrocarbons will be required for the construction of the proposed LRD Project and these are assessed herein.

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage after heavy rainfall.

Receptor: Groundwater and surface water rivers and streams (River Boyne, it's adjacent tributaries, springs and streamlets on the site).

Pre-Mitigation Potential Effect: Indirect, negative, slight, short term, likely effect to local groundwater quality. Indirect, negative, moderate, short term, likely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4 x 4 jeep to where machinery is located. The 4 x 4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel only;
- A permit to fuel system will be put in place;
- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm control system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,

- An emergency plan for the construction phase to deal with accidental spillages will be included within the Construction and Environmental Management Plan. Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Residual Impact: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The mitigation measures will ensure that surface water runoff from the site will be equivalent to baseline conditions and will therefore have no potential impact on the status or ecology of downstream waters. The residual effect of the proposed LRD Project will be negative, imperceptible, indirect, short-term, unlikely impact to local surface water and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

9.2.9. Groundwater and Surface Water Contamination from Waste Water Disposal (Proposed Project)

Waste water management will be required for the proposed LRD Site construction (Proposed Project) and is therefore assessed herein.

Release of effluent from domestic waste water treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater quality and surface water quality (River Boyne, it's adjacent tributaries, springs and streamlets on the site).

Pre mitigation Effect: Indirect, negative, significant, temporary, unlikely effect to surface water quality. Indirect, negative, slight, temporary, unlikely effect to local groundwater.

Proposed Mitigation Measures: It is proposed to manage waste water from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all waste water being tankered off site by permitted waste collector to waste water treatment plants. It is not proposed to treat waste water on-site.

Residual Effect: No residual effects of the Proposed Project.

Significance of Effects: No significant effects on surface water or groundwater quality will occur.

9.2.10. Potential Hydrological Effects on Designated Sites (Proposed Project)

Designated sites are located downstream of, and partially within, the proposed LRD Project, and are assessed herein.

The closest designated site to the Proposed Project site is the River Boyne and River Blackwater SAC (Site Code: 002299) and the River Boyne and River Blackwater SPA (Site Code 004232), both of which

are just outside the southern boundary of the site. The proposed LRD therefore intercepts a European Sites, down-gradient of the proposed area to be developed on the proposed LRD Site (see **Figure 9**).

The groundwater flow direction in the area of the Site (i.e. generally southwards, see **Figure 19**) means the designated sites are not screened out, and a full NIS accompanies this application. The current overland flood route is also southwards towards the River Boyne.

Pathway: Surface water and groundwater flowpaths.

Receptor: Down-gradient water quality and designated sites of the River Boyne and River Blackwater SAC and the River Boyne and River Blackwater SPA.

Pre-Mitigation Potential Effect: Direct, negative, moderate, short-term, likely effect on the River Boyne and River Blackwater SAC and the River Boyne and River Blackwater SPA.

Impact Assessment & Proposed Mitigation Measures: Drainage mitigation measures for surface water quality protection during the construction phase are summarised again following: (Refer to Sections 9.2.2 to 9.2.9 previously for the full description of these measures and how they will be applied).

- The proposed mitigation measures which will include 25 m buffer zones for avoidance of sensitive hydrological features (streams and rivers);
- Pre-construction drainage control measures;
- Robust sediment control measures will ensure that the quality of runoff from the proposed LRD Project area will be very high; and,
- Best practice measures with regard use of oils, fuels (Sections 9.2.4. and 9.2.8.).

Residual Impact: No effects on local designated sites from the proposed LRD Project.

Significance of Effects: No significant impacts on local designated sites will occur.

9.2.11. Potential Effects on Local Groundwater Well Supplies from Excavations (Proposed Project)

There will be excavations required for the proposed LRD Project and these are assessed herein in terms of effect on groundwater sourced water supplies.

In the area of the Proposed Project site, private dwelling houses (potential well locations) are mainly located along public roads over 500 m to the west of the proposed LRD Site which is alongside to the direction of groundwater flow in the area of the proposed LRD Site (i.e. southerly, See **Figure 9**).

There are therefore no risks to any down-gradient wells, or any wells in the vicinity of the proposed LRD Site at all.

Pathway: Groundwater flowpaths.

Receptor: Private Groundwater Supplies.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, short-term, unlikely effect on local wells.

Impact Assessment: The proposed LRD Project site will not impact in any significant way on any potential down-gradient private wells, owing to their absence, as well as the large set back distances between the proposed LRD Site and all potential well locations.

9.2.12. Effects of Construction Works on the WFD Status of Downstream Waterbodies (Proposed Project)

The proposed LRD Project has the potential to effect WFD status, and this is assessed herein.

WFD status and Risk Results for the downstream River Boyne waterbody and the underlying Trim GWB are presented in Sections 7.8.6. and 7.8.7. above.

Due to the predominantly 'High' groundwater vulnerability rating of the Proposed Project site (and the very minor area with bedrock at or near surface and thus only a minute area of 'Extreme' groundwater vulnerability in the southeastern extreme of the Site), and the design of the proposed LRD Project with all excavations and SUDS measures situated at a shallow depth in the topsoil, the potential to negatively affect the WFD status of the Trim GWB is very low, even in the absence of mitigation.

Without mitigation the proposed construction works do have the potential to adversely impact on surface water quality which may negatively impact on the WFD status of the downstream surface waterbodies, in the River Boyne itself and the springs / streamlets on the lower end of the site. As well as this, there is the potential that the rising main could act as a natural conveyance route for flood waters and flood risk along the alluvial floodplain.

The understanding of the objectives of the WFD is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all. This is reflected in the strict mitigation measures in relation to maintaining a high quality of surface water from the proposed LRD Project will ensure that the status of surface waterbodies in the vicinity of the proposed LRD Project will be at least maintained regardless of their existing 'Moderate' status.

Pathways: Drainage and surface water discharge routes.

Receptors: Trim GWB, and Surface waters (River Boyne, it's adjacent tributaries, springs and streamlets on the site) and associated dependent ecosystems.

Pre-Mitigation Potential Impact: Indirect, negative, slight, temporary, unlikely effect on river waterbody status. No effects on Trim GWB WFD status will occur.

Proposed Mitigation Measures: Comprehensive surface water mitigation and sediment controls are outlined above. Hydrocarbons from vehicles within the site confines will pass through the site interceptor system which will clean water and expose potential hydrocarbons to sunlight, to allow the breakdown of same, within the proposed surface water drainage network. These mitigation measures are considered sufficient to eliminate potential risks to ground/soils and subsoils, and groundwater and surface water quality, and will ensure the protection of surface water quality and flows in all downstream receiving watercourses.

Residual Impact: The potential for the release of suspended solids, hydrocarbons, cement-based products or altered flows to watercourse receptors is a risk to water quality and the aquatic quality of

the receptor. Proven and effective mitigation measures have been proposed and the Sustainable Drainage System's design, utilising both topsoil and subsoil, will break the pathway between the potential pollutant sources and the receptor. The mitigation measures will ensure that surface water runoff from the site will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. While drilling the rising main this will all be completed below the water table, so no conduit void for any extra water will exist, meaning no extra flood risk along the alluvial floodplain than there now. The residual effect of the proposed LRD Project is negative, imperceptible, indirect, short-term, unlikely impact on down gradient rivers, springs, streamlets, water quality, and dependent ecosystems. No effects on the status of the Trim GWB will occur.

Significance of Effects: For the reasons outlined above, and with the implementation of the proposed mitigation, no significant effects on waterbody WFD status will occur.

9.3. Potential Impacts and Mitigation Measures - Operational Phase

There are very few potential direct impacts are envisaged during the operational phase of the proposed LRD Project.

No potential impacts will be significant, as they would be small scale and also of an intermittent nature.

Mitigation measures for land, soils and geology during the operational phase include the use of aggregate from authorised quarries for use in road and hardstand maintenance. Hydrocarbons from vehicles within the site confines will pass through the Sustainable Drainage System's hydrocarbon interceptors which will clean water and expose potential hydrocarbons to sunlight, to allow the breakdown of same, within the proposed surface water drainage network.

These mitigation measures are considered sufficient to eliminate potential risks to ground/soils and subsoils, and groundwater and surface water quality.

9.3.1. *Removal of Vegetation Cover and Progressive Replacement of Natural Surface with Low Permeability Surfaces (Proposed Project)*

Hardstand emplacement will be required at the proposed LRD Site, and is assessed herein.

The potential for increased surface water runoff is the primary potential impact during the operational phase of the proposed LRD.

Progressive replacement of the vegetated surface with impermeable surfaces will decrease the permeability of the ground within the proposed LRD Site footprint (i.e. hardstandings, and the new access roads).

Overall there is an alteration in the average and natural runoff regime expected and results from a relatively small area of the overall proposed LRD Project site being developed as hardstand. The existing diffuse infiltration regime at the site, through topsoils and subsoils, has been maintained in as much as possible though, given the proposed SUDS design.

Pathway: Site drainage network.

Receptor: Surface waters (River Boyne, its adjacent tributaries, springs and streamlets on the site) and dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, long-term, likely effect on all downstream surface water bodies.

Proposed Mitigation by Design: The proposed drainage philosophy outlined throughout the design of the SUDS measures for the site and throughout this report states that runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the proposed LRD Project. The first being 'keeping clean water clean' and the second involving the collection of any drainage waters in the proposed, designed Sustainable Drainage System's surface water network. The second method therefore relates to proposed design measures that will prevent road surface and other hardstand areas acting as preferential flowpaths. All development site runoff will be collected, attenuated, treated and then released in a diffuse and regular manner that does not significantly change the natural drainage regime/hydrology of the site.

The operational phase drainage system of the proposed LRD Project will be installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the drainage drawings submitted with this planning application:

- Shallow interceptors will be maintained up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained.
- Permeable paving and shallow soakaways will be used to collect runoff from access roads and hardstanding areas of the site, likely to have entrained suspended sediment'.
- Individual soakaways for each building structure will maintain a diffuse infiltration regime in as much as possible;
- These measures will ensure all surface water runoff from new road and building surfaces will be captured and treated prior to discharge/release.

Residual Impact: Direct, negative, neutral, long term, likely effect of the proposed LRD Project on surface waters.

Significance of Effects: No significant effects on surface water quantity will occur during the operational phase of the Proposed Project.

9.3.2. Runoff Resulting in Suspended Solids Entrainment in Surface Waters

Site runoff will occur at the proposed LRD Site and is assessed herein.

During the operational phase, the potential for silt-laden runoff is very low.

There is a very low likelihood of the release of suspended solids to surface water and low potential increase in the suspended sediment load.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (River Boyne, it's adjacent tributaries, springs and streamlets on the site) and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, temporary, likely effect on surface water quality.

Proposed Mitigation Measures: The mitigation measures outlined above will ensure all surface water runoff from new road surfaces and hardstand areas within the proposed LRD will be captured and treated prior to discharge/release. Shallow basins, permeable paving, and swales will be used to collect runoff from access roads and hardstanding areas of the site. The proposed overland flood route following construction (see accompanying Drawing by Waterman Moylan Limited) mimics the current overland flow route across the site, which is southwards to the River Boyne.

Post-Mitigation Residual Effects: With the implementation of the proposed drainage measures as outlined above, and based on the post-mitigation assessment of runoff, residual effects are - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

9.4. Risk of Major Accidents and Disasters

Due to the nature of the proposed LRD Project site, i.e. absence of soft peat deposits, there is no risk of peat movement occurring. As well as this, all excavations are relatively shallow and will be completed using the Mitigation Methodologies outlined above e.g. in dry weather, maintaining the existing hydrological and hydrogeological regime, etc.

The residual effect of a landslide occurring is therefore determined to be imperceptible, given the site topography and the Sustainable Urban Drainage System's design.

Flooding can result in downstream Major Accidents and Disasters. But owing to the relatively small scale of the proposed LRD Project footprint, the naturally moderate runoff rates, the avoidance of fluvial flood zones for all aspects of building development, and with the implementation of the proposed mitigation measures, the increased flood risk associated with the proposed LRD Project is imperceptible.

9.5. Human Health Effects

In terms of land, potential health effects arise mainly through the potential for soil and ground contamination. The proposed LRD Project is not a recognized source of pollution (*e.g.* it's not a waste management site, or a chemical plant), and so the potential for effects during the operational phase is very low.

In terms of water, potential health effects arise mainly through the potential for surface and groundwater contamination which can have negative effects on public and private water supplies. The proposed LRD Project is not a recognized source of pollution and so the potential for effects during the operational

phase is very low. Notwithstanding this, the proposed LRD Project design and mitigation measures ensures that the potential for effects on the water environment as a whole will be insignificant.

Hydrocarbons will be used onsite during construction; however, the volumes will be small in the context of the scale of the proposed LRD Project and will be handled and stored in accordance with best practice mitigation measures. The potential residual effects associated with either soil or ground contamination, or groundwater or surface water contamination, and subsequent health effects are imperceptible.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues.

A detailed Flood Risk Assessment for the proposed LRD Site has been carried out and accompanies this application, with elements of this summarised in Section 7.5. This Flood Risk Assessment demonstrates that the risk of the proposed LRD Project contributing to downstream flooding is imperceptible, as all proposed structures and all related work on-site will be completed well outside the Flood Risk Zone. On-site (construction and operation phase) drainage control measures will ensure no downstream increase in local flood risk.

9.6. Post Construction Monitoring

Due to the nature of the proposed LRD Project site, there will be no requirements for any monitoring of the site post construction.

10.0 CONCLUSIONS AND RECOMMENDATIONS

- Dr. Robert Meehan was retained on behalf of Loughglynn Developments Limited to undertake an assessment of the potential likely and significant effects of the proposed Large Scale Residential Development (LRD) on a site on the Kildalkey Road, Trim, County Meath, in the townland of Crowpark (1st Division), Trim, on the Land, Soils, Geology, Hydrology and Hydrogeology aspects of the receiving environment.
- The Site is located in the central area of the Plains of Meath, at ground surface elevations between approximately 52 m - 66mAOD, and is bounded by the third class 'Kildalkey Road' at the north, and is situated on the southern backslope of a low, unnamed, linear ridge feature at Dunleever Glebe - Crowpark, which segues into the northern glaciofluvial terrace of the River Boyne on the site itself.
- The overall form / geometry of the site itself is of a ridge or 'bank' type feature along the mid-backslope of a much higher, bedrock-cored ridge, undulating with gentle to moderate slopes.
- The northern portion of the site itself is comprised of recently tilled and sown land, with a narrow band of wetland forestry running west to east along the southern extremity of the site.
- The subject site has a relatively homogeneous and uniform soils geology, with grey brown podzolics and brown earths in evidence across the area to be developed, and gleyed, saturated soils on the lower portion of the site adjacent to the River Boyne.
- The subsoils across the site comprise glacial till derived chiefly from limestones in the northern portion, glaciofluvial sands and gravels in a central band, and alluvium along the River Boyne, beneath it's floodplain.
- The bedrock geology beneath the site is of Lucan Formation 'Calp' limestones, which are impure and have a low potential for karstification compared to pure limestone rock.
- The majority of the site area has deep soils and subsoils across it (greater than 3 m), as evidenced by extensive trial pitting across the site, while one small pocket in the southeastern corner has bedrock coming close to the surface, recorded as 2.2 m from it while drilling a Site Investigation borehole.
- The annual recharge and runoff rates for the proposed LRD Site are estimated to be 238.31 mm/year and 120.04 mm/year respectively.
- The Site is located in the regional River Boyne Catchment within Hydrometric Area 07 of the Eastern River Basin District (ERBD), while on a more local scale is located in the majority in the Boyne_SC_070 surface water subcatchment, with the portion of the site crossing the river to host the proposed new foul sewer rising main protruding in to the Boyne_SC_060 surface water subcatchment.
- The proposed LRD Site in it's entirety drains to the River Boyne which flows west to east just south of the site's southern boundary, and this is designated as both SAC and SPA.
- Field mapping as part of the site investigation for this proposed LRD Project has led to the discovery of six previously undocumented springs just outside the southern boundary of the site to be developed, all within the area designated as SAC.

- These springs are ephemeral, petrifying and tufa-forming, and there is an approximate minimum dilution factor of between 2,301 and 20,492 on the spring flows once they meet the River Boyne, depending on the time of year and the antecedent weather conditions.
- Currently, the hydrological regime across the site involves rainfall infiltrating through the permeable soils and subsoils to the water table, which is generally hosted in the deep subsoils.
- This water table flows at depth beneath the higher portion of the site, and emerges at springs at the floodplain break of slope, *via* preferential flowpaths (probably gravel beds) before flowing as streamlets over a short distance, and into the River Boyne.

- Along the River Boyne each side of the site, EPA Q-rating data shows that the river surface water consistently has 'Moderate' status river waters either side of Trim.
- The dark limestones and shales of the Lucan Formation bedrock are poorly permeable and relatively unproductive, and are classified as a Locally Important Bedrock Aquifer - Bedrock that is Moderately Productive.
- The water table is at a relatively deep depth beneath the site, and will be well below all surface construction activities, including any (shallow) cut-and-fill.
- The site specific groundwater flow direction, as determined by groundwater levels beneath the site and spring emergence levels, is towards the River Boyne, as would be expected given the impure nature of the underlying limestone bedrock.
- The groundwater vulnerability beneath the site is in the majority 'High', with the small pocket with bedrock close to the surface having 'Extreme' groundwater vulnerability.
- The groundwater quality hydrochemistry of the springs sampled on the site is generally 'good', with exceedances of ammonia and ortho-phosphate in one of them in July 2025, potentially owing to low flows and adjacent (naturally occurring) organic matter in relict tufa soils.
- The Trim Groundwater Body beneath the site is at 'Good' status in terms of the EU Water Framework Directive.
- The River Boyne flowing through the site is at 'Moderate' status in terms of its surface water, and is 'At Risk' owing to a number of pressures.
- The River Boyne has a surface water-fed drinking water supply approximately 3.5 km downstream the proposed LRD Site, and is therefore identified as a Drinking Water Protected Area.

- Due to the nature of proposed LRD developments being near-surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments.
- The design of the proposed LRD Project has maintained the existing hydrological and hydrogeological regime on the site in as much as possible.
- This means that all SUDS measures will discharge as diffusely as possible and at as shallow a depth as possible, using individual shallow soakaways for each house individually and wide, expansive, shallow soakaways for the road network.
- This will mean no significant effects on groundwater levels and / or flows, and / or surface water, will occur as a result of the proposed LRD Project.

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APPENDIX A

PHOTOGRAPHS OF SALIENT FEATURES ON AND AROUND THE SITE



Plate 1: The emergence of Spring 1 (at the old 'Holy Well', 28th January 2025.



Plate 2: Streamlet flowing from Spring 1 entering the River Boyne, 28th January 2025.



Plate 3: Relict tufa / organics at base of Spring 1, 28th January 2025.



Plate 4: Channel following emergence of Spring 2, 28th January 2025.



Plate 5: Emergence of Spring 3, 28th January 2025.



Plate 6: Emergence of Spring 4, 28th January 2025.



Plate 7: Emergence of Spring 5, 28th January 2025.



Plate 8: Streamlet channel following emergence of Spring 5, 28th January 2025.



Plate 9: Emergence of Spring 6, 28th January 2025 (four days after Storm Eowyn).



Plate 10: The dry streamlet channel following Spring 1, 7th July 2025



Plate 11: Low flow from Spring 2, 7th July 2025.



Plate 12: Organic, humus rich topsoil and relict tufa from ancient spring locality, exposed in archaeological trench up-gradient of Spring 4, 9th September 2025.



Plate 13: Disused, disconnected hand pump just across the Kildalkey Road from the site.