CHAPTER TEN LAND SOILS & GEOLOGY

10.1. INTRODUCTION

This chapter describes the type of land, soils, and geology likely to be encountered beneath and in the general area of the proposed Cleeves Riverside Quarter development near the Shannon River, Limerick City, Co. Limerick. The proposed application site (Phase II) is part of a phased development proposal for a significant city centre, regeneration area or Masterplan Site (MS). This MS is divided into four different phases of delivery as detailed in Section 1.6.3 in Chapter 1.0 Introduction. The overall MS layout which illustrates the indicative layout of the subject site and adjoining lands in the ownership of the applicant is displayed on Figure 1.4 in Chapter 1.0 and full details of the proposed development phases are given in Chapter 2.0.

In addition to an in-depth assessment of the Proposed Development, this assessment takes a holistic approach and examines the wider MS area, taking into account the proposed future phases of development based on the available information. Specifically this chapter addresses the potential impact of the proposed development on land, soils and geology together with the mitigation measures that will be employed to eliminate or reduce any potential impacts.

10.2. ASSESSMENT METHODOLOGY

The following scope of works was undertaken by AtkinsRéalis in order to complete the land, soils and geology assessment presented in this chapter:

- Desk-based study including a review of available historical and relevant ground investigation information (detailed further below);
- Site walkover survey on 27th March 2025 by an experienced Geo-environmental Consultant;
- Review and evaluation of 61no. environmental soil analytical results, and ground gas monitoring data by an experienced Geoscientist; and,
- Preparation of the land, soils and geology impact assessment by an experienced Geo-environmental Consultant.

This assessment has been completed in accordance with relevant best practice guidance from the Institute of Geologists of Ireland (IGI), 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013). The IGI guidance document is an updated version of the 2002 guidelines, 'Geology in Environmental Impact Statements, A Guide' (IGI, 2002), which was revised to take account of legislative changes, and the operational experience developed by geoscientists in the production of relevant environmental assessments. This assessment has also been prepared in accordance with the relevant Environmental Protection Agency (EPA) guidance, *'*Guidelines on the information to be contained in Environmental Impact Assessment Reports*'* published in May 2022.

The desk-based study involved reviewing information from the following sources: -

- GSI Datasets Public Viewer and Groundwater web-mapping (consulted August 2025).

- Ordnance Survey web-mapping to assess the surface topography and landforms (consulted July 2025).
- EPA Public Viewer and web-mapping (consulted July 2025).
- Google Maps Aerial photography (consulted July 2025).
- Phoenix Environmental Safety Ltd. 2024. Asbestos Survey Report.
- Final Ground Investigation Report (Priority Geotechnical Ltd., 2025) & Additional Monitoring Results (Refer to Appendix 10-1).

A site specific Ground Investigation was carried out by Priority Geotechnical Limited (PGL) between March and May 2025. The results are presented in Appendix 10-1 and summarized as follows:

- 15 no. Cable Percussive Boreholes with standard penetration tests (SPTs), to a depth of 5 metres Below Ground Level (m BGL)
- 15 no. Rotary Core follow-on boreholes into bedrock to depths of 10 m BGL.
- 23 no. Trial Pits to depths of 4.5 m BGL or practical refusal
- 11 no. Groundwater monitoring installations, of which: four are located within bedrock and seven located within the overburden
- One Surface water installation within the reservoir location
- Six Slit Trenches with sampling and photographs to depths of 2.0 m BGL or refusal whichever occurred first to detect the existing services
- Seven Foundation Inspection Pits to record the foundations of the adjacent buildings
- Three groundwater level monitoring dataloggers in the bedrock installations (BH308, BH311, BH314)
- Installation of a groundwater level monitoring datalogger in the surface water installation within the reservoir
- Downhole colour (or optical if deemed necessary) televiewer survey within selected boreholes (BH301, BH302, BH303, BH304) to record spacing, dip, and azimuth of discontinuities in underlying bedrock
- Geotechnical sampling and laboratory testing
- Geo-environmental sampling and testing
- Groundwater sampling and testing (for all installations)
- Surface water sampling and testing;
- Ground gas monitoring; and
- Factual reporting, including AGS format files (to include for laboratory test data) with investigation data.

Exploratory locations are presented in Figure 10-10.

Gas level measurements were taken in accordance with CIRIA C665:2007 and performed using a calibrated gas meter. Gas results and flow rate measurements were recorded during each of the 6no. monitoring events undertaken between 7th August and 22nd September 2025.

Representative environmental soil samples were collected by PGL from selected window sample boreholes, trial pits and boreholes across the Site. Soil samples were taken at regular depth intervals for environmental testing. 61no. soil samples were subsequently scheduled for laboratory analysis for a comprehensive suite of parameters.
Full details of the ground investigation are presented in the Final Ground Investigation Report prepared by PGL (2025) and presented in Appendix 10-1.

No difficulties were encountered during the data collection and assessment stages of this land, soils and geology assessment.

10.2.1. Soil Screening Criteria

In the absence of specific Irish guidelines on soil quality, available analytical results for soil samples collected from the site were compared to Generic Assessment Criteria (GAC) for human health risk assessment. These GAC for soil are from the United Kingdom and are used for guideline purposes as they have no statutory basis in Ireland. Use of these GAC are recommended in EPA Guidance '*Management of Contaminated Land & Groundwater at EPA Licenced Sites'* (EPA, 2013).

For preliminary screening purposes the following soils GAC have been used in this assessment:

- Generic Assessment Criteria (S4ULs) LQM/CIEH [1] (Copyright Land Quality Management Limited reproduced with permission; publication number: S4UL3697. All rights reserved); and,
- Development of Category 4 Screening Levels (C4SL) for Assessment of Land Affected by Contamination.

To support the evaluation of potential risks to human health via direct contact exposure (inhalation of dust, accidental ingestion and dermal contact) and vapour inhalation, soil data have been screened against published Department for Environment, Food and Rural Affairs (DEFRA Category 4 Screening Levels (C4SLs).

C4SLs have been published by DEFRA (DEFRA, 2024) for the following contaminants: benzene; benzo(a)pyrene, lead, arsenic, cadmium, chromium, Vinyl Chloride; trichloroethene; tetrachloroethene; trans-1,2-dichloroethene; cis-1,2-dichloroethene; 1,2-dichloroethane; naphthalene; and PFAS. The UK Environmental Protection Act 1990 Contaminated Land Statutory Guidance (DEFRA, 2012) includes a categorisation for land contamination assessment, ranging from Category 4 (low risk) to Category 1 (significant / high risk). C4SLs are set at contaminant levels which are not representative of a Significant Possibility of Significant Harm (SPoSH) and, as such, where concentrations are below these levels a site would not be classed as Contaminated Land.

The results were screened against the Residential without plant update Soil Screening Values (SSVs) due to the proposed end use of the site. SSVs are available for a variety of land uses based on Soil Organic Matter (SOM) contents of 1% and 6%. The 1% values provide more conservative SSVs and are based on a sandy soil type, whereas the 6% values are based on a sandy loam soil type. For the purposes of this assessment, and taking a conservative approach, SSVs relating to a SOM of 1% have been adopted.

All available soils analytical results are presented in Appendix 10.2 and were screened against the relevant GAC as identified above. It should be noted that the following assumptions have been made when screening relevant soil analytical data:

- Human health GQRA comprises comparison of chemical analytical results for soil samples against appropriate GAC to assess the risk associated with the unsaturated soil source;
- Concentrations of contaminants which fall below the relevant GAC are not considered to represent an unacceptable risk; and,
- Any contaminants that exceed their respective GAC are termed Contaminants of Potential Concern (CoPC) and may require further assessment.

10.2.2. Impact Assessment Criteria and Significance of Effects

The following methodology has been used to assess the impacts to land, soils and geology as per IGI, 2013 guidance. This assessment has also been prepared in accordance with, and is fully compliant with the relevant Environmental Protection Agency (EPA) guidance, 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' published in May 2022, specifically with regard to the significance of effects (as per 'Table 3.4 Descriptions of Effects' of these Guidelines) of the proposed development on the receiving land soils and geology environment.

Table 10.1: Impact Classification Terminology

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 of the environment without affecting its sensitivities
	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
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasing for one year or less
Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminable	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 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 impacts arising from a development in the case where the mitigation measures may substantially fail

Table 10.2: Criteria for Rating Site Importance of Geological Features (IGI, 2013)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

Table 10.3: Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Geological Attribute (IGI, 2013)

Magnitude of Impact	Criteria	Typical Example
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment

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 Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment
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 Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils Requirement to excavate / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
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 10.4: Rating of Significant Environmental Impacts at EIS Stage (IGI, 2013)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

10.3. EXISTING RECEIVING ENVIRONMENT

This section provides a description of the land, soils and geology in the general region of the Masterplan Site, and also takes account of the current and historic uses of the Masterplan Site.

10.3.1. Site Development

A review of historic mapping resources including 6-inch and 25-inch maps, as well as aerial photographs spanning from 1995 to 2018 (Ordnance Survey Ireland, OSI, 2025) alongside current aerial imagery (Bing

Maps, 2025), confirm that land use in the vicinity of the proposed development has undergone significant transformation over time. The area has evolved from predominantly brownfield conditions to more developed land uses. Notably, the surrounding lands have experienced substantial urbanisation and infrastructure development since the late twentieth century.

The site was originally used for agricultural purposes. By 1839, there was an active dock yard located in the southern portion of the site operated by the Limerick Ship Company. During the 1850s, the site underwent rapid development associated with linen factory production and Cleeve's Condensed Milk Factory was built, ca. 1860 (OSI, 2025). In the late-19th century, the site and buildings were used for a variety of purposes. The site conditions and majority of structures remained relatively unchanged during the 20th century. Salesian's School in the northwest of the site was established in 1924 through the purchase of existing buildings from the Cleeve family. In 1950, additional packaging stores and storerooms were constructed associated with the cheese plant.

Active use and operation on the site, including milk processing, ceased in 2011.

Figure 10-1 - Map Genie 6 Inch First Edition 1829-1841 (OSI, 2025)

No significant change noted.

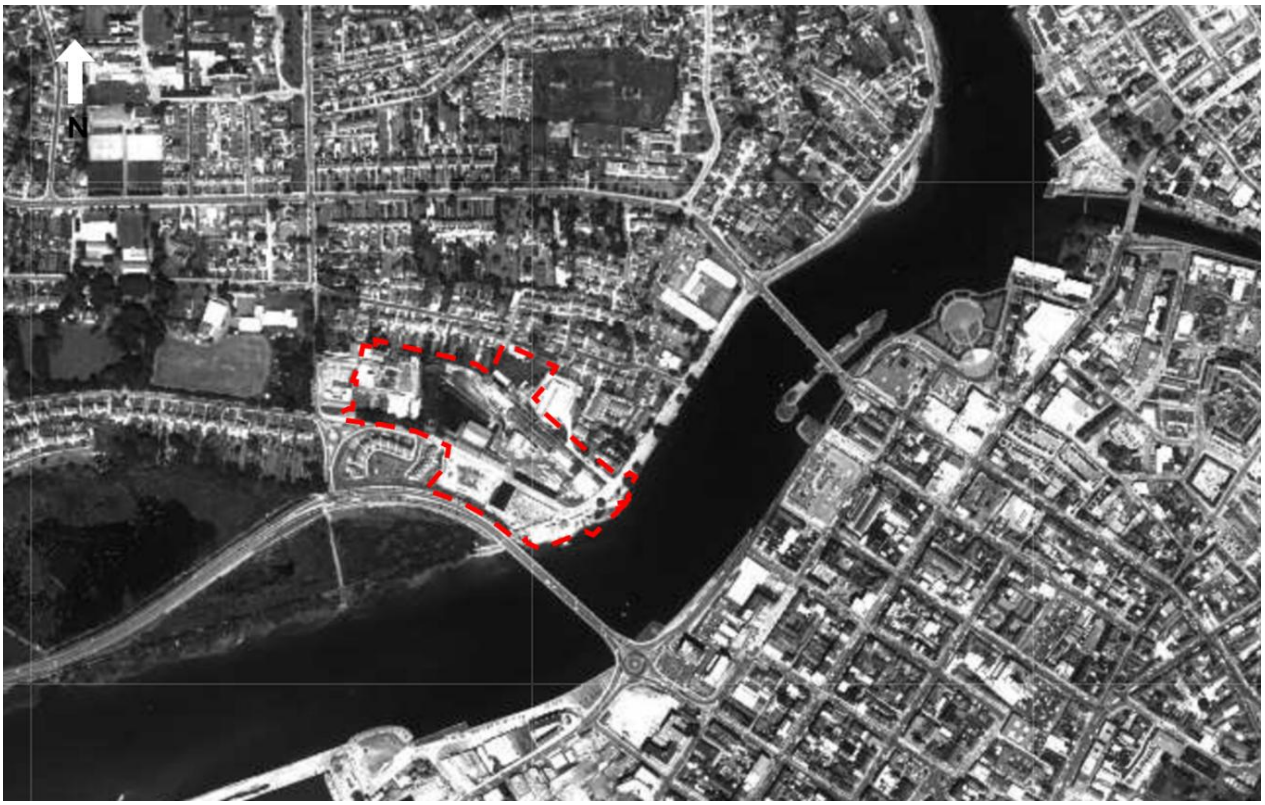

Figure 10-2 - Map Genie 25 Inch BW 1995 (OSI, 2025)

No significant change noted

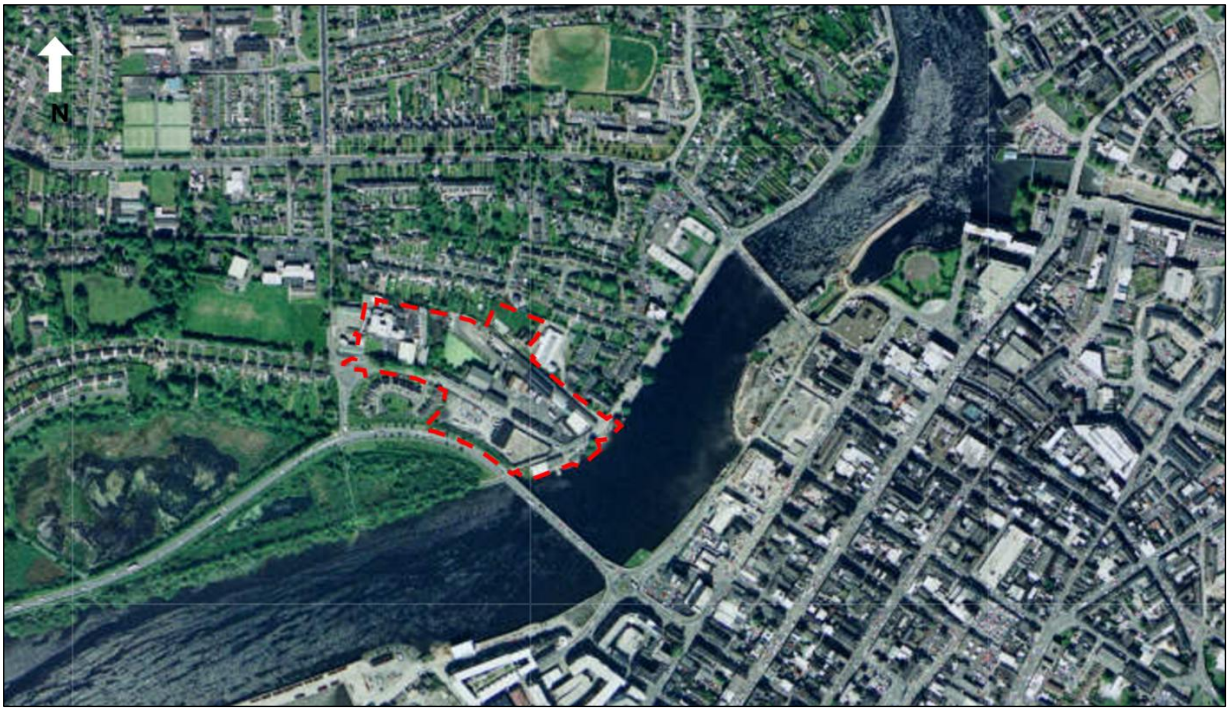

Figure 10-3 - Map Genie 1996-2000 (OSI, 2025)

No significant change noted.

Figure 10-4 - Aerial Map 2001-2005 (OSI, 2025)

The aerial photography between 2006 – 2011 shows new development constructed North West of the site as shown in Figure 10-5.

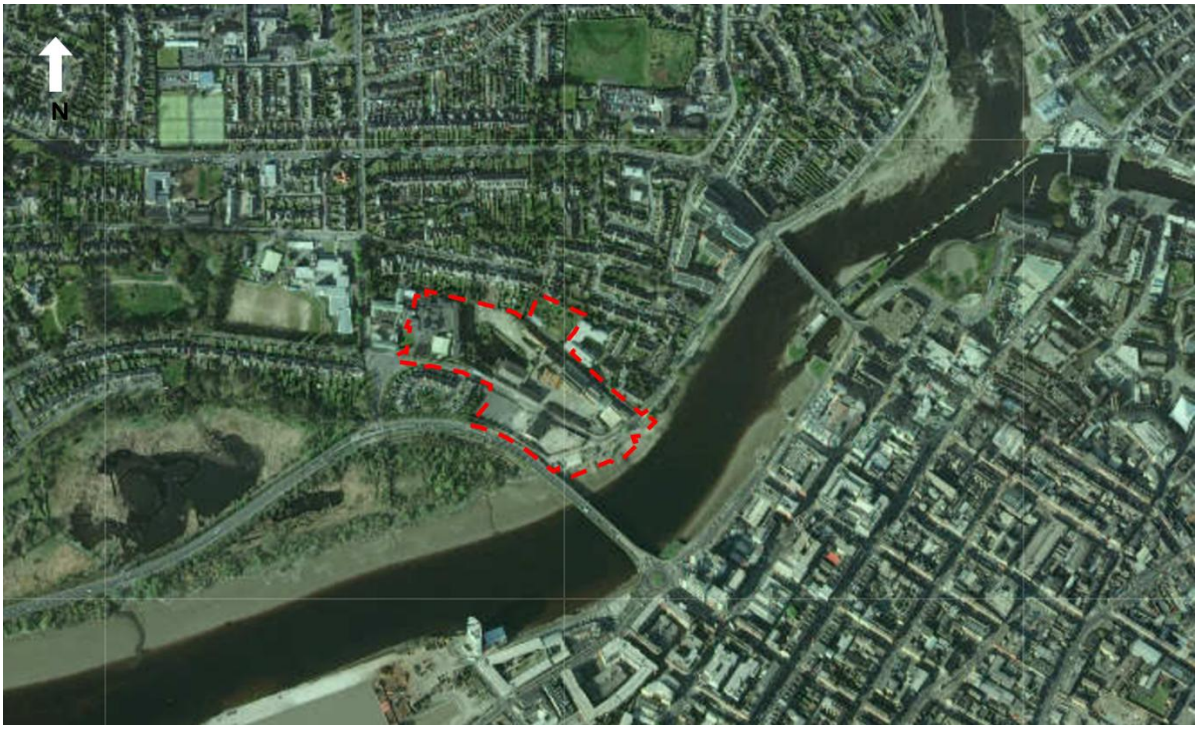

Figure 10-5 - Aerial Map 2006-2011 (OSI, 2025)

No significant change noted

Figure 10-6 - Aerial Map 2013-2018 (OSI, 2025)

10.3.2. Current Site Setting (and Topography)

The site is located to the west of Limerick City centre and the River Shannon. The site is brownfield consisting of disused industrial buildings constructed during the 19th and 20th centuries in the central portion of the site, the Salesian's School buildings in the western portion of the site, car parking facilities to the south, and St. Michael's Rowing Club boathouse along the eastern site boundary. There is a disused, flooded quarry pit in the centre of the site (refer to Figure 10-8 below). There are a number of significant heritage structures on the site such as the original early 19th century mill, the infiltration gallery, and the chimney stack.

The original topography of the site had a slight gradient from north-west to south-east and a steeper gradient from north to south sloping towards the River Shannon. However, the original topography has been substantially altered by the historical development of the site. The lowest elevations encountered across the site of approximately 1.5 mOD are associated with the disused quarry excavation in the centre of the site.

Figure 10-7- Exposed Limestone bedrock, north central portion of site

Figure 10-8 - Disused quarry excavation at the centre of the site, referred to as the 'Reservoir'.

The highest elevations are approximately 14 mOD and are encountered in the north-west of the site (former Salesian's School) and in the north of the site (Stonetown Terrace).

Additionally, there is evidence of imported material where the levels across the Stonetown Terrace portion of the site have been raised by approximately 1 to 2 m high.

10.3.3. Ground Investigation

10.3.3.1 Regional Setting

Regional site geology is obtained from the Geological survey of Ireland (GSI, 2025) and shows that the existing geological layers are predominately Marine shelf facies; Limestone & calcareous shale and made ground deposits beneath this portion of Limerick City, as discussed in detail below. A summary of available geotechnical data within the region is presented in Figure 10-9.

Figure 10-9 - Existing Boreholes (GSI, 2025)

10.3.3.2 Site-Specific Ground Investigation

The Ground investigation for the proposed development was conducted by PGL (2025). All exploratory locations completed during the Ground investigation are presented in Figure 10-10 below, and Appendix 10-1.

Figure 10-10 - Ground Investigation Locations (PGL, 2024)

10.3.3.3 Soils

Based on the Teagasc soils database available on the GSI public data viewer (GSI, 2025), the dominant soil type underlying the Site and surrounding area is ‘made ground’ with small area of ‘RckCa’ (exposed bedrock) in the centre of the proposed development site as shown in Figure 10-11. This classification is consistent with the site's historical industrial use.

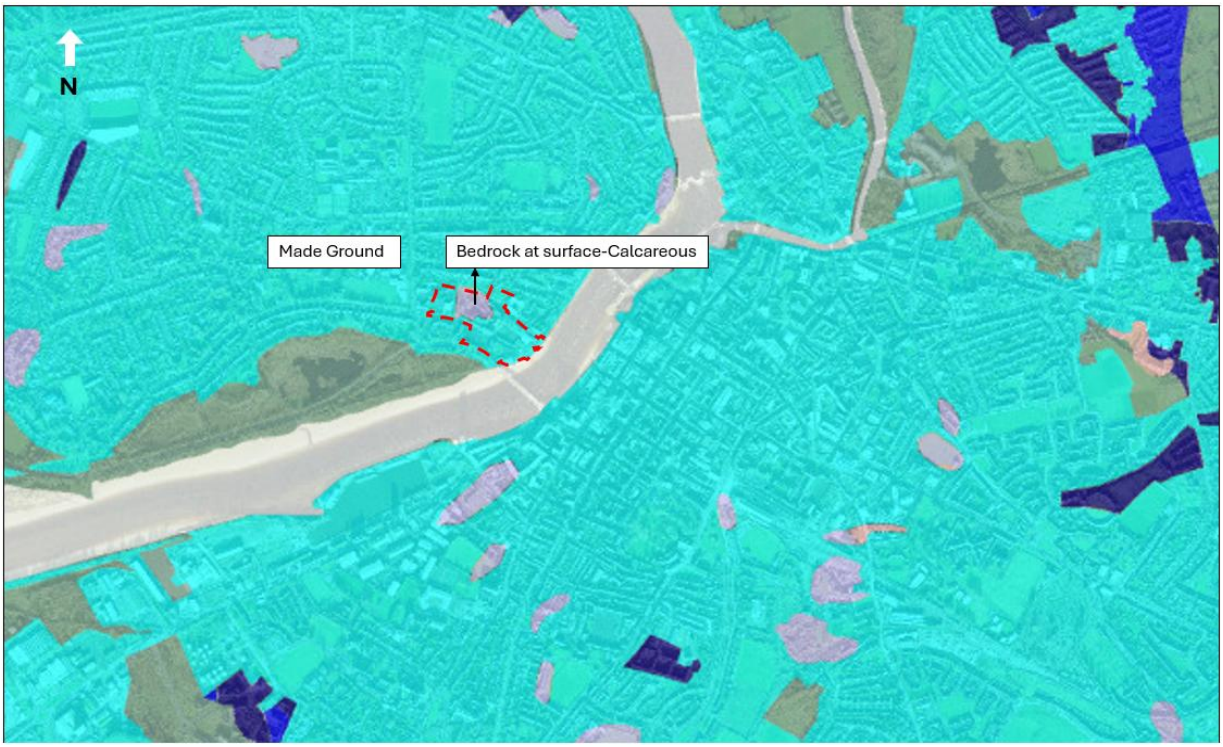

Figure 10-11 Teagasc Soil Maps (GSI, 2025)

Based on the GSI Public Data Viewer (GSI, 2025), the primary superficial (Quaternary) sediments underlying the site and its surrounding area comprise Urban sediments and Bedrock outcrop or subcrop (Rck). Esturine silts and clays are present along the River Shannon, which borders the proposed development. Refer to Figure 10-12 for a visual representation of the sediment distribution.

Figure 10-12 - Superficial / Quaternary Deposits (GSI, 2025)

10.3.3.4 Summary of Geotechnical Ground Conditions

Site Specific soils records, as observed during the Ground Investigation (PGL, 2025) are summarised within the Cleeves Riverside Quarter Structural Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025) as follows:

Salesians School Site

- Topsoil is only encountered in one exploratory location (BH301) from ground level to a maximum depth of 0.3 m BGL;
- Made ground is extensive across the Salesian's School site. Made ground in the form of surfacing tarmacadam or concrete hardstanding is encountered at ground level to a maximum depth of 0.3 m BGL;
- Both the topsoil and surfacing made ground is underlain by fill material made ground. At the Salesian's School site, the fill material is encountered from 0.1 to 0.3 m BGL to a maximum depth of 2.6 m BGL;
- Fill material described as reddish brown / brown / dark brown / grey / dark grey, slightly sandy to very sandy slightly gravelly to gravelly slightly clayey to very clayey CLAY / SAND / GRAVEL with occasional to medium cobble and boulder content and inclusions of red brick fragments, concrete, tiles, plastic timber, glass. Sand is fine to coarse.
- The extensive made ground at the Salesian's School site is underlain by glacial subsoils encountered from 0.3 to 1.5 m BGL to a maximum depth of 4.2, being typically described medium dense greyish brown to brown clayey, sandy to very sandy, gravelly CLAY / SAND / GRAVEL with low to high cobble content.
- Gravel is fine to coarse angular to sub-rounded. Cobbles are angular to sub-rounded, limestone lithology, 63-200mm diameter.

- The glacial subsoils is underlain by bedrock lithology encountered from 0.7 to 4.2 m BGL, being typically described as Strong, grey LIMESTONE. Slightly to moderately weathered. Minor clay accretion present on fracture surfaces with small areas of brecciation noted.

Stonetown Terrace site

- Made ground was encountered across the Stonetown Terrace site from ground level to a maximum depth of 2.7 m BGL, being typically described as soft to stiff, reddish brown to dark brownish black, very clayey, silty, slightly sandy to very sandy, gravelly to very gravelly CLAY / SAND / GRAVEL with organic matter, red brick fragments, construction rubble, waste material (plastic, silicon, slate tile, wires) and low to high cobble and boulder content. Boulders are sub-angular, limestone lithology, 200 t0 >850mm in diameter;
- The extensive made ground across the Stonetown Terrace site is predominantly underlain by fine grained glacial subsoils encountered during open hole drilling from 1.5 to 2.5 m BGL to a maximum depth of 14.5 m BGL, being typically described as stiff, reddish brown, slightly sandy gravelly CLAY;
- Coarse grained glacial subsoil, typically described as BOULDERS, is also present in the Stonetown Terrace site being encountered in BH307 at 2.7 m BGL to a depth of 4.5 m BGL;
- The fine grained and coarse grained glacial subsoils are underlain by bedrock lithology encountered from 3.0 to 14.5 m BGL, being typically described as strong to very strong, fossiliferous LIMESTONE, slightly weathered.

Flax Mill Site (PBSA / Quarry Building

- The made ground encountered during the PGL 2025 GI includes surfacing layers and underlying fill material. The surfacing layers, typically described as tarmacadam surfacing or concrete hardstanding, are encountered from ground level to 0.2 to a maximum depth of 0.3 m BGL;
- The underlying fill material is encountered from ground level to 0.3 m BGL to a maximum depth of 2.9 m BGL, being typically described as light brown to black, slightly clayey to very clayey, slightly sandy to very sandy, slightly gravelly to gravelly CLAY / SAND / GRAVEL with low to high cobble and boulder content with red brick fragments and waste materials (timber, glass, pottery). Boulders are sub-angular to sub-rounded, limestone lithology, 200-500mm in diameter.;
- Made ground is underlain by coarse grained and fine grained glacial subsoils. Coarse grained glacial subsoils are only encountered within the Flax Mill site at BH315 at a depth of 1.5 to 3.7 m BGL, being typically described as greyish reddish brown to brown very silty, very sandy GRAVEL. Sand is fine to coarse;
- The majority of the made ground across the Flax Mill site is underlain by fine grained glacial subsoils, which are encountered from 1.8 m BGL to 2.9 m BGL to a maximum depth of 5.1 m BGL, being typically described as firm to stiff, light brown to greyish brown, slightly sandy, slightly gravelly to gravelly CLAY / SILT with medium cobble and boulder content;
- The glacial subsoils are underlain by bedrock lithology which is encountered at 2.5 to 5.1 mBGL within the Flax Mill site. The bedrock encountered is typically described as strong to very strong, unweathered to moderately weathered LIMESTONE.

Shipyard Site (O'Callaghan Strand Building)

- Made ground, typically described as tarmacadam surfacing or concrete hardstanding is encountered from ground level to a maximum depth of 0.6 m BGL.
- The surfacing made ground is underlain by made ground fill material encountered at 0.1 m BGL to 0.6 m BGL to a maximum depth of 2.5 m BGL, being typically described as brown / grey to

black silty, clayey to very clayey, slightly sandy to very sandy, gravelly CALY / SAND / GRAVEL with low to high cobble content and occasional boulders with timber, red brick, mortar, metal, and concrete fragments, and ash. Boulders are angular to sub-angular, limestone lithology up to 600mm in diameter.;

- Made ground is underlain by interbedded lenses of fine grained and coarse grained glacial subsoils. The fine grained glacial subsoils are encountered from 1.0 m BGL to 7.0 m BGL to a maximum depth of 7.5 m BGL and are typically described as soft to stiff brown to greyish black, slightly sandy slightly gravelly CLAY with low cobble content;
- The coarse grained glacial subsoils, encountered from 1.2 m BGL to 5.5 m BGL to a maximum depth of 7.0 m BGL, are typically described as medium dense to dense, greyish brown, slightly clayey, slightly silty to very silty, gravelly SAND / GRAVEL with high cobble content;
- The glacial subsoils are underlain by bedrock lithology which is encountered from 2.4 m BGL to 7.5 m BGL. The bedrock encountered is typically described as medium strong to very strong, grey to dark grey, LIMESTONE, unweathered to highly weathered.

Refer to the Final Ground Investigation report prepared by PGL (2025) which includes a full set of all exploratory hole logs, water and ground gas monitoring records, and soil and water laboratory reports, and is presented in Appendix 10-1. Schematic geological cross sections across the site of the proposed development are presented in the Cleeves Riverside Quarter Structural Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025). Two key sections, in a general West - East direction (Section A A'), and general North - South direction (Section D D') are presented in Figure 10-13 and Figure 10-14 respectively (taken from Cleeves Riverside Quarter Structural Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025)[1].

[1] Note – sections provided for schematic purposes only, geological conditions and levels are indicative only. Site specific geological records to be reviewed / supplemented by Contractor(s) as required for the Construction Phase.

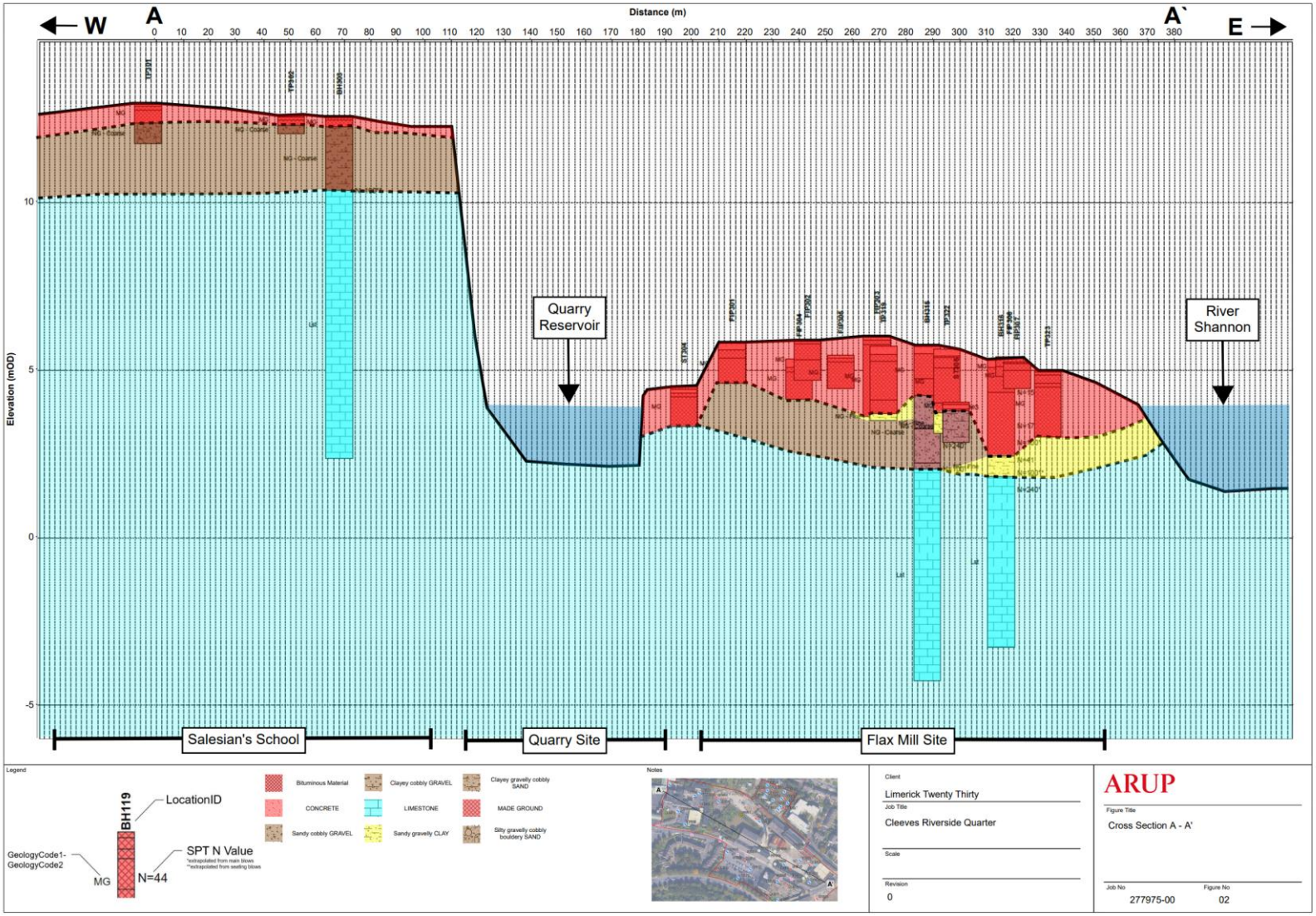

Figure 10-13 – Schematic Geological Section A-A' across the Proposed Development Site (West to East direction) (taken from Cleeves Riverside Quarter Structural Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025) (provided for schematic purposes only, geological conditions and levels shown provide an indicative summary)

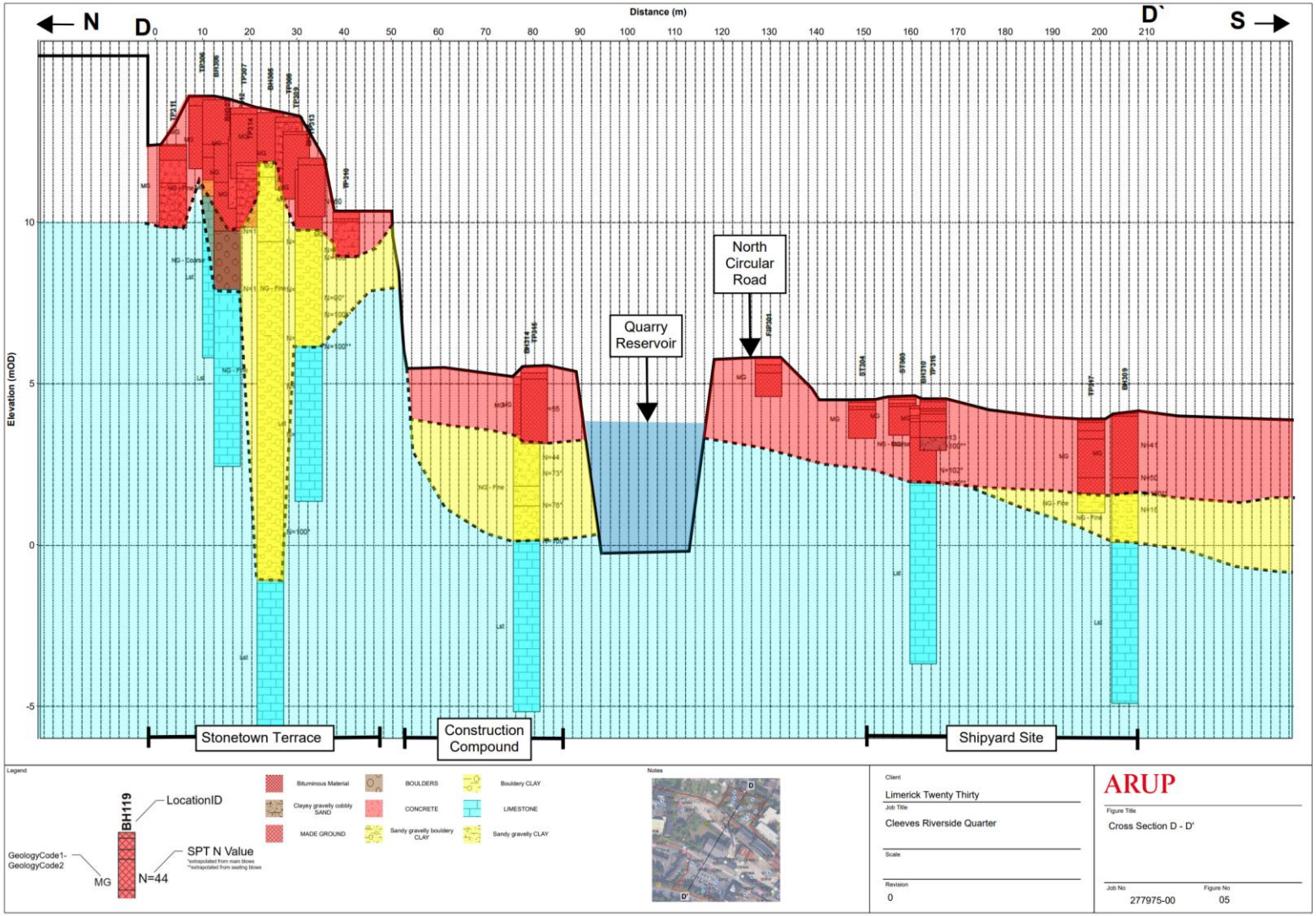

Figure 10-14 Schematic Geological Section D-D' across the Proposed Development Site (North to South direction) (taken from Cleeves Riverside Quarter Structural Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025) (provided for schematic purposes only, geological conditions and levels shown provide an indicative summary)

10.3.3.5 Soil Quality / Contaminated Land

On a regional scale, there are 2no. EPA-licensed waste facilities and 4.no EPA licensed industrial facilities (IE, IPC, and IPPC) located within the vicinity of the proposed development (refer to Figure 10-15). These include:

- Former Racecourse (Reg: W0259-01), located ca. 2.05km southwest of the Proposed Development. The EPA (2025) states the status of the facility licence has been withdrawn;
- Valcroft Ltd Company (site code: P1136), located ca. 2.65km southwest of the Proposed Development;
- J.H Roche and Sons Limited (site code: P1048), located 2km southwest of the Proposed Development;
- James McMahon Limited (site code: P0329), located ca. 1.5km southwest of the Proposed Development;
- Atlas Aluminium (Site code: P0436); a surrendered licence located ca. 1.3km southwest of the Proposed Development
- Longpavement Landfill site (Reg: W0076-01) located ca. 1.86km north of the Proposed Development

Additionally, there is an active dump site operated by Shannon Foynes Port Company (site code: S0009-03), primarily used for the disposal of dredged material located ca. 0.43km southwest of the proposed development.

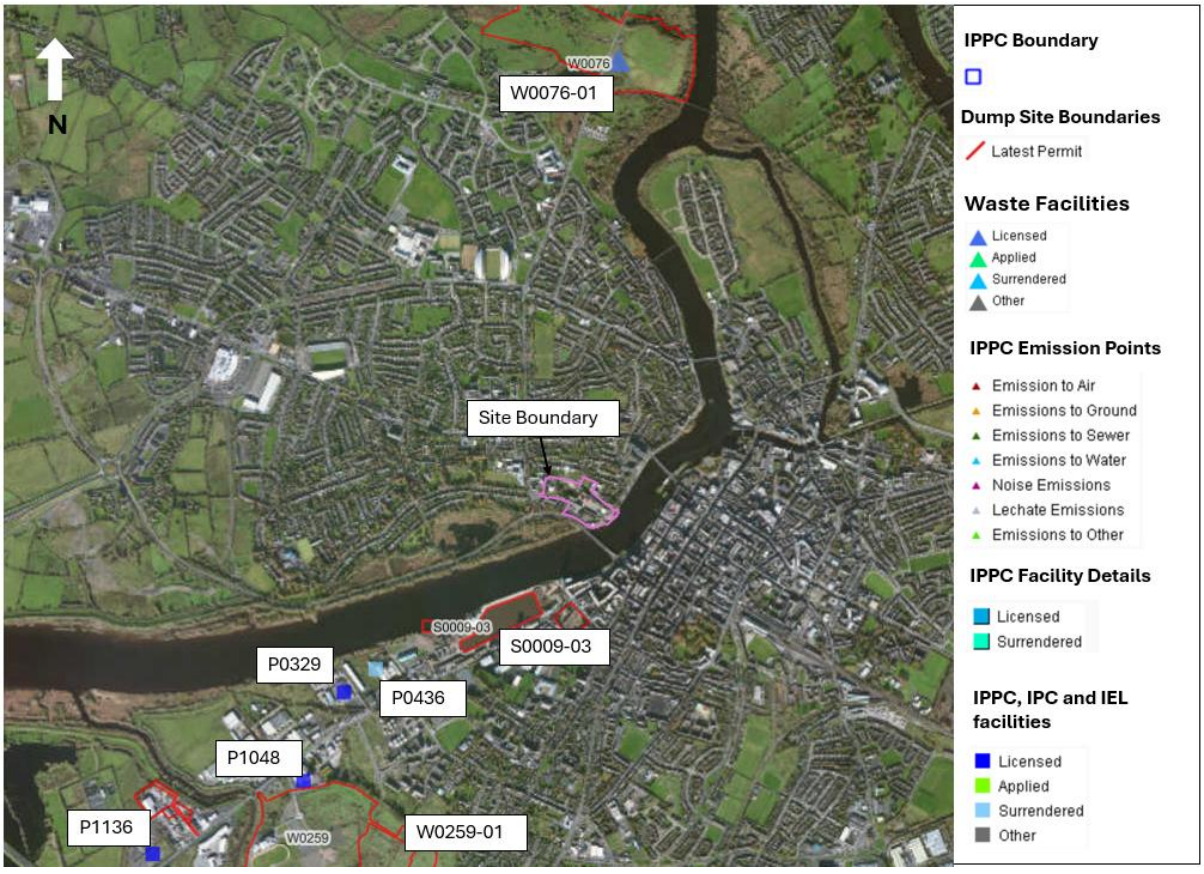

Figure 10-15 - EPA Licenced Facilities in the Vicinity of the Site (EPA, 2025)

During the 2025 Ground investigation (PGL, 2025), C&D waste material (including red brick fragments, construction rubble, plastic, silicon, slate tile, and wiring) was identified in made ground beneath the proposed Stonetown Terrace development. It is understood that this material was brought to site during previous construction works in the area. In addition, physical / olfactory evidence of potential hydrocarbon contamination was identified within the exploratory hole records for the 2025 Ground investigation (PGL, 2025).

61no. representative environmental soil samples were collected during the 2025 Ground investigation (PGL, 2025) at representative locations across the Site and analysed for a comprehensive suite of analytical parameters by a UKAS accredited laboratory (including asbestos containing material, heavy metals, key indicator parameters, petroleum hydrocarbons, polyaromatic hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs) and the full Rilta Waste Acceptance Criteria (WAC) soil disposal suite). All soil analytical results were subsequently evaluated by the author of this chapter.

Risk of Potential Current or future impacts to Human Health - Based on the soils analytical data, 8no. contaminants of potential concern with regards to human health risk (based on 'Residential without plant uptake' land use) (in 17no. of 61no. samples) have been identified within the soils and made ground beneath the Site. Results are summarised as follows:

- Asbestos Containing Material (ACM) in the form of Fibre/Clumps identified in 3no. samples (BH308, BH305 and BH306, all at 0.50m BGL). Asbestos was also identified in 2no. samples (BH305 and BH306, both at 0.50m BGL) in the form of Chrysotile.
- Arsenic levels range from 2.7mg/kg to 86mg/kg. Exceedances (with respect to the relevant soils Generic Assessment Criteria (GAC) were identified in 3no. locations (TP309, 1m BGL (43mg/kg); TP321, 1.5m BGL (47mg/kg); BH309, 2.5m BGL (86mg/kg)).
- Lead levels ranging from 9.2mg/kg to 6400mg/kg. Exceedances were identified in 11no. samples (BH307, 0.50m BGL (580mg/kg); BH311, 2.5m BGL (690mg/kg); BH311, 0.5m BGL (6400mg/kg); BH310, 1.5m BGL (370mg/kg); TP303, 2.0m BGL (330mg/kg); TP322, 0.5m BGL (4500mg/kg); TP317, 2.00m BGL (550mg/kg); TP320, 1.00m BGL (970mg/kg); TP321, 1.50m BGL (1200mg/kg); BH309, 2.50m BGL (4900mg/kg); TP318, 0.50m BGL (1500mg/kg)).
- Benzene: One exceedance was identified at BH314 (2.00m BGL, 1mg/kg);
- Naphthalene: One exceedance was identified at TP321 (0.75m BGL, 58mg/kg);
- Fluoranthene: One exceedance was identified at TP321 (0.75m BGL, 2100mg/kg);
- Benzo[a]pyrene: Exceedances were identified in 4no. samples (BH311, 0.5m BGL (7.2mg/kg); TP303, 2.0m BGL (16mg/kg); TP321, 0.75m BGL (870mg/kg); and TP321, 1.50m (27mg/kg)); and,
- Total Petroleum Hydrocarbons (TPH): Potential sources of TPH measured by the presence of PAHs in the soil were identified in 3no. samples (BH311, and TP321).
    - BH311 at depth 0.5m BGL. The ground examined comprised (Made Ground) Black, slightly sandy, gravelly silt. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular. The PAH Double Plot ratio indicated that high TPH concentration was derived from coal tar and creosote which can be identified by the dark brown to black colour of sampled material.
    - TP321 at depth 0.75m BGL. The ground examined comprised (Made Ground) Black, sandy gravel with macadam and glass pieces. Sand is fine to coarse. Gravel is fine to medium and angular to sub-angular.

- TP321 at depth 1.5m BGL. The ground examined comprised (Made Ground) Orangey brown, very clayey, very sandy gravel with medium cobble content with waste materials (metal, ash, brick). Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular. The PAH Double Plot ratio for TP321 indicated that high TPH concentrations were derived from refined coal tar. Tar macadam could be identified in the trial pit and was noted in strata description.

Refer to Appendix 10-2 for tabulated soil analytical results, screened against the relevant Soils Human Health Generic Assessment Criteria (GAC).

Based on the above results, ground conditions pose a potential human health risk (via. direct contact, inhalation) to construction workers and onsite visitors (demolition and construction phase) and to site users (operational phase). Made ground / subsoil in these locations is unsuitable for future residential land use and will require management and appropriate disposal where required as part of the proposed enabling works during the Construction Phase.

Waste soil classification for offsite disposal (as required) including identified asbestos material - As part of the PGL 2025 GI, 61 no. geo-environmental samples were tested and screened in terms of their Waste Acceptance Criteria (WAC) as defined in the Landfill Directive (2002) to categorise the samples in terms of suitable disposal locations. According to ARUP (2025) (CRQMP-ARUP-ZZ-ZZ-RP-S-0001), '*based on the findings of the PGL 2025 GI and the results of the geo-environmental testing, the following can be stated:*

- *Due to the extensive made ground across the site, there was minimal sampling and testing of the underlying glacial subsoil material. Of the glacial subsoil samples tested, three samples are suitable for disposal to a Soil Recovery Facility in all local domains (Domain 1, Domain 2, Domain 4, and Domain 5). One glacial subsoil sample tested is suitable for disposal to an inert licenced landfill facility (BH314), and one sample is suitable for disposal to a non-hazardous licenced landfill due to elevated levels of Total Organic Carbon (TOC) (TP301);*
- *Trace levels of asbestos (<0.001%), in the form of Chrysotile, was encountered at three exploratory locations, all of which were located in Stonetown Terrace (BH305, BH306 and BH308);*
- *The majority of the made ground material tested is suitable for disposal to an inert licenced landfill;*
    - *One made ground sample (BH309) is suitable for disposal to a non-hazardous licenced landfill due to elevated TOC;*
    - *Seven of the samples tested were categorised as hazardous, with the European Waste Code (EWC) 17 05 03*, all located in the Shipyard site (BH309, BH311, TP318, TP320, TP321, and TP322). The material tested was classified as hazardous due to elevated levels of heavy metal concentrations including Copper, Lead, and Zinc. One sample (TP321 at 0.75 m BGL) also displayed elevated levels of Polycyclic aromatic hydrocarbons (PAHs) (phenanthrene, anthracene, and fluoranthene);*
    - *Seven other samples were classified as non-hazardous (with the EWC 17 05 04), require disposal to a hazardous licenced facility due to exceeding the limits for acceptance into a non-hazardous licenced facility.'*

10.3.3.6 Bedrock Geology

Based on the GSI Bedrock Geology 100k and 500k maps, the underlying bedrock geology of the proposed development is predominantly composed of Carboniferous limestone formations, typical of the region. These include units of Visean Limestones (undifferentiated) and bedrock outcrops.

Limestone formations are generally well-suited for construction, though their karstic nature may require specific geotechnical considerations. In urbanised areas such as Cleeves, these bedrock units are often overlain by made ground, reflecting the site's historical industrial use and extensive modification over time.

Figure 10-16 - Map showing bed rock geology (100K) (GSI, 2025)

As presented in Figure 10-17, the proposed development is underlain by Marine shelf facies; Limestone and calcareous shale.

Figure 10-17- Bedrock Geology from GSI (500K) (GSI, 2025)

There are 3.no karst features identified within a 7km radius of the site, as illustrated in Figure 10-18. These include:

- Turlough (Karst ID: IE_GSI_Karst_40K_5954): Located ca. 5.27 km Southwest of the site.
- Loughmore Common (Karst ID: IE_GSI_Karst_40K_603): Located ca. 5.57 km southwest of the site.
- Swallow hole (Karst ID: IE_GSI_Karst_40K_2496) located ca. 7 km northeast of the site. GSI (2025) states '*Local knowledge indicates the presence of various sinkholes in the area, typically 2m in diameter and 1m deep. The limestone is Waulsortian limestone.'*

Figure 10-18- Map showing the Karst features in the study area (GSI, 2025)

10.3.3.7 Geo-hazards

There are no landslide events located within the general vicinity of the proposed development as presented in Figure 10-19.

Figure 10-19- Landslide events map (GSI, 2025)

Ground gas sampling was carried out at 5no. representative boreholes (BH305, BH306, BH307, BH308, and BH312) across the Site, as shown on Figure 10-10. 6no. gas monitoring events were carried out between 7th August and 22nd September 2025.

Gas monitoring data (including CH4 (%), CO2 (%), O2 (%), CO (%), H2S (%), Balance (%), Barometric Pressure (mb) and Gas Flow (l/hr)) is presented in Appendix 10-3. The gas monitoring results were classified according to the Characteristic Situations outlined in CIRIA C665 (2007) documentation 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'.

Based on the results of the gas monitoring programme, 4no. of the 5no. monitoring locations are deemed to be at 'very low risk' (Characteristic Situation (CS)1) with respect to ground gases, with one area (BH307) which is been deemed to be 'at low risk' (CS2), with respect to ground gas, due to marginally elevated concentrations of carbon dioxide. According to CIRIA C665 the typical sources of gases associated with CS1 is 'Natural soils with low organic content, typically made ground' and CS2 is 'Natural soils with high organic content, typically made ground' (CIRIA 665, 2007).

Refer to ground gas monitoring results presented in Appendix 10-3. The borehole (BH307) where elevated concentrations of carbon dioxide were observed is located in the northern, raised portion of the Site, in the vicinity of the proposed Stonetown Terrace development (screened in boulders / shallow limestone bedrock).

10.3.3.8 Geological Heritage

There are 2no. Geological Heritage Areas (GHA) in close proximity to the site, as presented in Figure 10-20.

Mungaret Quarry (LK026) is located ca. 3.50km southwest of the site. The GSI (2025) states *'This site is a complex of extensive branching network of pit offshoots, in a large, active quarry, which produces limestone for cement manufacture. Mungret Quarry is one of the largest quarries in the country, and given its long history and importance to the region economically, it is recommended for designation as a County Geological Site. The bedrock at the site is of Mississippian (Lower Carboniferous) limestone.*' The N18 Roadcut Ballykeefee (LK027) is located ca. 2.90 km southwest of the site.The GSI (2025) states '*Road cut excavated through limestone bedrock on the N18 route east of the Limerick Tunnel. The limestone visible in the road cut exposures along this stretch of the N18 Limerick Southern Ring Road near Junction 2 provides an insight into the strata and structure of the Carboniferous bedrock in this region of Limerick City. The road cut is around 200m long, with horizontal beds exposed along both the north and south sides of the road.'*

The proposed project will not result in any likely environmental effects to designated GHAs.

Figure 10-20- Geological Heritage Areas (GSI 2025)

10.3.3.9 Mineral Occurrences

Figure 10-21 shows there is 1no. non-metallic mineral locality (Ref:1902) within the proposed development. GSI (2025) identified the key mineral at the locality as Calcite. The GSI (2025) comments '*5ft. wide calcite vein with nearly clear crystals found in cutting foundations (1946). Only locality in Ireland of Iceland Spar variety of calcite'*.

Figure 10-21- Mineral Localities (GSI 2025)

10.3.3.10 Radon

A radon risk map was reviewed to assess the potential for elevated indoor radon concentrations within the study area. The EPA radon map for the area is presented in Figure 10-22 shows that towards the north of the proposed development 'about 1 in 20 homes in this area is likely to have high radon levels. The rest of the site shows an elevated risk of radon with about 1 in 10 homes in this area is likely to have high radon levels.

Figure 10-22 - Regional Radon Levels (EPA, 2025)

10.4. CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

Activities during demolition and construction will primarily comprise of:

- The demolition of the following structures (i) Salesians Secondary School and Fernbank House; (ii) 2 no. houses on North Circular Road; (iii) Residual piers from the basin of the reservoir; (iv) Upper Reservoir on Stonetown Terrace comprising 2 no. concrete water tanks, pump house and liquid storage tank; (v) 1960's lean-to building structures adjoining the Cold Store (former Weaving Mill); (vi) remaining fabric of c20th rear lean-to of the Flaxmill Building; (vii) c.1960s office building adjoining the Packing Store and Cheese Plant on North Circular Road; (viii) Cluster of buildings including altered part of the Linen Store, the former Linen Store, Storage Building, and Office/Lab building at O'Callaghan Strand / Stonetown Terrace with partial retention of existing stone wall; (ix) warehouse on the Shipyard site; and (x) partial removal of stone boundary wall defining the Cleeves site adjoining O'Callaghan Strand / Stonetown Terrace and around the Shipyard site.
- It is provisionally estimated that approximately 46,100 m³ (or 98,120 tonnes) of excavated material will be generated. The made ground is considered unlikely to be suitable for reuse due to its composition and potential contamination, therefore, approximately26,800 m³ (or 50,920 tonnes) is expected to require off-site disposal to licensed facilities.
- The remaining 19,300 m³ (or 47,200 tonnes) of excavated subsoils and rock are likely to be suitable for reuse on site to in line with circular economy principles. Excavated rock will also be crushed on site using a mobile crusher, to facilitate reuse within the development.
- The construction of 234 no. residential units; (b) 270 no. student bedspaces with ancillary resident services at ground floor level; (c) 256sqm of commercial floorspace; and (d) a creche (height ranging across the site from 3 – 7 storeys).
- Dedicated mobility hub with canopy and photovoltaic panels including double stacker bicycle parking; and EV Charging spaces, within the Shipyard Zone, temporary car parking and a temporary external event space, areas of civic and green spaces, a riverside canopy with photovoltaic panels functioning as an outdoor event space. All topsoil required for landscaping purposes will be imported to site.
- Site development works including (a) water services, foul and surface water drainage and associated connections across the site and serving each development zone; (b) attenuation proposals; (c) raising the level of North Circular Road between Fernhill and O'Callaghan Strand; (d) refuse collection store (e) car and bicycle parking; (f) public lighting; (g) all landscaping works.; and (h) temporary construction measures including (i) construction access to the Quarry site including provision of a temporary access across the reservoir; and (ii) temporary use of onsite mobile crusher.

During the construction stage, tracked excavators will likely be sufficient to excavate made ground (fill), glacio-fluvial subsoils, and bedrock across the Site in order to achieve proposed formation levels. The extent of excavation for service / utility trenches will vary. All excavations are anticipated to encounter made ground / sandy silt / clay and/or gravel. Rock breaking will be required in areas where shallow bedrock is encountered.

Given the existing ground conditions, ground improvement works are required to facilitate the construction stage of the proposed development. The preliminary foundation strategy for the proposed development is described as follows.

The formation levels for the foundations will be chosen such that there is a reasonably consistent bearing stratum under each individual building to negate differential settlement. All made ground beneath proposed structure floor plans will be excavated. Based on the results of the environmental soil sampling (as discussed in Section 10-3 of this assessment), excavated material from the following locations is unsuitable for reuse onsite: beneath the proposed PBSA / Quarry Building, Stonetown Terrace Building, and O'Callaghan Strand Building. This material will be disposed of to an appropriately licenced permitted facility in accordance with current waste legislation. As per the preliminary design, excavated material from beneath the Salesians site could be retained on site for suitable reuse, subject to compliance with structural engineering requirements.

10.4.1. Foundations

Pad foundations and strip footings will be used to support columns, superstructure walls and or core walls. Lean mix upfill will be required from the underside of the pad foundations down to competent bearing stratum or rock. The formation level for the foundations will be 1m below the ground floor level of the buildings to allow sufficient space for the buildup to the ground floor slab and for services coming into the building. Based on available information received, the only building that will require a piled solution is Stonetown Terrace Apartments. Ground beams, pile caps and cores supported by bored piles are proposed for this building. Sections through strip, reinforced concrete (RC) pad footing and pile cap foundations are presented in Figure 10-23 (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025).

A brief description of the typical methodology for each foundation type is provided as follows:

- During the construction phase, pad and strip foundations will be built by first excavating the site to the required depth, followed by setting out and installing formwork to hold the shape of the foundation. Steel reinforcement is placed within the formwork, and concrete is poured to fill the trenches or pits. After the concrete cures, the formwork is removed, and the foundation is backfilled.
- Bored piles are carried out where the removal of spoil forms a hole for a reinforced concrete pile which is poured in situ. They are drilled using buckets and/or augers driven by percussion boring which involves a cutting tool which is dropped using a winch to cut out a cylinder of earth. The operation is repeated until the hole has been sunk to the required depth. At the required depth, concrete is poured using a tremie pipe method and the reinforcement is lowered into the concrete. As the concrete reaches the hole's upper level, the temporary casing is withdrawn

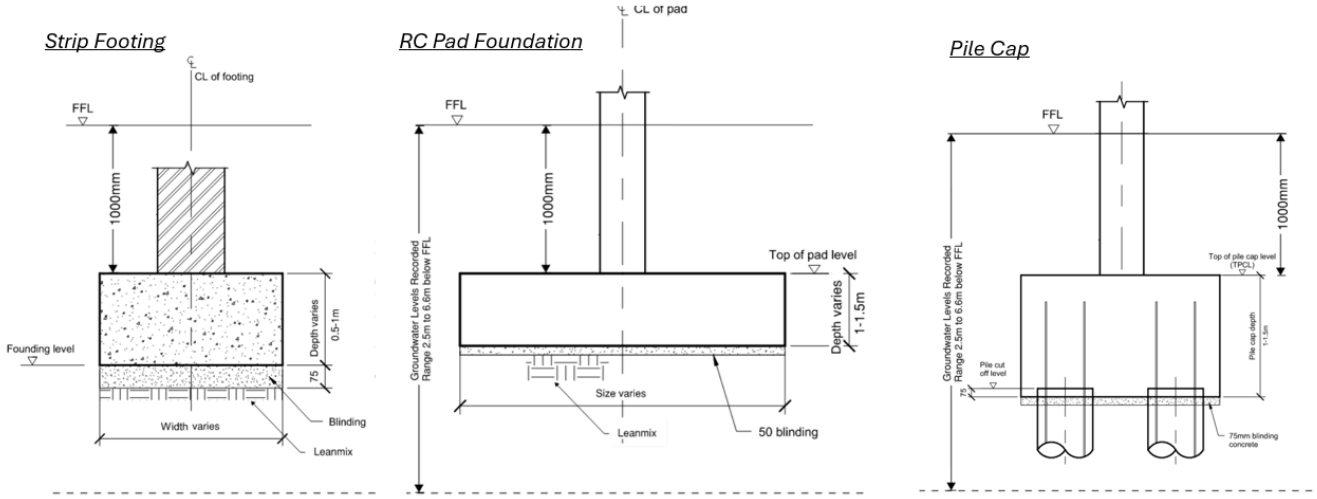

Figure 10-23- Standard Sections for 2no. Foundation Types considered for the Proposed Development (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025)

Groundwater levels range from 2.5m (Salesian Apartments) to 6.6m (Stonetown Terrace) below FFL (based on available information during preliminary design stage); however according to ARUP (2025) groundwater levels vary seasonally and are likely to be 0.5 to 1.0 metres higher during winter months[2]. Continuous groundwater level monitoring is ongoing (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025).

Groundwater control may be required for the proposed bored piles at Stonetown Terrace Apartments (this will be further assessed in Chapter 11 – Water).

Soil disposal will be required (during foundation excavation and via. bored piles at Stonetown Terrace Apartments). All such material will be removed and disposed offsite to a suitably permitted / licenced waste recovery / disposal facility in accordance with relevant waste management legislation (including the Waste Management Act of 1996, as amended and all subsequent waste management regulations as amended), with the exception of soil excavated at the proposed Salesian's site. This material may be reused onsite, as per the Structural Design Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025), subject to compliance with structural engineering requirements.

The specific methodology will be determined during the detailed design / pre-construction phase. For the purposes of this assessment the above scenarios have been considered. A summary of the proposed foundation solution at each development zone where structures are proposed is presented as follows, extracted from the Structural Design Report (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025):

Stonetown Terrace

'An assessment of the proposed structures has been undertaken based on the ground conditions encountered during the PGL 2025 GI. The stratigraphy and properties of the ground conditions

[2] Groundwater strikes encountered during the PGL 2025 GI and subsequent groundwater level monitoring in standpipe installations, indicate that there is a low probability for groundwater ingress into excavations across the site. Continuous groundwater level monitoring is ongoing to determine tidal and seasonal fluctuations in the groundwater regime (CRQMP-ARUP-ZZ-ZZ-RP-S-0001) (ARUP, 2025).

encountered, indicate that piled foundations bearing in the underlying competent limestone bedrock are required for the apartment block. Ground beams, pile caps and cores supported by bored piles are proposed. Bedrock noted at a range of 11mOD to -1mOD. Piles are to be end bearing on rock, with a 0.5m embedment. For the apartment block, a stepped raft slab to suit site levels on lean-mix blinded Clause 808 broken stone on stripped site is suitable. From the latest groundwater monitoring standpipes, the groundwater recorded at the Stonetown Terrace site is approximately 6.6m below the FFL. Continuous groundwater level monitoring is ongoing in Stonetown Terrace with a standpipe installation data logger installed in BH308 to determine tidal and seasonal fluctuations in the groundwater regime'.

Shipyard site (O'Callaghan Strand Building)

'An assessment of the proposed structure has been undertaken based on the ground conditions encountered during the PGL 2025 GI. The stratigraphy and properties of the ground conditions encountered, as detailed in Section 3.6.2.4 indicate that shallow pad foundations bearing on the shallow limestone bedrock can be used under the RC columns. RC ground beams are to be used under the columns at the perimeter where the existing stone wall is to be retained. This will limit the amount of disturbance to the base of the stone wall. An RC core slab is proposed under the RC core walls. From the latest groundwater monitoring standpipes, the groundwater recorded at the O'Callaghan Strand site is approximately 4.25m below the FFL. Continuous groundwater level monitoring is ongoing in the Shipyard site with a standpipe installation data logger installed in BH311 to determine tidal and seasonal fluctuations in the groundwater regime.'

Flax Mill site (PBSA / Quarry Building)

'A preliminary assessment of the proposed structures has been undertaken based on the ground conditions encountered during the PGL 2025 GI. The stratigraphy and properties of the ground conditions encountered, as detailed in Section 3.6.2.3 indicate that shallow pad foundations bearing on the shallow limestone bedrock are the suitable foundation solution for the PBSA building. An RC core slab is required under the RC core walls. From the latest groundwater monitoring standpipes, the groundwater recorded at the PBSA site is approximately 4.1m below the FFL. Continuous groundwater level monitoring is ongoing in the Flax Mill site with a standpipe installation data logger installed in BH314 to determine tidal and seasonal fluctuations in the groundwater regime.'

Salesian's Apartments & Triplexes

'A preliminary assessment of the proposed structures has been undertaken based on the ground conditions encountered during the PGL 2025 GI. The stratigraphy and properties of the ground conditions encountered, as detailed in Section 3.6.2.1 indicate that strip footings bearing on the shallow limestone bedrock are the foundation solution for the Salesian Apartments. An RC core slab is required under the RC core walls. For the Salesian Triplexes, a reinforced concrete raft foundation with thickenings under walls and columns is required. From the latest groundwater monitoring standpipes, the groundwater at the Salesian Apartments site is approximately 2.5m below the FFL. At the Salesian Triplexes, no groundwater was encountered in the groundwater monitoring installation. Continuous groundwater level monitoring is ongoing with a standpipe installation data logger to determine tidal and seasonal fluctuations in the groundwater regime.'

External Structures

Shipyard Canopies*: 'The shipyard site will provide 2no. canopy structures, with bowstring roof truss structures. The trusses are proposed to be constructed in timber and will be supported by steel columns down to individual pad foundations. The steel columns will be designed as cantilevers above the ground/foundation level to provide lateral stability to the structures in both directions.'*

Riverside Canopy: '*The proposed architectural intent for riverside canopy structure consists of 3no.parallel barrel-vaulted roofs which are formed using curved glulam beam sections in a structural diagrid pattern. Glulam columns are provided as the vertical structural elements, which transition to reinforced concrete stub columns below ground level. The foundation solution consists of conventional concrete pad foundations on leanmix build up from competent bearing stratum.'*

Salesians and Quarry Wall Stairs and Walkway*: 'The proposed architectural intent requires a suspended walkway and stairs over the existing reservoir basin. The structural scheme to support the walkway will consist of pairs of RC piers supported off the reservoir bedrock. Similarly, the adjacent stair structure will require 2no. RC piers intermediately to break up the span. Beneath the top landing of the stairs is a wildlife feature to house native bats. It is proposed to cantilever out two RC beams below ground level to provide support the top of the stairs without impacting the wildlife feature.'*

An impact assessment has been carried out in line with IGI, 2013 (IGI, 2013) and EPA (2022) guidance. A summary of the assessment is presented in Section 10.5 below.

10.5. LIKELIHOOD OF SIGNIFICANT EFFECTS

10.5.1. Baseline

The baseline assessment in Section 10.3 has identified features which have been given an importance rating in line with the methodology presented in Section 10.2.

Table 10.5: Land, Soil and Geology Importance Assessment

Category	Feature	Importance	Justification
Land contamination	On-site: Made Ground and subsoils associated with the historic use and operation of the brownfield site since 1800s.	High	A review of the historical development of the site records that the site is an industrial / commercial historical development, located within Limerick City, with identified potential significant sources of contamination (potential environmental / human health risk) in the Made ground and subsoils at specific areas (i.e. proposed PBSA / Quarry Zone, Stonetown Terrace Zone, O'Callaghan Strand Zone, Shipyard Zone). ACM identified in C&D material beneath proposed Stonetown Terrace Zone (human health risk). Asbestos present within existing onsite buildings scheduled for demolition. Risk of additional soils contamination (not detected during Ground Investigation).
Land contamination	On-site: C&D material beneath Stonetown Terrace	High	
Land contamination	On-site: Significant investigations have been undertaken. Notwithstanding there may remain some potential underground structures, historic tanks and unidentified contamination	High	

			Ground gas risk identified (associated with made ground).
Land contamination	Off-site: Offsite operations including industrial / commercial use.	Medium	The surrounding area within Limerick City is dominated by commercial and industrial use including 6no. EPA licensed sites (industrial and waste) and one active dumpsite operated by Shannon Foynes Port Company.
Land contamination	Off-site: Made Ground associated with the construction and operation of residential, commercial and industrial land uses within the study area.	Medium	
Soil	Quaternary Deposits - Urban	Low	Superficial (Quaternary) sediments
Geology	Karstified bedrock outcrop or subcrop	High	Bedrock outcrop present onsite. Onsite quarry (bedrock) 'Reservoir' Limestone encountered beneath the site (Strong to Very Strong). No identified karst features onsite or within 2km of the site. No geological heritage sites onsite or within 2km of the site.
Geology	Glacial Till and gravels and Eskers of gravels.	Medium	No eskers or gravel quarries onsite or within study area Site underlain by gravels and glacial till.
Geology	Bedrock – Visean Limestones (undifferentiated)	Medium	1no. non-metallic mineral locality (Ref:1902) within the Proposed Development (calcite vein with nearly clear crystals found in cutting foundations in 1946). No geological heritage sites onsite or within 2km of the site. Limestone encountered beneath the site (Strong to Very Strong).

10.5.2. Demolition and Construction Phase

The potential for impact to land, soil and geology as a result of the proposed development during the demolition and construction phase has been assessed and is presented in Table 10-6.

Table 10.6: Demolition & Construction Phase Impact Assessment

Category	Feature	Importance	Effect	Quality	Duration	Type	Magnitude	Significance
Land contamination	On-site: Made Ground and subsoils associated with the historic use and operation of the brownfield site since 1800s.	High	Potential for exposure of human receptors via. asbestos fibres during demolition works, and potentially contaminated dust / vapors and soil, released by the construction works.	Negative	Permanent	Irreversible	Large adverse	Significant
Land contamination	On-site: C&D material beneath Stonetown Terrace	High	Potential for exposure of human receptors via. contact with Asbestos Containing Materials (ACM) (present in C&D waste) released by the construction works.	Negative	Permanent	Irreversible	Large adverse	Significant
Land contamination	On-site: Potential Underground structures, historic tanks and unidentified contamination	High	Potential for exposure of human receptors by generation of potentially contaminated dust / vapors and soil, released by the construction works.	Negative	Permanent	Irreversible	Moderate adverse	Moderate
Land contamination	Off-site: Offsite operations i.e. industrial / commercial use.	Medium	Potential contamination risk posed by offsite industrial / commercial use.	Negative	Short term	Reversible	Small adverse	Slight
Land contamination	Off-site: Made Ground associated with the construction and operation of residential, commercial and industrial land uses within the study area.	Medium	Potential contamination risk posed by offsite made ground.	Negative	Short term	Reversible	Small adverse	Slight
Soil	Quaternary Deposits - Urban	Low	Removal of significant volume of made ground and subsoils.	Negative	Permanent	Irreversible	Moderate adverse	Slight
Soil	Quaternary Deposits - Urban	Low	Potential adverse impact to subsoils beneath the historical site during Demolition & Construction works via. in exposure of underlying subsoil layers to the effects of weather / construction traffic and generation of sediment laden runoff; Soils may become unnecessarily compacted by machinery.	Negative	Short term	Irreversible	Small adverse	Imperceptible
Geology	Exposed Bedrock i.e. outcrop present onsite and Onsite quarry (bedrock) 'Reservoir'	High	Direct impact to bedrock through Site construction activity; in particular the risk of spillages and leakage of any fuel oils and paint.	Negative	Long Term	Irreversible	Small adverse	Slight

Category	Feature	Importance	Effect	Quality	Duration	Type	Magnitude	Significance
Geology	Glacial Till and gravels	Medium	Direct impact to subsoils and gravels through Site construction activity; in particular the risk of spillages / leakage of any fuel oils and paint. Temporary onsite groundwater / gas monitoring wells, and proposed piling (at Stonetown Terrace) provide a conduit for potential contamination of subsoils / gravels.	Negative	Long Term	Reversible	Small adverse	Slight
Geology	Bedrock – Visean Limestones (undifferentiated)	Medium	Direct impact to exposed bedrock via. site construction activity; in particular the risk of spillages / leakage of fuel oils and paint. Temporary onsite groundwater /gas monitoring wells, and proposed piling (at Stonetown Terrace) provide a conduit for potential contamination of bedrock. Rockbreaking will result in localised impacts to bedrock onsite.	Negative	Long Term	Reversible	Small Adverse	Slight
Land	Land-take	Medium	Land take associated with the proposed development, in an area zoned for residential and commercial development with existing housing / commercial land use within the immediate vicinity of the Site. Proposed regeneration of an existing brownfield site (including site remediation).	Positive	Permanent	Irreversible	Moderate Beneficial	Moderate (Positive)

10.5.3. Operational Phase

The potential for impact to land, soil and geology as a result of the proposed development during the operational phase has been assessed and is presented in Table 10-7.

Table 10.7: Operational Phase Impact Assessment

Category	Feature	Importance	Effect	Quality	Duration	Type	Magnitude	Significance
Land contamination	On-site: Made Ground and subsoils associated with the historic use and operation of the brownfield site since 1800s.	High	Potential for exposure of human receptors via. contaminated soil (made ground and subsoils), vapors and ground gas during operational stage. Radon membrane to be installed as standard in all building structures; hence mitigating potential ground gas risk.	Negative	Permanent	Irreversible	Large adverse	Significant
Land contamination	Off-site: Offsite operations including industrial / commercial use.	Medium	Potential contamination risk posed by offsite industrial / commercial use during operational stage..	Negative	Permanent	Reversible	Small adverse	Slight
Land contamination	Off-site: Made Ground associated with the construction and operation of residential, commercial and industrial land uses within the study area.	Medium	Potential contamination risk posed by offsite made ground during operational stage..	Negative	Permanent	Reversible	Negligible	Imperceptible
Geology	Exposed Bedrock i.e. outcrop present onsite and Onsite quarry (bedrock) 'Reservoir'	High	Direct impact to bedrock through Site operation activity; in particular the risk of spillages and leakage of any fuel including diesel storage for onsite emergency generators.	Negative	Long Term	Irreversible	Negligible	Imperceptible
Geology	Glacial Till and gravels	Medium	Direct impact to subsoils and gravels through Site operation activity; in particular the risk of spillages and leakage of any fuel including diesel storage for onsite emergency generators.	Negative	Long Term	Irreversible	Negligible	Imperceptible
Land	Land-take	Medium	Land take associated with the proposed development, in an area zoned for residential and commercial development with existing housing and commercial land use within the immediate vicinity of the Site.	Positive	Permanent	Irreversible	Moderate Beneficial	Moderate (Positive)

Category	Feature	Importance	Effect	Quality	Duration	Type	Magnitude	Significance
			Proposed regeneration of an existing brownfield site (including site remediation). This change is consistent with existing and emerging trends.					

10.6 CUMULATIVE IMPACTS & EFFECTS

As part of this assessment, a comprehensive review of other permitted developments within a 1 km radius of the proposed site was undertaken, focusing on those submitted and approved within the last five years. This review was conducted using the Limerick City and County Council's online planning application portal. The relevant projects are listed in Appendix 1.1 of the EIAR and have been considered in evaluating the cumulative environmental effects of the proposed development.

All relevant developments in the immediate environs of the proposed development, which have been approved but are not yet fully constructed or operational have been reviewed as part of this assessment. Based on the location, nature and scale of these developments, and taking account of the results of the impact assessment for the proposed development (i.e. subject of this application), no significant cumulative effects will arise.

The masterplan development for Phase I has been assessed with respect to potential cumulative effects, based on available information. The masterplan development for Phase III and IV has been assessed with respect to potential cumulative effects, based on available information. It is noted that the proposed development has been designed to ensure future proofing where required of the overall masterplan development strategy, including Phase II demolition, ground improvement works (via. removal of contaminated materials / made ground) and drainage design.

Cumulative effects to land, soil and geology are considered likely to have a imperceptible impact and are therefore not significant.

10.7 REMEDIAL & MITIGATION MEASURES

10.7.1 Demolition and Construction Phase

As part of the asbestos management strategy, mitigation specific measures have been proposed by Phoenix Environmental Safety Ltd in their 2025 Asbestos Survey Report. These measures include the following:

- Asbestos containing materials will be removed prior to the commencement of any works;
- A licensed asbestos removal contractor will be contracted for removal and disposal of asbestos waste; and,
- All asbestos removal works shall be undertaken in full compliance with the Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006–2010 (S.I. No. 386 of 2006).

Stripping and management of hardstanding, made ground, subsoil and C&D waste materials arising from the demolition of existing buildings and structures will be carried out in a controlled way, coordinated with the proposed staging for the development, and will be removed from Site as soon as possible.

Temporary concrete crushing activity will be carried out by the Contractor(s) in accordance with the requirements of Limerick City and County Council / EPA, ensuring that all required statutory permits /

licences (Waste Facility Permit, Certificate of Registration, or EPA Licence) are in place prior to commencement of such operations, and compliance of same during the relevant period of works.

All waste material will be removed for offsite disposal or reused to a suitably licenced / permitted waste facility, or via. Article 27 (where applicable), in accordance with the Construction & Demolition Resource and Waste Management Plan (CDRWMP) (ARUP 2025), submitted as part of this planning application, The Contractor(s), in consultation with the Client and the Engineer, will be responsible for removing and replacing with suitable material as required.

All waste arising from the proposed development, during the Demolition and Construction phase (including enabling works) will be managed in line with the principles and objectives set out in the Construction & Demolition Resource and Waste Management Plan (CDRWMP) (ARUP 2025), submitted as part of this planning application, ensuring compliance with best practice in prevention, segregation, recovery and disposal and align with regional waste infrastructure principles and policy. It will be the contractors responsibility to ensure that a project specific Detailed Resource and Waste Management Plan (developed in accordance with relevant 2021 EPA Guidance, and the CDRWMP (ARUP, 2025)) is fully implemented onsite for the duration of the project.

The duration that subsoil layers are exposed to the effects of weather will be minimised. Disturbed subsoil layers will be stabilised as soon as practicable (e.g., backfill of service trenches, construction of road capping layers, construction of building foundations and completion of landscaping).

Based on CIRIA 665 guidance, gas protection measures would be required for the proposed Stonetown Terrace building, based on this part of the Site being CS2 (low risk). The typical scope of protective measures for residential buildings (not low rise traditional housing), such as apartment blocks (for CS2) is as follows (CIRIA 665, 2007):

- **Option a) -** Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g damp proof membrane (DPM) and underfloor venting; or;
- **Option b)** - Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane and underfloor venting; and,
- All joints and penetrations sealed.

Gas protection measures (based on the above scope) for the Stonetown Terrace building, will be incorporated into the Detailed Design Stage of the proposed development; and will be installed by experienced and trained specialists and will be subject to inspection and certification, during the Construction Stage. The Contractor, in consultation with the Client and the design team, will be responsible for ensuring that these measures are fully implemented and verified.

Material at the following locations requires excavation, and will not be reused onsite. Based on the results of environmental testing, this material is unsuitable for the proposed site end use:

- **Stonetown Terrace Building** – all onsite C&D material; and made ground / subsoils to a depth of 1.5m BGL (existing ground level) or to the maximum excavation / piling depth of foundations (if greater).

- **O'Callaghan Strand Building** – all made ground / subsoils to a depth of 1.0m BGL (existing ground level) or to the maximum depth of excavation for foundations (if greater).
- **Flax Mill site (PBSA / Quarry Building)** - all made ground / subsoils to a depth of 3.0m BGL (existing ground level) or to the maximum depth of excavation for foundations (if greater).
- **Main Shipyard site** – all made ground / subsoils excavated to facilitate the installation of proposed utilities (including drainage), tanks and any proposed underground structures in this area.

This material will be classified, managed, transported and disposed of offsite in accordance with the requirements of the Waste Management Act 1996, as amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation.

At all other locations onsite, excavation of material will be minimised as much as possible to reduce the impact on land, soils and geology. Where soil material is unsuitable for use or where excess soil is generated with no certainty for use, soils (including Made Ground) will be appropriately sampled and tested prior to offsite removal. Soils will be classified in accordance with the EPA Guidance (2019). It will be the contractors responsibility to ensure that all waste soils are classified correctly and managed, transported and disposed of offsite in accordance with the requirements of the Waste Management Act 1996, as amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation.
Further mitigation measures for the prevention of soil / bedrock contamination during construction are proposed below. Mitigation measures outlined in Chapter 11- Water are also applicable to the protection of soils and geology during the construction phase:

- Health and safety risk assessments, method statements (RAMS) and the use of appropriate Personal Protective Equipment (PPE) will be adhered to by all site personnel and site visitors;
- Earthworks / piling plant and vehicles delivering construction materials to site will be confined to predetermined haul routes around the site for each phase of the proposed development;
- The need for vehicle wheel wash facilities will be assessed by the Contractor depending on the phasing of works and onsite activity and will be installed as needed, near any site entrances and road sweeping implemented as necessary to maintain the road network in the immediate vicinity of the site;
- Dust suppression measures (e.g., dampening down) will be implemented as necessary during dry periods;
- All excavated materials will be stored away from the excavations / immediate works area, in an appropriate manner at a safe and stable location. The maximum height of temporary stockpiles will be 3m;
- A comprehensive monitoring and supervisory regime including monitoring of all excavations and stability assessments as required will be put in place to ensure that the proposed construction works do not constitute a risk to the stability of the site;
- In the event that any additional evidence of ground contamination is encountered beneath the site, during the construction works, works within that specific area will cease. Advice will be sought from an experienced contaminated land specialist to assess any associated potential environmental and/ or human health risks associated with this material and to ensure that any such material is managed and disposed of in accordance with the requirements of the Waste Management Act 1996, as

amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation.

- The employment of good construction management practices will serve to minimise the risk of pollution from construction activities at the proposed development in line with the Construction Industry Research and Information Association (CIRIA) publication entitled, Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, CIRIA - C532 (2001) which are also detailed in Chapter 11– Water;
- Temporary onsite groundwater and gas monitoring wells will be either suitably protected for the duration of the works and / or appropriately decommissioned in accordance with best practice guidance (SEPA guidance document "Good Practice for Decommissioning Redundant Boreholes and Wells").
- All fill material imported to the site for the proposed development will be clean, uncontaminated, suitable engineering grade fill material;
- Specifically, regarding pollution control measures, the following will be adhered to; - Fuels, lubricants and hydraulic fluids for equipment used on the construction site, as well as any solvents, oils, and paints will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice;
- Waste oils and hydraulic fluids to be managed in accordance with best practice requirements and pollution measures as detailed in the CEMP;
- Strict supervision of contractors will be adhered to in order to ensure that all plant and equipment utilised on-site is in good working condition. Any equipment not meeting the required standard will not be permitted for use within the site. This will minimise the risk of soils and bedrock becoming contaminated through site activity; and,
- The highest standards of site management will be maintained and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the site and surrounding environment during construction. A named person will be given the task of overseeing the pollution prevention measures agreed for the site to ensure that they are operating safely and effectively.

The above mitigation measures will be incorporated during Detailed Design Stage and will form part of a site-specific CEMP which will be implemented during the Demolition and Construction Stage (including initial Site preparatory / enabling works).

10.7.2 Operational Phase

Taking account of the relevant mitigation measures to be implemented during the Demolition and Construction Stage, no further mitigation measures will be required during the operational phase.

10.8 MONITORING REQUIREMENTS

10.8.1 Construction Phase

A comprehensive monitoring and supervisory regime including monitoring of all excavations and stability assessments as required will be put in place to ensure that the proposed construction works do not constitute a risk to the stability of the site.

10.8.2 Operational Phase

No monitoring will be required during the operational phase

10.9 RESIDUAL IMPACTS

10.9.1 Demolition and Construction Phase

There will be no significant adverse effects to land (including land-take) during the construction phase as a result of the proposed development.

Implementation of the measures outlined above will ensure that potential Significant and Moderate adverse effects of the proposed development on human receptors (via. inhalation of asbestos fibres, contaminated dust / vapours and direct contact with identified contaminated soil) do not occur during the demolition and construction phase. Residual human health effects will be **Imperceptible and permanent**.

Implementation of the measures outlined above will ensure that the residual effect on soils and geology (with respect to generation of ca. 9,605 tonnes of demolition material and ca. 50,920 tonnes of excavated material for offsite disposal) will be **Slight adverse and permanent.**

Implementation of the measures outlined above will ensure that the residual effect on soils and geology (via. offsite sources of potential contamination) will be **Slight adverse and short-term**. The residual effect to onsite Urban soils via. compaction, exposure of underlying subsoil layers and generation of sediment laden runoff will be **Imperceptible and short-term**. The residual effect to glacial till, gravel deposits and exposed bedrock via. site construction activities (including spillages / leakage of fuel oils and paint), existing onsite groundwater / gas monitoring wells, and proposed piling at Stonetown Terrace) will be **Imperceptible and long-term.**

Therefore, no significant effects (with respect to Land, Soils and Geology) to the receiving environment are likely to arise as a result of the proposed development during the Demolition and Construction Phase.

10.9.2 Operational Phase

The residual impact on land take, given the proposed regeneration and remediation of an existing brownfield site in an area zoned for residential and commercial development, is likely to have a **Moderate positive permanent effect** on the environment of the area. As a result, there will be no significant adverse effects to land during the operational phase as a result of the proposed development.

Implementation of the measures outlined above, during the Detailed Design and Demolition and Construction Stages (specifically the excavation and removal offsite of identified contamination beneath Stonetown Terrace Building, O'Callaghan Strand Building, Flax Mill site, and main Shipyard site) will ensure that potential Significant adverse effects of the proposed development on human receptors (via. vapours, ground gas, and identified contaminated soil) do not occur during the operational phase. Residual human health effects will be **Imperceptible and permanent**.

The residual effect on soils and geology (via. offsite sources of potential contamination / made ground) will be **Imperceptible to Slight adverse, and permanent**. The residual effect to glacial till, gravel deposits and exposed bedrock via. operational activities (i.e. spillages / leakage of fuel oils and paint) will be **Imperceptible and long-term.**

Therefore no significant effects (with respect to Land, Soils and Geology) to the receiving environment are likely to arise as a result of the proposed development during the Operational Phase.

10.10 'DO NOTHING SCENARIO'

The Do-Nothing scenario will have a neutral and imperceptible effect on the site with regards to land, soils and geology.

10.11 REFERENCES

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- CIRIA (2001). C532. Control of water pollution from construction sites. Guidance for consultants and contractors
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- Waste Management (Registration of Brokers and Dealers) Regulations 2008, SI No. 113 of 2008
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