Project No. 34.03/2022

Environmental Impact Assessment Report

RE: Canal Bank, Limerick
SHD Application to An Bord Pleanala

DATE: March 2022

on behalf of: Revington Developments Ltd.

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PART 1 - NON TECHNICAL SUMMARY

Chapter 1 – Introduction

This Environmental Impact Assessment Report ('EIAR') has been prepared by RW Nowlan and Associates on behalf of Revington Developments Ltd., who intend to apply to An Bord Pleanála (ABP) under the Planning and Development Act 2000 (as amended by the Residential Tenancies Act 2016) for a strategic housing scheme located at Canal Bank, Pa Healy Road, Co. Limerick. The application is being made under the Strategic Housing Provisions of the Planning and Development (Housing) and Residential Tenancies Act, 2016.

The Proposed Development

The applicant, Revington Developments Ltd., is seeking a ten year permission for development of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;

A. Demolition of existing 530m2 warehouse building on site.

B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

G. Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

H. Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;

I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;

J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;

K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;

L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development.

Legislative Context

The relevant classes/scales of development that normally require Environmental Impact Assessment (EIA) are set out in Schedule 5 (Part 2) of the Planning and Development Regulations 2001, as amended. Section 172 of the Planning & Development Act 2000, as amended, provides the legislative basis for mandatory EIA.

The proposed residential development does not exceed the criteria as set out to determine the need for a mandatory EIA. However, section 172 of the Planning & Development Act 2000, as amended, also sets out the basis for EIA for developments which do not equal or exceed, the relevant quantity, area or other limit specified in Part 2 of Schedule 5, i.e., "sub-threshold development". Thus, an EIA is required where subthreshold development is likely to have significant effects on the environment and therefore should be subject to EIA.

It was deemed prudent to undertake an EIAR in relation to the subject development to ensure that the proposal would not negatively impact on the environment.

EIA Guidance

The Environmental Protection Agency (EPA) published its 'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, August 2017), and these draft guidelines have been used in the compiling of this EIAR.

In preparing this EIAR regard has also been taken of the provisions of the 'Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment', published by the Department of Housing, Planning and Local Government (DHPLG) in August 2018 to the extent these guidelines are relevant having regard to the enactment of the revised EIA Directive.

The European Commission also published a number of guidance documents in December 2017 in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU as amended by 2014/52/EU) including 'Guidance on the preparation of the Environmental Impact Assessment Report'. RW Nowlan & Associates has prepared the EIAR with regard to these guidelines also.

Purpose and Scope of the EIAR

This EIAR provides an assessment of the likely significant effects associated with the proposed strategic housing development.

It is important to distinguish the Environmental Impact Assessment (EIA) to be carried out by An Bord Pleanála, from the Environmental Impact Assessment Report (EIAR) accompanying the planning application. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of the proposed development on the following:

a) population and human health

b) biodiversity, with particular attention to species and habitats protected under Directive

92/43/EEC and Directive 2009/147/EC

c) land, soil, water, air and climate

d) material assets, cultural heritage and the landscape

e) the interaction between the factors referred to in points (a) to (d)

Structure and Content of the EIAR

This EIAR uses the grouped structure method to describe the existing environment, the potential impacts of the proposed development thereon and the proposed mitigation measures. Background information relating to the proposed development, consultation undertaken and a description of the proposed development are presented in separate sections.

The EIAR has been divided in to three parts;

Part 1 – This Non Technical Summary

Part 2 – The Main Body of the EIAR which contains 15 Chapters as follows;

- Introduction
- Alternatives Considered
- Description of Proposed Development
- Population and Human Health
- Biodiversity
- Land, Soil, Geology and Hydrogeology
- Water and Hydrology
- Air Quality and Climate
- Noise and Vibration
- Landscape and Visual Impact
- Traffic and Transportation
- Material Assets – Waste
- Cultural Heritage

- Interactions and Cumulative Impacts
- Summary of Mitigation and Monitoring Measures

Part 3 – Appendices – The appendices are numbered in accordance with the chapter they relate

Description of Likely Significant Effects and Impacts

This section sets out how the impacts/effects of the development may be described throughout the EIAR.

The criteria for impact characterisation (i.e. for describing effects / impacts) are as per the EPA 2017 EIAR Guidelines. The significance of an impact is determined through comparison of the character of the predicted impact to the sensitivity of the receiving environment / receptor as per the EPA 2017 Guidelines within the following categories;

Quality – Measurements of effects/impacts in terms of whether it is Positive, Neutral or Negative.

Significance – Extent of an impact/effect ranging from Imperceptible to Profound.

Extent and Context – Extent relates to the size of the area, population etc. that may be affected. Context describes how the effect/impact relates to the established baseline conditions.

Probability – How likely it is that an impact/effect will occur.

Duration and Frequency – How long and/or often the impact is expected to occur.

Type – The kind of impact expected i.e. an Indirect Impact is one that is not a direct result of the proposed development but may occur due to additional external factors.

Project Team

The Environmental Impact Assessment Report was completed by a project team led by RW Nowlan & Associates, who also prepared a number of the chapters. In accordance with EIA Directive 2014/52/EU, we confirm that the experts involved in the preparation of this EIAR are fully qualified and competent in their respective fields. Each has extensive proven expertise in the relevant field concerned, thus ensuring that the information provided herein is complete and of high quality. The individual members of the team and their respective inputs and competency are detailed both in Chapter 1 and in their respective chapters throughout the EIAR.

Difficulties Compiling the EIAR

No difficulties, such as technical deficiencies, lack of information or knowledge, were encountered in compiling any specific information contained in the EIAR.

Chapter 2 – Alternatives Considered

This Chapter of the EIAR provides an overview of how the proposed development has evolved to date. A number of alternative development options for the site were analysed, including a ‘do nothing’ option. The proposed development is located within lands which have been is zoned for Residential Development under the Limerick City Development Plan 2010-2016. This zoning designation is also proposed to continue in the Draft Limerick Development Plan 2022-2028. As such consideration of alternative sites for the construction of residential units proposed in this development was not considered necessary.

The design process was an iterative process, where findings at each stage of the assessment were used to further refine the design, always with the intention of minimising the potential for environmental impacts. The layout has also evolved through discussions with Limerick City and County Council at pre-application stage, and following receipt of An Bord Pleanála’s Opinion at Section 5 pre-application discussion stage.

The proposed development provides for new residential development on lands zoned for residential use under the Limerick City Development Plan 2010-2016 which was subject to the SEA process. As such, consideration of alternative sites for the construction of houses and apartments proposed in this residential development was not considered necessary.

During the design process, the layout and design of the proposed development evolved in response to architectural, landscape and environmental requirements and several iterations of the site layout and alternative designs were considered. Any difficulties from an architectural, landscape or environmental viewpoint were assessed and, where necessary, the design was amended to address the issues encountered.

The evolution of the current scheme was informed by consideration of environmental aspects; vehicular and pedestrian movements; maximisation of pedestrian connectivity through the site and protection of adjoining residential amenity. Furthermore, the final scheme has been directly influenced by the technical and specific issues raised in the Board’s Opinion.

Chapter 3 – Description of Proposed Development

The site (4 ha.) is a vacant site near Limerick city centre which has been zoned for mixed use development in the Limerick City Development Plan. It is bounded to the north by the canal plus walking/cycling route and to the south by Pa Healy Road. A previous application for the proposed development at the site was refused by An Bord Pleanála because of deficiencies in the submitted Natura Impact Statement. These deficiencies have been addressed in this application. The proposed development is for a predominantly residential, high density, mixed use scheme of 'build to rent' apartments, houses, a student accommodation block and retail units, plus community facilities building. Vehicular access to the scheme will be from Pa Healy Road.

The site is triangular in shape and is bounded by the following;

North - The site is bounded by the Park Canal to the north. The canal banks are a public walkway and are part of the Lough Derg Way (walking/hiking trail) which starts in Limerick City to the west of the site. The other side of the canal has been designated as a Special Area of Conservation by the National Parks and Wildlife Services–Site Code002165–Lower River Shannon SAC.

South - A single warehouse of Clancy Lewis fruit distribution is located to the south east of the site. Pa Healy Road borders the site to the south which is bounded by commercial properties, undeveloped land recreational grounds of O'Brien's Park.

East - The eastern boundary of the site is bordered by the Park Road, which is further bounded by a mixture of commercial (Musgraves Cash & Carry, Park Road Recycling Centre, David Mead Fitted Furniture) and detached residential premises.

West - The site narrows down towards the west. There is a bridge crossing the canal located to the west of the site. Sport grounds are located further West.

Proposed Development

The proposed development is set out in the statutory notices as follows;

A ten year permission for a strategic housing development at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;

A. Demolition of existing 530m2 warehouse building on site.

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The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development.

The proposed housing mix is set out in Table 3.1 below.

Unit Type	**Studio**	**1 Bed**	**2 Bed**	**3 Bed**	**4 Bed**	**Total**
Apartment	66	67	230	-	-	363
Houses	-	-	-	-	18	18
Student Accommodation	-	-	9 (18)	37 (111)	15 (60)	61 (189 no. bedspaces)

Table 3.1: Proposed Dwelling Mix

The application for the proposed development seeks a ten year planning permission. Having regard to the large scale of the development and the number of units in the overall scheme, it is considered that this such a duration is appropriate. As such, it is proposed to complete the overall development over three no. phases of construction as shown below in Figure 3.1.

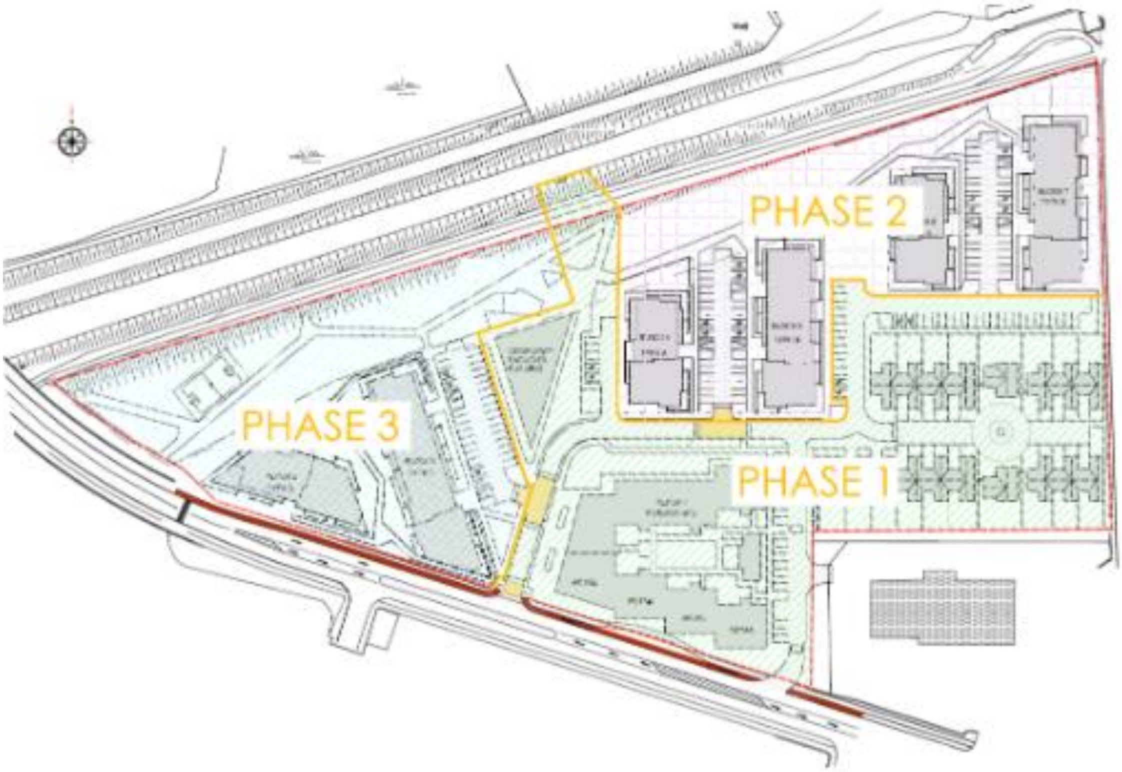


Figure 3.1: Proposed Development Phasing

The facilities and number of units to be completed in each phase is set out in Table 3.2 below.

Phase	Elements to be Complete
Phase 1	18 no Housing Units, Student Accommodation Block (189 Student Bedspaces), Creche and Facilities Building
Phase 2 – 2A	Block 4 – 45 no. Units, Block 5 – 66 no. Units
Phase 2 – 2B	Block 6 – 45 no. Units, Block 7 – 56 no. Units
Phase 3	Block 2 – 63 no. Units, Block 3 – 88 no. Units

Table 3.2: Breakdown of Units Provided in Each Phase of Development

Construction Stage

This application seeks a ten year permission for complete development of the proposed scheme. The relevant construction stage activities are discussed under the following headings;

- Site Establishment and Access
- Hoarding
- Site Security
- Working Hours
- Health and Safety
- Site Preparation Works

- Construction of New Buildings
- Traffic
- Waste Management
- Noise and Vibration
- Good Housekeeping

Construction methodologies that will be used for the proposed housing development are described in this chapter. Further details are also provided in the Construction and Environmental Waste Management Plan (CEWMP) prepared by PHM Consulting and submitted under a separate cover. All construction methodologies proposed conform to industry best practice.

Chapter 4 – Population and Human Health

This section of the Environmental Impact Assessment Report (EIAR) describes the potential impacts of the proposed development on human beings, population and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA) in 'in particular the Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, August 2017).

One of the principal concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. Ultimately, all the impacts of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this section of the EIAR include population, human health, employment and economic activity, land-use, tourism, noise and health and safety.

Potential Impact

Do Nothing Impact

If the proposed residential development were not to proceed, there would be no change to the existing environment. The potential for additional investment and employment in the area in relation to the construction and operation of the proposed residential site would be lost. It is considered that the 'Do Nothing' impact would be permanent, negative, and slight as the proposed development site is zoned for residential development and will contribute to the much-needed housing stock of Limerick.

Population

Construction Phase

During the construction phase of the proposed project, it is unlikely that there will be any significant impact upon the local population. The construction phase will result in a number of workers at the site, however, it is not envisaged that their place of residence will change as a result of the development, it is envisaged that construction workers would travel from their existing place of residence rather than moving, temporarily, to the area surrounding the site.

As a result, the impact on the local population during the construction phase is considered to be neutral, not significant and temporary in nature and therefore, no significant impacts are expected to arise in this regard.

Giving consideration to local residents, it is predicted that there may be some impacts which are likely to be associated with construction traffic, nuisance and disturbance. Such impacts are dealt with separately and assessed elsewhere in the EIAR and are considered to be short term, negative impacts. The level of impact predicted above is considered to align with the normal disturbance associated with the construction industry where a site is efficiently, sensitively and properly managed in the context of surrounding existing neighbouring development.

Operational Phase

The proposal includes 363 no. apartment units, 18 no houses and 189 no student bedspaces. Table 4.1 below shows the breakdown of unit type proposed. Based on the Average household size identified in the 2016 Census of 2.75, the projected population for the new development is estimated as 1,048 for the build to rent and housing elements. When the student bedspaces are included, the total projected population is 1,237 no. residents.

Unit Type	Studio	1 Bed	2 Bed	3 Bed	4 Bed	Total
Apartment	66	67	230	-	-	363
Houses	-	-	-	-	18	18
Student Accommodation	-	-	9 (18)	37 (111)	15 (60)	61 (189 no. bedspaces)

Table 4.1: Breakdown on Unit Type by Size

The above estimated additional residents will be a significant increase to the existing local population. The development will provide much needed residential accommodation in the Limerick area in line with current Local, Regional and National planning policies.

The introduction of additional residents to the local area will support the existing community and social infrastructure. The proposed childcare facility, designed to accommodate the projected demand for childcare places resulting from the development, will mitigate any pressure upon existing childcare facilities. Please refer to the Childcare Demand Analysis submitted under a separate cover in this application for further details on projected childcare demand resulting from the proposed development.

As such, it is considered that the proposed project will have a positive, significant and permanent impact on the local population.

Land Use and Settlement Patterns

Construction Phase

The proposed development complies with zoning policies contained within the Limerick City Development Plan 2010-2016 (as amended) as well as National and Regional policies relating to land use, compact development and provision of housing.

The construction phase will comprise of earthworks and construction works and will not have any impact on the residential amenities, rights of way or existing pedestrian and cycling routes. There will be some short term negative impact in terms of visual amenity as discussed further in the Landscape and Visual Amenity chapter in this EIAR but this is considered standard to construction activities and will only occur during the construction phase of development.

Operational Phase

The subject site is largely undeveloped at present with the exception of a vacant warehouse unit and associated services on the eastern side of the site.

The site is zoned for residential development within the Limerick City Development Plan 2010-2016 and the proposed development would enable 363 no. built to rent units, 18 no. houses and 189 no. student bedspaces to be provided in a prime location.

As such, it is considered that the proposed development, once complete, will positively impact on land use and settlement patterns in the area through provision of much needed housing on a prime site that is zoned for such development and underutilised at present.

Economic and Employment Activity

Construction Phase

The construction phase of the development will have a positive impact in terms of economic and employment activity in the local area. The most notable benefit will be to the construction and building service sectors. The positive impact to these sectors is predicted to last for the duration of the construction stage over the three phases as outlined in Chapter 3 above. There will also be indirect economic benefits to local service and retail sectors during this time.

The number of workers on site is predicted to fluctuate during different stages of the development process but the construction manager and their team will be present on site during the whole process.

Overall, it is considered that proposed development will result in a positive, short term benefit in terms of economic and employment activity within the local area.

Operational Phase

The operational phase of the development will result in 363 no. apartment units, 18 no houses and 189 no student bedspaces, a creche and small scale retail units. This will likely result in increased spending in the local economy and utilisation of local services. The creche and retail units will also provide a small number of employment opportunities.

It is considered that the operational phase of the development will result in a long term, positive impact on economic and employment activity in the local area.

Social Infrastructure

Construction Phase

It is not anticipated that any social infrastructure will be provided on the site during the construction phase of development. As such, it is considered that there is a neutral impact in terms of social infrastructure in this case.

It is possible that workers on site may utilise local social infrastructure during this time but it is not anticipated that this will be frequent or cause any negative impact.

Operational Phase

As discussed above, the subject site is well served by existing social infrastructure within 5 minutes walking distance. Residents within the proposed development would support local businesses and provide a boost to the local economy. It was assessed within the Childcare Demand Analysis report submitted under a separate cover in this application that a childcare facility should be provided within the development so as not to burden the local existing facilities which are recorded as close to capacity at present.

It is considered that the proposed development would result in a positive long term impact for the local social infrastructure through increased business and local participation.

Human Health

Construction Phase

The EPA Draft Guidelines (2017) sets out how human health should be considered through assessment environmental pathways through which health could be affected.

The relevant pathways in relation to human health during the construction phase are considered to be air quality, noise and vibration, water and soil. The expected air quality effects are detailed in Chapter 8 along with proposed mitigation measures to ensure the protection of human health. Similarly, the potential noise and vibration related impacts arising from the construction phase and associated mitigation measures are contained in Chapter 9.

As with all construction projects, there will be inherent health and safety risks at this stage of the development. In order to manage this, a Construction Environmental and Waste Management Plan has been prepared by PHM Consulting for the application and is submitted under a separate cover, to ensure that the relevant health and safety legislation is complied with at all stages of the construction process.

Operational Phase

Given the nature of the proposed project, it is not likely that any significant impacts on health and safety will arise during the operational phase. The development has been designed to provide a safe environment for future occupiers and visitors. The public realm, inclusive of pedestrian paths, cycle paths, roads and communal open spaces, have been designed in accordance with the best practice and relevant planning policy standards.

Similarly, the proposed residential units are all designed in accordance with the relevant guidelines and standards and are capable of meeting all relevant building standards and regulations. Having regard to the above, it is considered that the proposed project will result in a high standard of health and safety for all residents and visitors.

Once operational, the proposed project will not result in any significant impact on human health and safety.

MITIGATION

Construction Phase

The potential impacts upon human environment relate to other environmental factors such as air quality, noise and vibration and traffic. Where required, the related mitigation measures are dealt with in the corresponding chapters of this EIAR. Other than this, no significant adverse effects will arise in respect of the population during the construction or operational phase of this development.

Operational Phase

Once development is complete, the operational phase of the development is predicted to have a positive impact through provision of additional housing stock, a creche facility, small retail units and additional open space.

No risks to human health have been identified during the operation phase of the development. A management company will be put in place upon completion of development to manage the day to day maintenance of the development and ensure health and safety is prioritised within the development for the long term.

PREDICTED IMPACTS

Adherence to the mitigation and monitoring measures referred to above and throughout this EIAR will ensure that the proposed project will not give rise to significant adverse effects upon population and human health during the construction and operational phases of the proposed project. It is considered that once complete, the proposed development will have a positive impact for the local area.

Chapter 5 – Biodiversity

The purpose of this biodiversity chapter is to inform the application for ten-year planning permission for the proposed SHD, the Canal Bank Development, at Pa Healy Road and Park Road in Limerick City. This chapter forms part of the EIAR that will be submitted with the application for permission to assist the competent authority, in this case An Bord Pleanála (ABP) to carry out an Environmental Impact Assessment (EIA) of the proposed SHD. Extensive site surveys were undertaken between 2020 and 2021. The surveys included a Habitat Survey, A Bat Survey and an Otter Survey.

The City Canal is located approximately 30 m north of the Site boundary. The proposed development is connected to the Canal as it will discharge surface water to the canal during construction and operation.

The effects of the construction and operation of the proposed mixed-use development are likely to be localised in nature and would typically be limited to the Site or the area immediately adjacent to the Site. However, given that the proposed development will discharge surface water to the canal, and there is a surface water pathway linking the Site to the sites designated for nature conservation, applying a precautionary approach a zone of influence of 2 km has been adopted for the purposes of this report.

The potential for effects on Natura 2000 sites is addressed in the AA screening report and NIS prepared for the proposed development (SLR, 2021). The City Canal is approximately 30 m north of the Site boundary and this forms part of the Lower River Shannon SAC (002165). The River Shannon and River Fergus Estuaries SPA (004077) is approximately 1.6 km south - west of the Site. Both of these Natura 2000 sites are considered to be within the potential zone of influence of the project as the proposed development will discharge surface water to the canal during construction and operation. All other Natura 2000 sites are considered to be sufficiently distant from the project and / or have no landscape or ecological connectivity with the Site such that they are not likely to affected by the project.

There are no Natural Heritage Areas (NHA) located within the zone of influence for the project. There is one proposed Natural Heritage Area (pNHA) within 2 km of the Site and therefore, within the zone of influence. There is no potential for impacts on the pNHA given the nature and scale of the proposed development, the localised nature of any potential impacts and the distance between the Site and the pNHA.

Potential Impacts and Effects

Otter

The Site itself is evaluated as not important for otter and direct effects on otter are not considered likely. However, the City Canal is ca. 30 m north of the Site and otter activity was recorded along the canal during the June 2020 survey. Otter is typically a crepuscular species but is also known to forage and move along watercourses in the daytime. There is potential for the proposed development to result in indirect effects on otter as a result.

During the construction phase activities such as increased artificial lighting and increased human presence on the site could have the potential to disturb otter. However, as the otter is mainly crepuscular it is likely to avoid the site during the working hours and therefore any impact will be low and will be temporary.

The completed development has the potential to see increased the numbers of people using the canal bank for amenity. While an increase in people walking or running along the bank may increase disturbance, it is the likely increase in the presence of dogs that may pose the highest risk disturbance to otter. However, as the otter is mainly crepuscular it is likely to avoid the canal area during ay and while the increase in day-time disturbance may be permanent, the impact will be slight.

Lighting for the project has been designed such that there will be no increase in light intensity along the canal that may cause disturbance. In addition, the nature of the completed development (i.e. largely residential with a creche, café and some retail units) is not likely to result in a perceptible increase in noise levels along the canal (see Chapter 9 Noise and Vibration - AWN).

The discharge of water from the development that has become contaminated by hydrocarbons or silt has the potential to reduce the quality of the water and could affect prey species or aquatic plants that otter rely on.

There will be no significant effect on otter within the Site but discharge of water from the Site along with construction activities causing increased noise, light and human presence and increased recreational use of the canal pathway along the City Canal by residents and their dogs may cause negative effects on otter associated with the SAC through disturbance.

The effect of the proposed development on otter would be significant at the Local level.

Mitigation Measures

The following measures will be employed to minimise potential disturbance to otter:

- At the project outset, the construction site will be fenced off and no construction activities will be permitted outside designated works area. No access will be gained from the construction site to the canal.
- Noise and vibration control will follow BS 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites.
- Work will be completed during daylight hours. There will be no constant artificial lighting of the construction site at night. Motion triggered security lighting may be used but this will be directed downwards and sited so as to avoid any light spill onto the tow path and canal.
- All plant will be regularly maintained to minimise unnecessary noise.
- Machines which are used intermittently will be shut down or throttled back to a minimum during those periods when they are not in use.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be of the "sound reduced" models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Surface water and groundwater encountered during excavations will be treated using appropriate measures in advance of discharge to the canal. If contaminated groundwater is encountered these measures would include those set out in the Verde (2021) report. Mitigation measures to prevent discharge of contaminated and / or silt laden water will include, but are not limited to, hydrocarbon interceptors, silt barriers, settlement ponds / tanks and silt traps. The equipment used in the management of surface water will be subject to weekly checks and a regular maintenance schedule.
- Design and construction of attenuation measures shall be in line with current good practice. Guidance such as that produced by CIRIA shall be used to inform the development of such measures. Guidance to be considered, but not limited to, includes:
    - *Drainage of development sites - a guide (X108)* (CIRIA, 2004).
    - *The SuDs Manual* (CIRIA, 2015)

The surface water drainage design for the development incorporates silt traps, a hydrocarbon interceptor (Kingspan NSBE040 Class I Interceptor or similar) and hydrobrake to control surface water run-off from the development to the canal during the operational phase.

During the operation phase, the following measures will be employed to minimise potential disturbance due to increased human activities and lighting:

- During the operational phase, access to the canal walkway will limited to daylight hours. The development's management company will be responsible for locking pedestrian access gates each day.
- Signage will be put in place at the egress points of the Site to the canal walkway, requesting that dogs are kept on leads at all times.
- Information boards will be installed at the egress points to the canal, providing information on the ecology of the canal with particular focus on local otter populations.
- The lighting design for the development provides for reduced effect of lighting on wildlife, while meeting current safety standards. The lighting design for the development includes low luxe and directional lighting that will avoid any light spill. External security lighting will be set on motion-sensors and short (1min) timers.

Significance of Residual Effects

With best practice incorporated into the project design and the above mitigation implemented, residual effects of disturbance on nearby otter populations is not considered significant.

<u>*Bats*</u>

Construction of the proposed development will result in the loss of bat foraging and commuting habitat in the form of scrub and a small area of woodland removal. This is not considered to be a significant effect, given the small scale of habitat loss and the availability of suitable alternative habitat along the canal and the wider landscape.

Any negative effects arising from loss of foraging and commuting habitat will be temporary due to the provision of landscaping measures, such as planting of native trees and shrubs, that should offset any loss of foraging/commuting habitat. Connectivity with the wider landscape will be maintained.

No potential roosts were identified within the Site and there is no potential for effects on roosting bats.

Mitigation Measures

Specific mitigation measures are not required as no significant effect on bats is predicted to occur as a result of the proposed development.

However, while specific mitigation for bats is not required the following mitigation measures are proposed:

- A pre-construction survey of the building will be carried out in advance of demolition to ensure that no bats have moved into or started using the building in the period between the pre-planning survey and the grant of permission. The pre-construction survey will be carried out during the optimal survey season (May – September) by an appropriately experienced ecologist and the building should be dismantled / demolished as soon as possible after it has been confirmed that there are no bats present.

If bats, or signs of bats, are discovered during the pre-construction survey of the building then works should not commence until all necessary bat surveys are complete and, if required, a derogation licence has been granted.

Significance of Residual Effects

There will be no significant residual effect on bats as a result of the proposed development.

Monitoring

The proposed development is not likely to result in significant residual effects and monitoring is not required.

Chapter 6 – Land, Soil, Geology and Hydrogeology

This chapter of the EIAR covers land, soils (& geology) and hydrogeology (groundwater) and it has been prepared to support an application for strategic housing development (SHD) at Canal Bank, Pa Healy Road / Park Road, Limerick. It has been prepared by SLR Consulting on behalf of Revington Developments Ltd.

For the purposes of this assessment, the study area comprises the application site the surrounding area up to 2 km radius around the site boundary and is increased to 5km reflect the sensitivity of the subsurface, for example where karst systems are present. This is in line with the Institute of Geologists of Ireland's (IGI) guidelines (2013). Unmitigated potential impacts on land, soils and hydrogeology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed. The identified potential impacts are then re-assessed assuming the identified mitigation measures in place.

Protected areas are outlined in the Natura Impact Statement (NIS, SLR 2021). The NIS identifies two sites which are considered to be within the Zone of Influence of the project site. To the north, the site is adjacent to the Lower River Shannon SAC, in the form of the Park Canal 30m from the site boundary and a large area of wetland habitat to the north of the canal. The canal is raised in relation to the site, and groundwater from the therefore passes underneath it as it moves north-west.

The assessment indicates that if no mitigation measures are applied during the proposed development, there is potential for the activity to increase the risk of pollution to groundwater quality.

Mitigation and management measures incorporated into the proposed development will reduce the significance of potential impacts associated with the proposed development to **not significant,** or lower, to land, soils (& geology), and hydrogeology (groundwater)are identified.

During the Construction Stage, the following Best Management Practices (BMPs) and Waste and Materials Pollution Control (WM) procedures will apply:

- WM-3 Stockpile Control;
- WM-4 Spill Prevention and Control, and;
- WM-7 Contaminated Soil Management;
- Water Pollution Control Best Management Practices (BMPs);
- Temporary Soil Stabilisation BMPs;
- Non Storm Water Management BMPs, and;
- Waste Management and Materials Pollution Control.

During the Operational Stage, the following will be in place:

- Engineered capping layer;
- Surface water collection and management system (including attenuation and hydrocarbon interceptor).

PREDICTED IMPACTS

Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to land, soils (& geology) and hydrogeology (groundwater) during the construction stage.

Operational Stage

Examination of the identified potential impacts on the receiving environment indicates there are no significant residual impacts with respect to land, soils (& geology) and hydrogeology (groundwater) during the operational stage of the proposed development.

Chapter 7 – Water and Hydrology

SLR Consulting Ireland (SLR) was requested to undertake a surface water (hydrology) assessment of the site and proposed development at the Canal Bank site on Pa Healy Road, Limerick.

This chapter of the EIAR provides a description of the surface water conditions in the application area within the context of the Site and regional setting and assesses the potential impacts that the proposed development will have on surface water. Mitigation measures are proposed, where required.

For the purposes of this assessment, the study area comprises the application site the surrounding area up to 2 km radius around the site boundary, this is in line with the Institute of Geologists of Ireland’s (IGI) guidelines (2013). Unmitigated potential impacts on water and hydrology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed. The identified potential impacts are then re-assessed assuming the identified mitigation measures in place.

In the context of the proposed development, the construction stage in this case is taken to be the site preparation and the construction works at the site.

The impact assessment undertaken here indicates that without mitigation measures then the proposed development will have a Significant to Very Significant impact on the local surface water environment of the Park Canal.

Therefore, mitigation measures required to reduce the significance of potential impacts associated with the proposed development on the water environment receptors. A range of mitigation measures are identified and discussed here for the earth works and construction phase and for the post construction phase of the proposed development.

The majority of the potential impacts on surface water arising from the proposed development relate to the earthworks and construction stage. A specific Construction Environmental and Waste Management Plan (CEWMP) has been developed for the site to address potential construction stage impacts.

With the mitigation measures in place at the site during the earthworks and construction stage, and during the lifetime of the development, it is considered that that the following reduction in the assessed significance of impacts will result:

- Reduction of the potential impact on surface water quality from accidental fuel spillages or leaks from **Significant / Very Significant** to **Slight**.

- Reduction of the potential impact on surface water quality from sediment erosion and suspended solids from **Significant / Very Significant** to **Slight**.
- Reduction of the potential impact on surface water quality on adjoining streets from **Moderate / Significant** to **Slight**.
- Reduction of the potential impact on surface water quality from accidental fuel spillages or leaks from **Moderate / Significant** to **Slight**.

Predicted Impacts – Residual

Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to surface water quality during the earthworks and construction stage.

Post Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to surface water quality during the post construction stage.

Chapter 8 – Air Quality and Climate

This chapter assesses the likely air quality and climate impacts associated with the proposed strategic housing development (SHD) at Canal Bank, Pa Healy Road, Limerick. The SHD consists of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3 no. retail units, creche and management facilities building, and dwelling houses.

This chapter was completed by Dr. Avril Challoner who is a Senior Environmental Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Chartered Scientist (CSci), Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling. She has experience with preparing air quality and climate impact assessments for EIARs for various residential, mixed-use, commercial and industrial developments.

Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted.

Shannon Airport meteorological station, which is located approximately 27 km west of the proposed development at the closest point, collects meteorological data in the correct format for the purposes of this assessment and has a data collection of greater than 90%. Long-term hourly observations at Shannon Airport meteorological station provide an indication of the prevailing wind conditions for the region. For data collated during five representative years (2016 – 2020), the predominant wind direction is south-westerly, with generally moderate wind speeds.

Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is “Air Quality In Ireland 2020” (EPA, 2021a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2021b). The EPA data provides a long-term data set for background air quality at a variety of locations throughout Ireland. The use of existing long-term data is considered best practice in air quality assessments (TII, 2011).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2021b). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed development is in Zone C (EPA 2021b). The long-term EPA monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

Worst Case Scenario

In terms of construction phase impacts, worst-case assumptions regarding volumes of excavation materials and number of vehicle movements have been used in order to determine the highest level of mitigation required in relation to potential dust impacts (see Section 8.4.1.1).

Worst-case traffic data was used in the assessment of construction and operational phase impacts. In addition, conservative background concentrations were used in order to ensure a robust assessment. Thus, the predicted results of the construction and operational stage assessment are worst-case, and the significance of effects is most likely overestimated.

There are no likely risks of major accidents and disasters in relation to air quality associated with the proposed development due to the nature and scale of the development.

Mitigation Measures and Monitoring

Incorporated Design Mitigation

The proposed development has been designed so as to reduce the impact on climate as much as possible during operation. The External Lighting and Building Lifecycle Report prepared as part of the proposed project and submitted under separate cover with this planning application details a number of design measures that have been considered in order to reduce the impact on climate wherever possible.

Construction Phase Mitigation

Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. A dust management plan will be implemented onsite. The main contractor will be responsible for the coordination and ongoing monitoring of the dust management plan.

Climate

Impacts to climate during the construction stage are predicted to be imperceptible however, good practice measures can be incorporated to ensure potential impacts are lessened.

Operational Phase Mitigation

The impact of the proposed development on air quality and climate is predicted to be imperceptible with respect to the operational phase in the long term. Therefore, no additional site specific mitigation measures are required beyond the site specific incorporated design mitigation.

Overall, it is considered that subject to adherence with the proposed mitigation measures, the impact of the development on Air Quality and Climate during construction phase will be short-term, negative and imperceptible at nearby receptors while at operational phase it will be imperceptible, negative and long-term.

Chapter 9 – Noise and Vibration

This assessment has been prepared by Mike Simms BE MEngSc MIOA MIET, Senior Acoustic Consultant at AWN, who has worked in the field of acoustics for 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential.

This report includes a description of the receiving ambient noise climate in the vicinity of the subject site and an assessment of the potential noise and vibration impact associated with the proposed development, during both the short-term construction phase and the permanent operational phase, on its surrounding environment. The assessment of direct, indirect and cumulative noise and vibration impacts on the surrounding environment have been considered as part of the assessment.

In accordance with the Limerick Noise Action Plan (NAP), a complete assessment of inward noise impact has been incorporated into this EIAR chapter to comply with the appropriate policies.

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*.

In addition to the noise survey, proprietary noise calculation software has been used for the purposes of this impact assessment to calculate road traffic noise levels at various facades across the development site. The results of the noise survey were used to calibrate the noise model. It is concluded that the development site may be categorised as 'low to medium' risk and as such an Acoustic Design Strategy will be required to demonstrate that suitable care and attention has been applied in mitigating and minimising noise impact to such an extent that an adverse noise impact will be avoided in the final development.

Potential Impacts

Construction Stage

The largest noise and vibration impact of the proposed development will occur during the construction phase due to the operation of various plant machinery and HGV movement to, from and around the site. However, the construction phase can be classed as a short-term phase.

The nearest noise-sensitive locations to the site are the residential properties to the east of the site at The Park, which are and east, each of which is approximately 25 m from the closest point of the site boundary. Based on the results of the baseline noise surveys undertaken, the ambient daytime noise level at these properties was found to be between 61 and 63 dB.

The calculated noise levels show that there is potential for the maximum permissible daytime noise level to be exceeded at distances up to 30 m from the works. This indicates that additional mitigation measures will be required to prevent likely significant impacts at residential properties.

Taking account of the distance to the nearest sensitive off-site buildings, vibration levels at the closest neighbouring buildings are expected to be below the limits to avoid any cosmetic damage to buildings. Vibration levels are also expected to be below a level that would cause disturbance to building occupants. The potential vibration impact during the construction phase if of short-term, neutral and imperceptible impact.

Operational Stage

The main potential noise outward noise impact to the surrounding will be from additional vehicles on the surrounding road network and building services and mechanical plant serving the development.

It is expected that the principal items of building and mechanical services plant will be for heating and ventilation of the buildings. These items and their location will be selected at the detailed design stage to ensure that noise emissions to sensitive receivers both external and within the development itself will be within the relevant criteria set out above. The effects are considered neutral, not significant and permanent.

The predicted increase in traffic flows associated with the development in the years of 2023 and 2038 will result in an increase less than 1dB along all roads receiving traffic from the proposed development will have a negligible effect. The effect is therefore neutral, imperceptible and permanent.

Residual Impact of the Proposed Development

In order to ameliorate the likely noise impacts, a schedule of noise control measures has been formulated for both construction and operational phases. The residual impacts following implementation of the mitigation measures are as follows;

Construction Phase

During the construction phase of the project there will be a short-term noise impact on nearby noise sensitive properties from site activities and the close proximity of adjacent buildings. The application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration are kept to minimised. For the nearest noise sensitive locations within 50m of the proposed development, negative, significant and temporary effects are likely.

For the majority of noise sensitive locations at greater distances from the proposed development, negative, moderate and short-term effects are likely.

Operational Phase

Building Services Plant

With the application of mitigation measures for building services noise, the range of potential noise levels is not expected to add significantly to the existing noise environment. The resultant noise effect from this source will be of neutral, not significant, permanent impact.

Additional Traffic on Surrounding Roads

The predicted change noise levels associated with additional traffic is predicted to be of imperceptible impact along the existing road network. In the context of the existing noise environment, the overall effects from noise contribution of increased traffic is considered to be of neutral, imperceptible and permanent effect to nearby noise sensitive locations.

Chapter 10 – Landscape and Visual Impact

This chapter has been prepared by Cass Roche, the principal of PC Roche and Associates. Cass is a qualified Landscape Architect with over 20 years of experience. He holds a Diploma in Physical Planning from Trinity College Dublin, along with continued professional development courses in Computer Aided Design and Town Planning Development from University College Dublin. He is also a lecturer of Landscape Planning and Garden Design at Beechfield College. Cass is a full member of the Landscape Institute London.

The objective of this assessment is to demonstrate how the proposed development would sit within its physical landscape. It summarizes the impact of the proposed development on the landscape character, the visual amenity of the current site, and the adjoining environs. An outline of the guidelines and methodology utilised to assess the impacts and describe the receiving environment (baseline) and its potential impacts of the development is included.

A description of the site and surrounding lands demonstrate the landscape character and assist in assessing its visibility from significant viewpoints in the locality. This has been demonstrated through photomontages to give a perspective of how the proposed development would appear from several vantage points. The description of each viewpoint, along with consideration of mitigation measures to offset or ameliorate impacts are considered and the resultant residual impacts are outlined.

Chapter 11 – Traffic and Transport

This chapter of the EIAR has been prepared on behalf of Revington Developments Limited, by Matthew Steele BA (Hons) MSc FCILT FRGS MCIHT and Pamela Townley BSc (Hons), both Directors of TTRSA with over twenty years experience of assessing the impacts of traffic and transport related to development.

This chapter provides an assessment of the traffic and transport related impacts of 'A ten year permission for a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, crèche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick'. The site will be served by two new accesses off the northern side of Pa Healy Road, the easternmost of which will operate as a left in only.

The main significance criteria when assessing traffic and transport impacts is the performance of affected junctions. Other criteria include, for example: any increase in road traffic collisions (which may result in environmental impacts due to spillage); likely damage to the road structure; and, measurable increases in noise and atmospheric pollutants.

The impact of the proposed development on the assessed junctions is a permanent moderate/slight, being a low impact on a medium sensitivity environment where background traffic growth is the main driver of change. There is potential for the Pa Healy Road/Park Road junction to be over capacity in the PM peak in the 2028 and 2038 future years with the development in place. Whilst minor works may be needed in the future at the Pa Healy Road/Park Road junction to increase capacity, there is an increasing degree of uncertainty in relation to traffic volumes and patterns when forecasting ahead over a seventeen year period.

In terms of road structure degradation, the additional traffic generated by the proposed development is not significant as it is negligible in terms of the proportion of the overall traffic volumes recorded on Pa Healy Road.

Taking into account the analysis contained within this chapter, and mitigation measures proposed, the residual short-term and long-term traffic and transport related environmental impacts of the proposed development are not significant.

Chapter 12 – Material Assets – Waste

AWN Consulting Ltd. carried out an assessment of the potential impacts associated with waste management during the construction and operational phases of the proposed development. The receiving environment is largely defined by Limerick City and County Council as the local authority responsible for setting and administering waste management activities in the area through regional and development zone specific policies and regulations.

During the construction and demolition phase, typical C&D waste materials will be generated which will be source segregated on-site into appropriate skips/containers, where practical and removed from site by suitably permitted waste contractors to authorised waste facilities. Where possible, materials will be reused on-site to minimise raw material consumption. Source segregation of waste materials will improve the re-use opportunities of recyclable materials off-site. Completion of the construction of new foundations and the installation of underground services will require the excavation of c.14,043m^3 of material. The excavated materials which is either unsuitable for use as fill, or not required for use as fill, will be exported off site. Excavated material which is to be taken offsite will be taken for offsite reuse, recovery, recycling and/or disposal.

A carefully planned approach to waste management and adherence to the site-specific Construction and Demolition Waste Management Plan (Appendix 19.1) during the construction phase will ensure that the effect on the environment will be **short-term, neutral and imperceptible**.

During the operation phase, waste will be generated from the residents as well as the commercial tenant. Dedicated communal waste storage areas have been allocated throughout the development for residents. The residential waste storage areas have been appropriately sized to accommodate the estimated waste arisings in both apartments and shared residential areas. The commercial tenant has their own commercial WSA allocated, separate from residential WSAs. The waste storage areas have been allocated to ensure a convenient and efficient management strategy with source segregation a priority. Waste will be collected from the designated waste collection areas by permitted waste contractors and removed off-site for re-use, recycling, recovery and/or disposal.

An Operational Waste Management Plan has been prepared which provides a strategy for segregation (at source), storage and collection of wastes generated within the development during the operational phase including dry mixed recyclables, organic waste, mixed non-recyclable waste and glass as well as providing a strategy for management of waste batteries, WEEE, printer/toner cartridges, chemicals, textiles, waste cooking oil, furniture and abandoned bicycles (Appendix 19.2). The Plan complies with all legal requirements, waste policies and best practice guidelines and demonstrates that the required storage areas have been incorporated into the design of the development.

Provided the mitigation measures outlined in Chapter 19 are implemented and a high rate of reuse, recycling and recovery is achieved, the predicted effect of the operational phase on the environment will be **long-term, neutral and imperceptible**.

Chapter 13 – Cultural Heritage

This Chapter was prepared by Rose Cleary. Rose graduated in 1980 with a BA degree in archaeology from University College Cork and subsequently undertook masters research on the Newgrange prehistoric pottery assemblage. Her research interests lie in prehistoric pottery, with a particular interest in ceramic technology, petrology studies and charactisation of clay sources. She is also involved in long-term research on the prehistoric archaeology of north Munster, with particular reference to the Lough Gur landscape. She has extensive fieldwork experience, having undertaken excavations at numerous prehistoric sites in that region. She has published widely on projects connected to pipeline and infrastructural projects, including urban regeneration schemes in Cork City.

Visual impact

The proposed development is located at some distance from the known archaeological sites (Figure 13.16) and apart from the Holy Well (RMP LI005-030) and graveyard (RMP LI005-027-02) there are no above ground traces of the remaining sites. The Holy Well and graveyard are some distance to the south and the development will not have a visual impact on these sites. The historic buildings (Protected Structures) are also some distance from the development site. The proposed buildings of significant heights of up to ten storeys will be seen from the complex of late nineteenth/early twentieth century buildings on the LIT campus albeit the view will be partially obscured by intermediary housing and retail units. St. Patrick's Church is south of the development and the higher buildings will be visible from the church.

Archaeological Impact

The archaeological assessment is based on documentary and cartographic records and a site inspection. This information is used to predict the archaeological potential of the development site in terms of archaeological remains. The site is to the east of and outside the medieval city of Limerick. The two bastioned forts (RMP LI005-113 and 089) and a battery (RMP LI005-017-082) are outside the development curtilage. There are no recorded archaeological monuments on the site. There is therefore no direct impact on the known archaeological landscape.

There is no predicted impact on any recorded archaeological site or feature. The proposed development may however, directly impact on previously unrecorded sub-surface archaeological remains. Archaeological monitoring is recommended to mitigate any potential adverse impact on archaeological remains.

Chapter 14 – Interactions and Cumulative Impacts

In preparing the EIAR, each of the specialist consultants have and will continue to liaise with each other and will consider the likely interactions between effects predicted as a result of the proposed Project during the preparation of the proposals for the subject site and this ensures that mitigation measures are incorporated into the design process.

This chapter of the EIAR seeks to identify where the environmental factors examined in the above sections may be inter-related.

Population and Human Health

All environmental factors have the potential to impact on Population and Human Health. The potential impacts and appropriate mitigation measures have been examined in Chapter 4 of this EIAR. The most likely interactions with human health are considered to be the following chapters;

- Land, Soils, Geology and Hydrogeology
- Water and Hydrology
- Air Quality and Climate
- Noise and Vibration
- Landscape and Visual Impact
- Material Assets – Waste

It is considered that once all mitigation measure recommended within this EIAR are incorporated within the final development, there will be no adverse impact on Population and Human Health.

Biodiversity

The habitats present within the Site are commonly occurring throughout Ireland and are evaluated to be either important at the Site level or not important. Key areas of interact are identified as the following;

- Land, Soils, Geology and Hydrogeology;
- Water and Hydrology
- Landscape and Visual Impact.

The proposed development will not result in any significant effects on the biodiversity of the Site and provided the recommended best practice and mitigation is implemented it is considered that development will not result in any residual significant effects on the biodiversity of the Site

Land, Soil, Geology and Hydrogeology

The key areas of interaction are identified as;

- Population and Human Health;
- Water and Hydrology

Subject to implementation and adherence with mitigation measures proposed, there are no significant impacts relating to Land, Soil and Geology anticipated as a result from the proposed development.

Water and Hydrology

The earthworks for the site has the potential to impact on the surface water quality, by silt generated from runoff or chemicals/oils from construction vehicles carrying out the works. Potential health effects arise mainly through the potential for soil and ground contamination. The protection of the water environment will help to ensure that Human Health is not significantly impacted by the implementation of the SHD. The key areas of interaction in this case are identified as;

- Population and Human Health;
- Land, Soils and Geology;
- Biodiversity

Subject to the implementation of the proposed mitigation measures during construction and operational phase of the development, there are no significant impacts predicted in relation to Water and Hydrology.

Air Quality and Climate

The most significant potential impacts to air quality are predicted to occur within the construction phase of the development. It is predicted that the impact on air quality from the operational phase of the development will not be significant. The most notable areas of interaction with Air Quality and Climate are:

- Population and Human Health
- Traffic and Transportation

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated to result from the proposed development.

Noise and Vibration

Noise and vibration interacts particularly with human health, especially during the construction phase of the project where there is potential disruption due to increased activity on site and associated construction traffic. Additional noise is also associated with the operational phase where additional traffic is predicted.

The key areas of interaction are therefore considered to be:

- Population and Human Health
- Roads and Traffic

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated.

Landscape and Visual Impact

The long-term effects of the proposed development will have a positive effect the landscape of the local area and is to include use of native species planting. The proposed project generates visual significant effects as the subject site is currently largely undeveloped lands with existing hoarding surrounding the site. The key areas of interaction are considered to be:

- Population and Human Health
- Biodiversity

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated in relation to Landscape and Visual Impact.

Traffic and Transportation

The changes to traffic in the surrounding area during both the construction and operational phase of the development.

The key identified interactions in this case are;

- Air Quality and Climate;
- Noise and Vibration

Subject to the adherence with the proposed mitigation measures, no significant impacts relating to Traffic and Transportation are predicted.

Material Assets – Waste

The construction and operational phases of the proposed development will generate waste which has the potential to interact with human health. The identified areas of interaction are therefore considered to be:

- Population and Human Health

Subject to adherence to the proposed mitigation measures relating to the orderly management of waste during construction and operational phase of the development, no significant adverse impacts are anticipated.

Cultural Heritage

There are no interactions identified between Cultural Heritage and other environmental factors examined within this EIAR.

Cumulative Impacts

This Chapter also identifies potential cumulative impact upon the environment arising from the proposed project, in combination with other developments (committed or planned projects) in the surrounding area. Cumulative impact is defined by the EU Guidelines as:

"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project. For example:

- Incremental noise from a number of separate developments;
- Combined effect of individual impacts, e.g. noise, dust and visual, from one development on a particular receptor; and
- Several developments with insignificant impacts individually but which together have a cumulative effect."

Each environmental issue assessed within this EIAR has been considered in respect to the cumulative impact of the proposed project with the surrounding area. No cumulative impacts have been identified.

Chapter 15 – Summary of Mitigation and Monitoring Measures

This Chapter provides a consolidated list of all of the environmental commitments/ mitigation measures and monitoring that have been recommended by the various specialists throughout the Chapters of this EIAR. The mitigation and monitoring measures have been recommended on the basis that they are considered necessary to protect the environment during both the construction and operational phases of the proposed project.

1.0 INTRODUCTION

This Environmental Impact Assessment Report ('EIAR') has been prepared by RW Nowlan and Associates on behalf of Revington Developments Ltd, who intend to apply to An Bord Pleanála (ABP) under the Planning and Development Act 2000 (as amended by the Residential Tenancies Act 2016) for a strategic housing scheme located in Canal Bank, Co. Limerick. The application is being made under the Strategic Housing Provisions of the Planning and Development (Housing) and Residential Tenancies Act, 2016.

1.1 SUMMARY OF PROPOSED DEVELOPMENT

The ca. 4 hectare site is a triangular shaped site of vacant land. It forms one of the last remaining development sites within walking distance of the city centre. There is no current active use on the site. There is one disused industrial building complex near the eastern boundary of the site. This building is no longer in use and is vacant. The site is generally level, is located adjacent to the canal and has been filled in.

The site is bounded to the south by Pa Healy Road, a relatively recently constructed road which provides an important connecting road linking Dooradoyle to Corbally and the general inner-city circular bypass route. Pa Healy road rises to a bridge over the canal near the northwestern corner of the site. As a result the road is above the level of the site near the south western portion of the site.

The site is adjoined to the east by Park Road and to the north by the canal. Along the canal on the side of the development site, there is a pedestrian walkway linking the University of Limerick grounds with the city centre. The site is immediately accessible from this walkway.

Along the southern site boundary the site adjoins established industrial development. To the north the area consists of generally open fields which form part of the Lower River Shannon SAC and public open space lands attached to residential development. To the east the site is adjoined by a mixture of residential and industrial development. To the northwest the site is adjoined by a shopping complex. A currently functioning commercial building stands near the south eastern corner of the site at the junction between Pa Healy Road and Park Road. This building is in active use and has separate vehicular access.

The site is located at Canal Bank, Pa Healy Road, Limerick as shown on Figure 1.1 below.

Figure 1.1 Site Location

The proposed development is set out in the public notices as follows;

A ten year permission for a strategic housing development at Canal Bank, Pa Healy Road, Limerick.
The development will consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;
A. Demolition of existing 530m2 warehouse building on site.
B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;
D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;
E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;
F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;
G. Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;
H. Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;
I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;
J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;
K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;
L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development

1.2 LEGISLATIVE CONTEXT

The consolidated European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive'), has been transposed into Irish planning legislation by the Planning and Development Acts 2000 to 2019 and the Planning and Development Regulations 2001 to 2019. The EIA Directive was amended by Directive 2014/52/EU which has been transposed into Irish law pursuant to the provisions of amendments made to Part X of the Planning and Development Act 2000 and European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018), as amended.

Accordingly, this EIAR has been prepared in compliance with the EIA Directive as amended by Directive 2014/52/EU and Irish implementing legislation, including Part X of the Planning and Development Act 2000, as amended and Planning and Development Regulations 2001 (S.I. No. 600 of 2001), as amended in particular as amended by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

The European Union Directive 2011/92/EU, amended by EU Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive'), requires Member States to ensure that a competent authority carries out an assessment of the likely significant effects of certain types of project, as listed in the Directive, prior to development consent being given for the project. The Environmental Impact Assessment (EIA) of the proposed development will be undertaken by An Bord Pleanála as the competent authority, in compliance with the provisions of EU and Irish law and guidance.

1.3 EIA SCREENING

The relevant classes/scales of development that normally require Environmental Impact Assessment (EIA) are set out in Schedule 5 (Part 2) of the Planning and Development Regulations 2001, as amended. Section 172 of the Planning & Development Act 2000, as amended, provides the legislative basis for mandatory EIA. It states the following:

"An environmental impact assessment shall be carried out by a planning authority or the Board, as the case may be, in respect of an application for consent for proposed development where either:

(a) the proposed development would be of a class specified in –

(i) Part 1 of Schedule 5 of the Planning and Development Regulations 2001, and either –

I. such development would exceed any relevant quantity, area or other limit specified in that Part, or

II. no quantity, area or other limit is specified in that Part in respect of the development concerned,

or

(ii) Part 2 of Schedule 5 of the Planning and Development Regulations 2001 and either –

I. such development would exceed any relevant quantity, area or other limit specified in that Part, or

II. no quantity, area or other limit is specified in that Part in respect of the development concerned,

Accordingly, Schedule 5 of the Planning & Development Regulations 2001, as amended sets out a number of classes and scales of development that require EIA.

With regards to the proposed strategic housing development, the provisions of Part 2 of Schedule 5 require an EIA to be undertaken where it is proposed to carry out the following - "Construction of more than 500 dwelling units", as per paragraph 10 (b)(i) of Part 2 of the Schedule and urban development which would involve an area greater than either 2ha (business district), 10 ha (built up area) or 20ha (elsewhere) as per paragraph 10(b)(iv).

The proposed residential development does not exceed the 500 unit threshold in paragraph 10(b)(i). In respect of paragraph 10(b)(iv), the site is not located in a business district and does not propose urban development of an area greater than 10 hectares. Therefore the proposed development does not equal or exceed the relevant quantity, area or other limit specified in Part 2 of Schedule 5 and is not subject to mandatory EIA.

However, section 172 of the Planning & Development Act 2000, as amended, also sets out the basis for EIA for developments which do not equal or exceed, the relevant quantity, area or other limit specified in Part 2 of Schedule 5, i.e., "sub-threshold development". Thus, an EIA is required where subthreshold development is likely to have significant effects on the environment and therefore should be subject to EIA. In this context, the consideration of 'significant effect' is not determined by reference to relevant quantity, area or other limit thresholds but also considering factors such as the nature and location of a project must also be taken into account. On this basis, it was decided to compile an EIAR in respect of the proposed strategic housing development.

Article 299A of the Planning and Development Regulations 2001, as amended, provides that, where a planning application for a "sub-threshold" strategic housing development is accompanied by an EIAR and a request for a EIA screening determination under section 7(1)(a)(i)(I) of the 2016 Act was not made – as is the position in relation to this application – then the application shall be dealt with as if the EIAR had been submitted in accordance with subsection 172(1).

The EIAR provides information on the receiving environment and assesses the likely significant effects of the project and proposes mitigation measures to avoid or reduce these effects. The function of the EIAR is to provide information to allow the competent authority to conduct the Environmental Impact Assessment (EIA) of the proposed development.

1.4 CONTENT OF AN EIAR

Article 5 of the EIA Directive provides that, where an EIA is required, the developer shall prepare and submit an environmental impact assessment report (EIAR) previously referred to as an Environmental Impact Statement ('EIS'). The information to be provided by the developer shall include at least:

a) a description of the project comprising information on the site, design, size and other relevant features of the project;

b) a description of the likely significant effects of the project on the environment;

c) a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;

d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;

e) a non-technical summary of the information referred to in points (a) to (d); and (f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.

In addition, article 94 of Schedule 6 to, the Planning and Development Act 2000 to 2019 sets out the information to be contained in an EIAR, with which this EIAR complies.

1.5 EIA GUIDANCE

The Environmental Protection Agency (EPA) published its 'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, August 2017), and these draft guidelines have been used in the compiling of this EIAR.

In preparing this EIAR regard has also been taken of the provisions of the 'Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment', published by the Department of Housing, Planning and Local Government (DHPLG) in August 2018 to the extent these guidelines are relevant having regard to the enactment of the revised EIA Directive.

The European Commission also published a number of guidance documents in December 2017 in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU as amended by 2014/52/EU) including 'Guidance on the preparation of the Environmental Impact Assessment Report'. RW Nowlan & Associates has prepared the EIAR with regard to these guidelines also.

1.6 PURPOSE AND SCOPE OF THE EIAR

As part of the Environmental Impact Assessment process, the developer of the project must prepare and submit an Environmental Impact Assessment Report (hereafter referred to as the EIAR). This is the first step of the EIA process, as mentioned in Article 1(2)(g) of European Union Directive 2011/92/EU, as amended by Directive 2014/52/EU on assessment of the effects of certain public and private Projects on the environment ("the EIA Directive"). The EIAR is the document prepared by the developer that presents the output of the assessment. It contains information regarding the project, the likely significant effect of the project, the baseline scenario, the reasonable alternatives considered by the developer, the features and measures to mitigate adverse significant effects as well as a Non-Technical Summary and any additional information specified in Annex IV of the EIA Directive. Article 5 of the EIA Directive sets out what must be included in the EIA Report, and how to ensure that it is both of a sufficient high quality and complete. This EIAR provides a statement of the likely significant effects associated with the proposed strategic housing development.

It is important to distinguish the Environmental Impact Assessment (EIA) to be carried out by An Bord Pleanála, from the Environmental Impact Assessment Report (EIAR) accompanying the planning application. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of the proposed development on the following:

a) population and human health

b) biodiversity, with particular attention to species and habitats protected under Directive

92/43/EEC and Directive 2009/147/EC

c) land, soil, water, air and climate

d) material assets, cultural heritage and the landscape

e) the interaction between the factors referred to in points (a) to (d)

1.7 STRUCTURE AND CONTENT OF THE EIAR

This EIAR uses the grouped structure method to describe the existing environment, the potential impacts of the proposed development thereon and the proposed mitigation measures. Background information relating to the proposed development, consultation undertaken and a description of the proposed development are presented in separate sections. The grouped format sections describe the impacts of the proposed development in terms of human beings and population, flora and fauna, soils and geology, water, air and climate, noise, landscape, cultural heritage and material assets such as waste, together with the interaction of the foregoing.

The chapters of this EIAR are as follows:

1. Introduction
2. Alternatives Considered
3. Description of Proposed Development
4. Population and Human Health
5. Biodiversity
6. Land, Soil, Geology and Hydrogeology
7. Water and Hydrology
8. Air Quality and Climate
9. Noise and Vibration
10. Landscape and Visual Impact
11. Traffic and Transportation
12. Material Assets – Waste
13. Cultural Heritage
14. Interactions and Cumulative Impacts
15. Summary of Mitigation and Monitoring Measures

The EIAR also includes a non-technical summary, which is a condensed and easily comprehensible version of the EIAR document. The non-technical summary is laid out in a similar format to the main EIAR document and comprises a description of the proposed development followed by the existing environment, impacts and mitigation measures presented in the grouped format. The Non Technical Summary (Part 1) and the Main Chapters (Part 2) along with Appendices to Chapters (Part 3). For ease of reference, smaller appendices have been included within the main body of Part 2. Where appendices are included within Part 2, they are referenced in the Main Body Table of Contents above.

1.8 DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS AND IMPACTS

The impact assessment methodology is detailed in respect of the various EIAR topics in the respective specialist Chapters herein. Unless otherwise stated, the criteria for impact characterisation (i.e. for describing effects / impacts) are as per the EPA 2017 EIAR Guidelines.

The significance of an impact is determined through comparison of the character of the predicted impact to the sensitivity of the receiving environment / receptor as per the EPA 2017 Guidelines as shown in Table 1.1 below.

Criteria	**Term**	**Description**
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences
	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment

	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
	Profound	An effect which obliterates sensitive characteristics
Extent and Context	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions
Probability	Likely	Effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
	Unlikely	Effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented
Duration and Frequency	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-Term	Effects lasting one to seven years
	Medium-Term	Effects lasting seven to fifteen years
	Long-Term	Effects lasting fifteen to sixty years
	Permanent	Effects lasting over sixty years
	Reversible	Effects that can be undone, for example through remediation or restoration

	Frequency	Describes how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Type	Indirect	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out
	Worst Case	The effects arising from a project in the case where mitigation measures substantially fail
	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 effect is of greater significance than the sum of its constituents

Table 1.1: Impact Classification Terminology (EPA, 2017)

1.9 PROJECT TEAM

The companies and staff listed in Table 1.2 below were responsible for completion of the EIAR in respect of the proposed development. The EIAR project team comprises a multidisciplinary team of experts with extensive experience in the assessment of projects and in their relevant area of expertise. The qualifications and experience of the principal staff from each company involved in the preparation of this EIAR are summarised in Table 1.2 below. Each chapter of this EIAR has been prepared by a competent expert in the subject matter as detailed below.

Consultant	Members Involved with EIAR Preparation	Experience	Inputs
RW Nowlan & Associates (RWN) **37 Lower Baggot Street,** **Dublin 2**	Hendrick van der Kamp Kirsty McDonnell	Hendrik W van der Kamp - The former Head of the planning school in Technological University Dublin. Fellow and Past-president of the Irish Planning Institute and Honorary President of the European Council of Spatial Planners. Senior Planning Inspector with An Bord Pleanala from 1989 to 1995. In that role he has conducted oral hearings for large scale projects and carried out the assessment of numerous large scale residential and mixed use development schemes throughout the country. Planning consultant to advise Fingal County Council on planning matters in 2003. Instrumental in developing their methodology for delivering community infrastructure as part of large scale housing development through a collaborative approach with private developers. He has been consulted by the Government on a number of occasions on planning matters. He acted as the Minister's appointee on the Technical Assessment Board for Architects between 2009 and 2015. In 2013 he was appointed to carry out an Independent Review of the Minister's Planning Review Report. In 2016 he was appointed as independent Inspector to review a Draft Ministerial Direction on Wind Farm Policy. He was member of advisory groups of both the National Spatial Strategy and the National Planning Framework. Kirsty McDonnell - Qualified with a Masters in Regional and Urban Planning from University College Dublin. Experience coordinating large scale Strategic Housing Development applications through all stages from initial design through submission to An Bord Pleanala. Kirsty is a member of the Irish Planning Institute.	Project Management and EIAR Chapters; 1 Introduction 2 Alternatives Considered 3 Description of Proposed Development 4 Population and Human Health 14 Interactions and Cumulative Impacts 15 Summary of Mitigation and Monitoring Measures
SLR Consulting **7 Dundrum Business Park,** **Windy Arbour,** **Dublin 14**	Michael Bailey Una Nealon Owen Twomey Richard Arnold Anne Merkle	Michael Bailey holds a BSc (Hons) in Biology and Ecology from the University of Ulster, and an MSc in Quantitative Conservation Biology from the University of the Witwatersrand, Johannesburg, South Africa. Michael is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). He has prepared	EIAR Chapters; 5 Biodiversity 6 Land, Soil and Geology 7 Water and Hydrology

	Peter Glanville Dominica	Appropriate Assessments and Ecological Impact Assessments for a wide range of projects in Ireland and the UK. Úna Nealon holds a BSc (Hons) Environmental Science from NUI Galway and a PhD in Ecology from University College Dublin. Úna has prepared ecological reports, including Biodiversity chapters, Ecological Impact Assessments, Appropriate Assessment Screening Reports and Natura Impact Statements, for a range of projects in the residential, commercial, renewable energy and public infrastructure sectors. Owen Twomey has worked in ecological consultancy since 2016. Owen holds a BSc in Environmental Science (Zoology) and a Postgraduate Diploma in Ecological Assessment. Owen has prepared Ecological Impact Assessment and Appropriate Assessment reports for a number of projects. Richard Arnold is a Technical Director with SLR. Richard has 23 years of experience as a consultant ecologist, which has included preparing and overseeing assessments under the Habitats Regulations/Directive for multiple projects, including small and large infrastructure projects. Anne Merkle holds a Technician's Certificate in Arboriculture and is a Technicians member of the Arboricultural Association. Dominica Baird (CGeol) - Dominica is a Chartered Hydrogeologist with twenty years' consultancy experience. Dominica has practised hydrogeology, groundwater risk assessment and contaminated land in London, Edinburgh and Dublin and leads groundwater monitoring, water resources and due diligence projects. Key competencies include hydrogeological assessments and aquifer characterisation, developing conceptual site models, quantitative and qualitative groundwater risk assessments and groundwater	

		investigations. Has presented findings of hydrogeological assessments at oral hearings and prepared briefs of evidence. Dominica has project managed numerous water sections for EIARs, which included assessment of potential impacts on the water environment. Peter Glanville (PGeo. EurGeol.) - Peter is a Professional Geologist and is a Technical Director in the Water (Hydrology and Hydrogeology) team in SLR's Dublin office. He has over twenty years' experience in environmental consulting including hydrology, flood risk, geomorphology and geology. Peter's specialist experience is in the field of hydrology and hydrogeology and includes undertaking Environmental Impact Assessments and preparing Environmental Impact Assessment Reports for a range of development types including infrastructure, mining, minerals and power related projects. His range of experience also includes discharge licencing and consents, flood risk assessments, Peat Landslide Hazard Risk Assessments, the preparation of Construction and Environmental Management Plans, baseline water monitoring, Quaternary Geomorphology and Subsoils.	
AWN **The Tecpro Building,** **Clonshaugh Business & Technology Park,** **Dublin 17**	Mike Simms Chonaill Bradley Avril Challoner	Mike Simms BE MEngSc MIOA MIET, Senior Acoustic Consultant at AWN, who has worked in the field of acoustics for 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential. Chonaill Bradley (Bsc ENV AssocCIWM) is a Senior Environmental Consultant in the Environment Team at AWN. He holds a BSc in Environmental Science from Griffith University, Australia. He is an Associate Member of the Institute of Waste Management (CIWM). Chonaill has over seven years' experience in the	EIAR Chapters; 8 Air Quality and Climate 9 Noise and Vibration 12 Material Assets - Waste

		environmental consultancy sector and specialises in waste management. Dr. Avril Challoner who is a Senior Environmental Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Chartered Scientist (CSci), Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling. She has experience with preparing air quality and climate impact assessments for EIARs for various residential, mixed-use, commercial and industrial developments.	
PC Roche & Associates **Dublin,** **Ireland**	Cass Roche	Cass Roche is the principle of PC Roche and Associates and a qualified landscape architect with the following qualifications; Diploma in Physical Planning, Trinity College. Membership of Landscape Institute, London. Supplementary professional development courses include a Computer Aided Design and a Town Planning Development Course in UCD. Cass is also a lecturer in Landscape Planning and Garden Design at Beechfield College.	EIAR Chapter; 10 Landscape and Visual Impact
TTRSA **Barran,** **Blacklion,** **County Cavan**	Matt Steele Pamela Townley	Matthew Steele BA (Hons) MSc FCILT FRGS MCIHT is a Director of TTRSA with over 20 years of professional experience Traffic and Transport assessments. Pamela Townley BSc (Hons) is a Directors of TTRSA with over twenty years experience of assessing the traffic and transport impacts of development.	EIAR Chapter; 11 Traffic and Transportation
Rose Cleary	Rose Cleary	Rose Cleary graduated in 1980 with a BA degree in archaeology from University College Cork and subsequently undertook masters research on the Newgrange prehistoric pottery assemblage. Her research	EIAR Chapter; 13 Cultural Heritage

		interests lie in prehistoric pottery, with a particular interest in ceramic technology, petrology studies and charactisation of clay sources. She is also involved in long-term research on the prehistoric archaeology of north Munster, with particular reference to the Lough Gur landscape. She has extensive fieldwork experience, having undertaken excavations at numerous prehistoric sites in that region. She has published widely on projects connected to pipeline and infrastructural projects, including urban regeneration schemes in Cork City.	

Table 1.2: Project Team Qualifications

1.10 DIFFICULTIES IN COMPILING THE EIAR

RW Nowlan & Associates is responsible for the preparation of this EIAR. No difficulties, such as technical deficiencies, lack of information or knowledge, were encountered in compiling any specific information contained in the EIAR.

2.0 ALTERNATIVES CONSIDERED

2.1 INTRODUCTION

Article 5 of the Environmental Impact Assessment (EIA) Directive as amended by Directive 2014/52/EU states that the information provided in an Environmental Impact Assessment Report (EIAR) should include a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the final choice, taking into account the environmental effects.

The primary obligation under Article 5(1)(d) of the EIA Directive is upon the developer to provide a description of the 'reasonable alternatives' considered in the course of the application process. In this regard, the Directive states:

'(d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment'

The consideration of alternatives is an effective means of avoiding environmental impacts. As set out in the 'Draft Guidelines on The Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2017), the presentation and consideration of reasonable alternatives investigated is an important part of the overall EIA process.

This chapter of the EIAR contains a description of the reasonable alternatives that were considered in respect of the development of the site in terms other land-use options, unit numbers, unit types, design, and site layout.

It is important to acknowledge that although the consideration of alternatives is an effective means of avoiding environmental impacts, there are difficulties and limitations when considering alternatives.

Indeed, as is clear from the provisions of the EIA Directive itself, the requirement is to consider "reasonable alternatives" which are relevant to the project and its characteristics. In general terms, issues such as hierarchy, non-environmental factors and certain site-specific issues may also be relevant to the consideration of reasonable alternatives by the developer.

2.2 ALTERNATIVE LOCATIONS

The proposed development is located within lands which have been is zoned for Residential Development under the Limerick City Development Plan 2010-2016. This zoning designation is also proposed to continue in the Draft Limerick Development Plan 2022-2028. As such consideration of alternative sites for the construction of residential units proposed in this development was not considered necessary. It is considered that the proposed site is a suitably zoned residential development site, available to the applicant for the proposed development. During the design process for the proposed development several iterations of the site layout and alternative designs were considered. This planning application demonstrates that the subject site and the surrounding area have the environmental capacity to accommodate the proposed development without any significant risk of impact upon environmental sensitivities due to the site location.

2.3 DO-NOTHING ALTERNATIVE

The 'Do-Nothing' alternative considers the likely scenario that would arise, assuming the proposed Project were not progressed, i.e. if nothing were done. Note that this Chapter discusses the Do-Nothing scenario in terms of development (or lack thereof) in the absence of the proposed Project. The likely impacts of a Do-Nothing scenario in relation to the various environmental topics (e.g. cultural heritage, biodiversity, traffic and so on) are discussed in the respective chapters of this EIAR.

If the proposed development was not to proceed, the opportunity to develop 363 no. apartment units, 18 no. Houses and 189 student bedspaces, a childcare facility, commercial/retail units, open space, landscaping and ancillary works at this long standing residential zoned site would be lost.

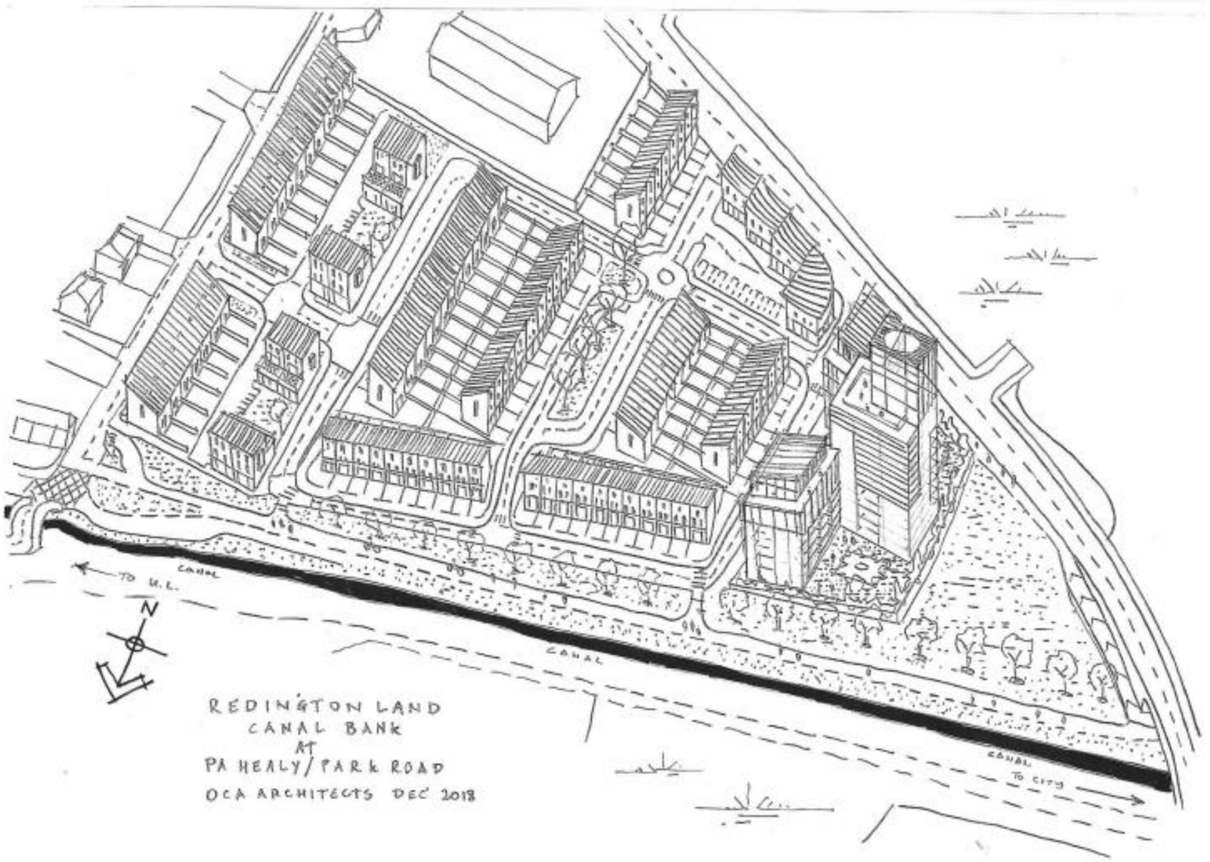
Under the "Do Nothing" alternative, the zoned residential lands would not be used for the development of housing. There remains a long-standing housing need in Limerick and Limerick City and County Council have, through the inclusion of the site for residential development in their adopted Plan, given their support for the site to be developed for residential purposes. Therefore, under this "Do Nothing" scenario, the construction of badly needed housing would have to occur on another site in Limerick to fulfil that need. It is entirely possible that any alternative site would be less suitable than the proposed development site.

In circumstances where the utilisation of alternative unzoned lands and the non-utilisation of lands zoned for residential development would represent an unsustainable land use, the "Do-Nothing" alternative was not considered the appropriate option.

2.4 ALTERNATIVE LAYOUTS

This section provides an overview of how the proposed development has evolved to date. The design process was an iterative process, where findings at each stage of the assessment were used to further refine the design, always with the intention of minimising the potential for environmental impacts. In particular, in developing the proposed design, cognisance was taken of the designs proposed in respect a previous SHD proposal (ref: 306541-20), the applicants in this instance have ensured that the previous considerations of An Bord Pleanála were taken into account. The layout has also evolved through discussions with Limerick City and County Council at pre-application stage, and following receipt of An Bord Pleanála's Opinion at Section 5 pre-application discussion stage.

Alternative Layout 1



At initial project inception and feasibility stage, a low-density housing scheme was explored, based on market advice surrounding a demand for 3 no. bedroom and 4 no. bedroom houses in the area. The above design proposal was initially presented to Limerick City and Council at the beginning of the design process to open discussion of development on the subject site. This iteration of the design proposed mainly low density housing units with some apartment units on the western portion of the site. This design was deemed unfeasible at an early stage when planning policies relating to density and housing mix were examined. It was further considered that a mix of typologies would be required not just to increase the residential density at the site, but to provide a mix of typologies that could meet the needs of different demographics and tenure typologies.

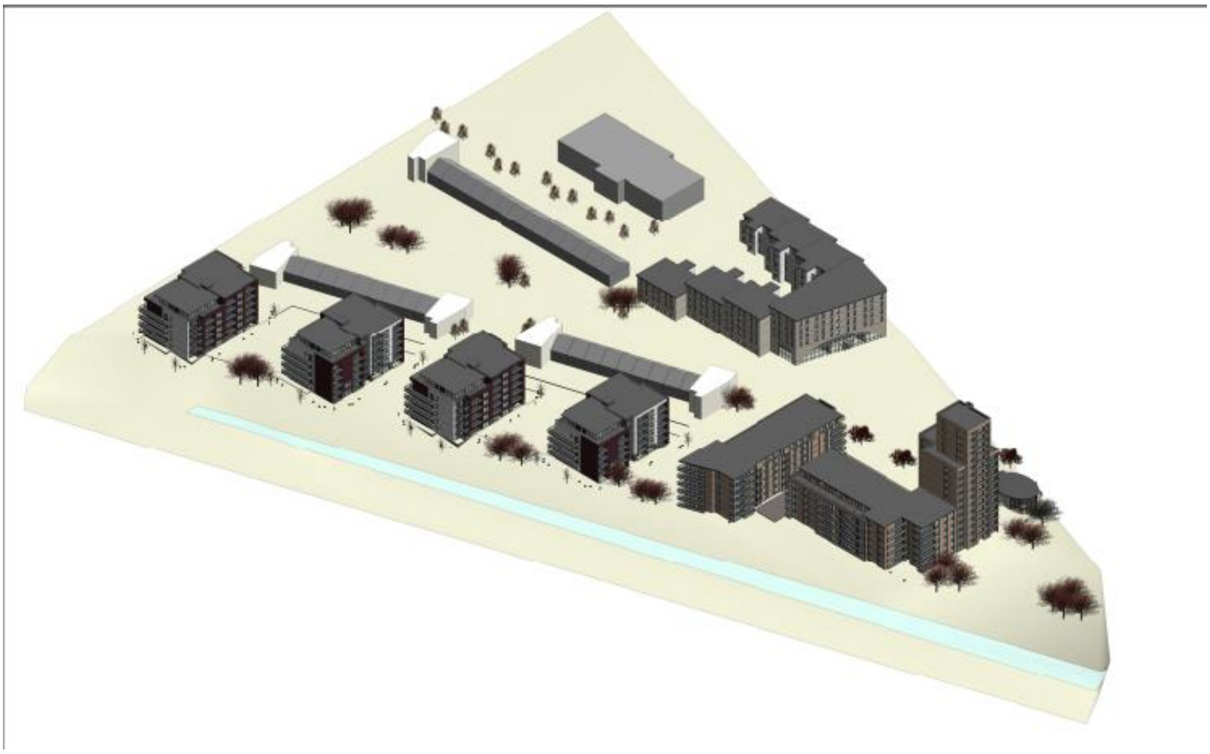
Alternative Layout 2

The above layout was examined following initial discussions with Limerick City and County Council. The design was successful in increasing the overall density of the development and proposed a landmark type building which would be viewed when travelling down Pa Healy Road. It was considered at this stage of the design process that the above iteration was not the most sustainable use of the zoned lands with housing units located in the middle of the site and the higher density units located around the perimeter.

Alternative Layout 3

At this stage of the design process, the student accommodation units were included in the design due to the prime location of the development site and in direct response to a recognised underprovision of student accommodation to serve third level institutes in Limerick. The Alternative Layout 3 resulted in increased residential density, good pedestrian and cyclist permeability and a vehicle access strategy that did not result in adverse impacts upon the local road network. While further revision was required, the housing mix within Alternative Layout 3 was similar to the final design as presented in this application.

Alternative Layout 4



The above iteration of the development design is relatively close to the eventual final design as presented in this application. While undertaking pre planning and applying for a Confirmation of Feasibility letter from Irish Water, it became apparent that the above design was no longer feasible. This proposal would have required moving Irish Water sewer infrastructure located along the canal. When this proposal could not be agreed with Irish Water, the design was amended to provide open space along the canal so that the Irish Water infrastructure would be unaffected. Overall, it is considered that this has led to a much more sustainable development design, as presented in this application, with increased open space provision for future residents of the development as well as residents in the surrounding area.

Final Layout

The proposed project constitutes the final alternative, and preferred, option. The design has been progressed via an iterative process with design amendments arising from consultation with An Bord Pleanála and Limerick City and County Council during the pre-application process. The current design takes account of both planning and environmental considerations. The full description of the final proposed development is outlined in Chapter 3 below.

2.5 CONCLUSIONS

The proposed development provides for new residential development on lands zoned for residential use under the Limerick City Development Plan 2010-2016 which was subject to the SEA process. As such, consideration of alternative sites for the construction of houses and apartments proposed in this residential development was not considered necessary.

During the design process, the layout and design of the proposed development evolved in response to architectural, landscape and environmental requirements and several iterations of the site layout and alternative designs were considered. Any difficulties from an architectural, landscape or environmental viewpoint were assessed and, where necessary, the design was amended to address the issues encountered.

The evolution of the current scheme was informed by consideration of environmental aspects; vehicular and pedestrian movements; maximisation of pedestrian connectivity through the site and protection of adjoining residential amenity. Furthermore, the final scheme has been directly influenced by the technical and specific issues raised in the Board’s Opinion.

3.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 INTRODUCTION

The site (4 ha.) is a vacant site near Limerick city centre which has been zoned for mixed use development in the Limerick City Development Plan. It is bounded to the north by the canal plus walking/cycling route and to the south by Pa Healy Road. A previous application for the proposed development at the site was refused by An Bord Pleanála because of deficiencies in the submitted Natura Impact Statement. These deficiencies have been addressed in this application. The proposed development is for a predominantly residential, high density, mixed use scheme of ‘build to rent’ apartments, houses, a student accommodation block and retail units, plus community facilities building. Vehicular access to the scheme will be from Pa Healy Road.

3.2 CHARACTERISTICS OF THE SITE

The subject site comprises of mostly undeveloped lands with the exception of a single steel framed warehouse unit which has been vacant for a considerable period. At the early stages of the application process, Verde Environmental Consultants were commissioned to undertake a preliminary environmental assessment of the subject site. The Verde report is submitted within this application under a separate cover, titled ‘Phase 2 Environmental Due Diligence Report’. The Verde report identified areas on the site of significant deposits of soil and construction and demolition materials dating from the 1990’s.

The site is triangular in shape and is bounded by the following;

North - The site is bounded by the Park Canal to the north. The canal banks are a public walkway and are part of the Lough Derg Way (walking/hiking trail) which starts in Limerick City to the west of the site. The other side of the canal has been designated as a Special Area of Conservation by the National Parks and Wildlife Services–Site Code002165–Lower River Shannon SAC.

South - A single warehouse of Clancy Lewis fruit distribution is located to the south east of the site. Pa Healy Road borders the site to the south which is bounded by commercial properties, undeveloped land recreational grounds of O’Brien’s Park.

East - The eastern boundary of the site is bordered by the Park Road, which is further bounded by a mixture of commercial (Musgraves Cash & Carry, Park Road Recycling Centre, David Mead Fitted Furniture) and detached residential premises.

West - The site narrows down towards the west. There is a bridge crossing the canal located to the west of the site. Sport grounds are located further West.

The physical setting of the subject site at present is outlined in Table 2.3 of the Verde report as shown below in Table 3.1 of this report.

FEATURE	DETAILS & COMMENTS
Geology	**Overburden:** The GSI describes the subsoils underlying the site as Made Ground with marine/estuarine silts and clays located in the north western corner.
	Solid Geology: According to GSI data, the majority of the site is located on top of undifferentiated limestones. The south west corner of the site is underlain by volcanoclastic rocks among limestones
Hydrogeology	**Regional Classification**: According to GSI data, the bedrock aquifer underlying the majority of the site is classified as Lm, Locally Important aquifer which is generally moderately productive. The maximum recharge capacity of such an aquifer is 200mm/year.
	Vulnerability: The GSI classification of the bedrock aquifer beneath the majority of the site is described as having a vulnerability rating of (L) Low. This suggests that bedrock will not be encountered in the first 10mBGL. The eastern boundary has a vulnerability rating of (M) Moderate. This suggests that bedrock will not be encountered in the first 10mBGL in this area also.
	Well Search: According to the GSI database there is one well located within 1km of the site. This well is located approximately 0.39km to the south west of the site and was drilled in 1978 by Shamrock to a depth of 73.2m. This well produces good yields of approximately 288m3d and is defined as being of industrial use.
Hydrology/Ecology	**Surface Water Courses/ Abstractions**: The Park Canal is located along the northern boundary of the

	site and connects the Abbey River to the River Shannon flowing in an easterly direction. The Abbey River is located approximately 580m to the west of the site and flows in a southerly direction joining the River Shannon lower approximately 1.1km to the west of the site
	Water Framework Directive status: The River Shannon Lower has not been assigned a status under the Water Framework Directive (WFD); It is defined as being "Not At Risk" of deteriorating in the future. The groundwater body beneath the site is classed as having "Poor" status and is at risk of deteriorating in the future. (Ground waterbody Name: Limerick City East, Code: IE_SH_G_138)
	Protected Areas: According to National Parks and Wildlife Service (NWPS) records the Lower River Shannon Special Area of Conservation (SAC) is located approximately 30m north of the site on the northern bank of the canal. (Site code: 002185). This protected site includes also Abbey River.
	Flooding: According to OPW resources, the entire site is prone to coastal flooding in extreme events. The northern part of the site is, adjacent to the canal, might be prone to pluvial flooding

Table 3.1: Physical Site Setting Source: Verde Phase 2 Environmental Due Diligence Report (Page 8, Oct 2021)

3.3 PROPOSED DEVELOPMENT

The proposed development is set out in the statutory notices as follows;

A ten year permission for a strategic housing development at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;

A. Demolition of existing 530m2 warehouse building on site.

B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

G. Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

H. Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;

I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;

J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;

K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;

L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all *apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.*

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development.

The proposed housing mix is set out in Table 3.2 below.

Unit Type	**Studio**	**1 Bed**	**2 Bed**	**3 Bed**	**4 Bed**	**Total**
Apartment	66	67	230	-	-	363
Houses	-	-	-	-	18	18
Student Accommodation	-	-	9 (18)	37 (111)	15 (60)	61 (189 no. bedspaces)

Table 3.2: Proposed Dwelling Mix

The application for the proposed development seeks a ten year planning permission. Having regard to the large scale of the development and the number of units in the overall scheme, it is considered that this such a duration is appropriate. As such, it is proposed to complete the overall development over three no. phases of construction as shown below in Figure 3.1.

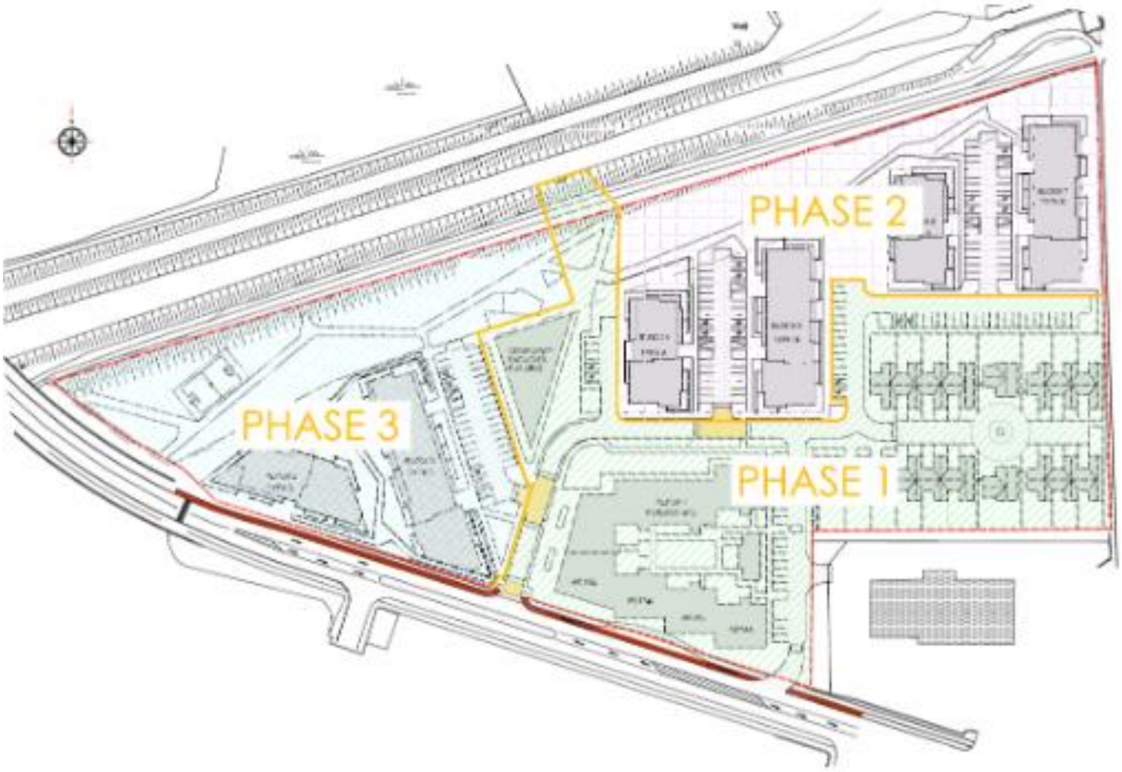


Figure 3.1: Proposed Development Phasing

Each phase includes the following elements of the overall development;

Phase 1 – Student accommodation, Facilities Building and the proposed Houses;

Phase 2 – Due to the scale of development proposed in Phase 2, this phase will be subdivided in to the following;

Phase 2A – Apartment blocks 4 and 5;

Phase 2B – Apartment blocks 6 and 7;

Phase 3 – Apartment blocks 2 and 3

The facilities and number of units to be completed in each phase is set out in Table 3.3 below.

Phase	**Elements to be Complete**
Phase 1	18 no Housing Units, Student Accommodation Block (189 Student Bedspaces), Creche and Facilities Building
Phase 2 – 2A	Block 4 – 45 no. Units, Block 5 – 66 no. Units
Phase 2 – 2B	Block 6 – 45 no. Units, Block 7 – 56 no. Units

Phase 3	Block 2 – 63 no. Units, Block 3 – 88 no. Units

Table 3.3: Breakdown of Units Provided in Each Phase of Development

3.4 CONSTRUCTION STAGE

This application seeks a ten year permission for complete development of the proposed scheme. The relevant construction stage activities are discussed below.

Site Establishment and Access

The first activity to be carried out at the site will be the establishment of site facilities and security. The location of the compound, associated haul roads and main site access point will be determined and agreed with the Local Authority prior to commencement of site works. All sub-contractors as well as the main contractor and project managers will occupy offices within the construction compound. The site parking for all staff, contractors and visitors will also be located in this area. The proposed site compound implementation is shown in Figure 3.2 below. However, it should be noted that this is to be agreed with Limerick City and County Council prior to commencement of development.

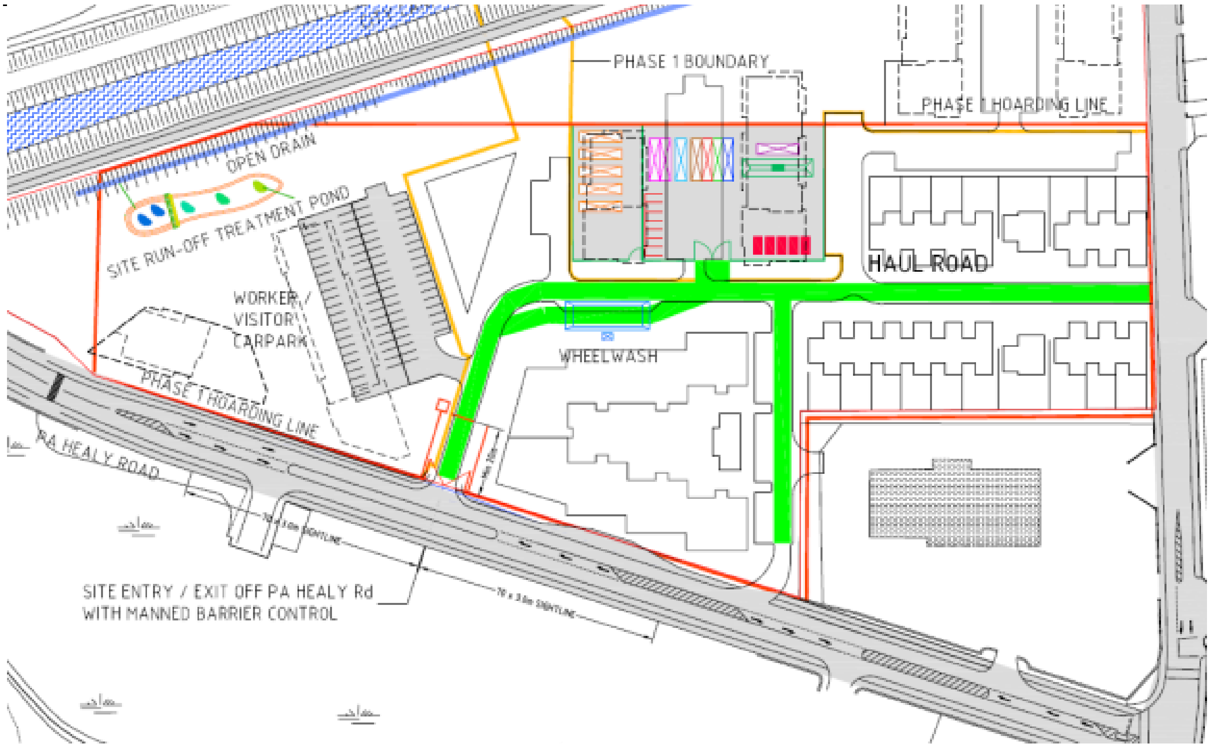


Figure 3.2: Proposed Site Compound. Source: PHM Drawing no 108-96-901

The compound will be used as a storage area for the various components, fuels and materials required for construction. Any fuels will be stored in self bunded tanks. The compound will be fenced off to ensure site security is maintained. The compound may be situated in an area of future landscaping within the proposed development so as not to interfere with the areas where structures are to be constructed. Any area used will be reinstated in accordance with the grant of planning at the end of the construction period. Until such time as the construction of the first phase of construction work is complete, the new access road will not be open to members of the public.

Hoarding

Construction phases will be closed off using hoarding which will be constructed before any significant development works commence on site for that phase. The proposed hoarding will be standard in nature consisting of mounting posts would be set in concrete, with horizontal rails and metal sheeting. It is intended that where practicable, hoarding will be retained and re-configured for re-use between working areas as construction progresses.

The following measures will be applied to the installation and maintenance of the site hoarding;

- Maintenance of adequate hoarding to an acceptable condition to prevent unauthorised access to works areas;
- Maintain appropriate sightlines to ensure safety of vehicles and pedestrians;
- Temporary fencing may be used for short term works areas;
- Retain existing walls, fences, hedges and earth banks as far as reasonably practicable.

Site Security

Security will be the responsibility of the contractor who will provide adequate security to prevent unauthorised entry to or from any working areas. Robust security measures will be put in place to prevent unauthorised access at all times which will include;

- Installation of CCTV and alarm system with remote access, two-way communication and appropriate backup storage;
- Provision of adequate security patrols during out-of-hours and holiday periods;
- Providing manned access control at the main site access.
- Liaison with local community groups, An Garda Síochána and Limerick City and County Council when setting up security plan.

Working Hours

The site working hours would be stipulated in the planning conditions attached to a grant of permission. As standard, the working hours envisioned for development on site are the following;

- Monday to Friday – 8:00 to 20:00
- Saturday – 8:00 to 16:00
- Sunday and Holidays – No works on site

It is not intended that any works would be undertaken outside of the above hours of operation. However, should this be absolutely unavoidable in any instance, any working hours outside the normal construction working hours will be agreed with the planning authority.

Health and Safety

In accordance with the statutory requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013, a Health and Safety Plan will be prepared prior to commencement of development. This plan will include measures such as;

- Construction Health & Safety training requirements
- Induction procedures
- Emergency protocols
- Details of welfare facilities
- Risk assessments and Method Statements.
- All workers and visitors will be required to wear appropriate personal protective equipment prior to going on to the site and will undergo a safety briefing by a member of the site safety team. All PPE to be level assessed for its appropriateness for particular tasks.
- Regular site safety audits will be carried out throughout the construction programme to ensure that the rules and regulations established for the site are complied with at all times.

Site Preparation Works

Upon commencement of development, top surface material will be stripped back and either stockpiled on site for pending re-use where feasible in landscaped areas or removed off site to a permitted or licensed facility as part of a recovery operation. This will be done in accordance with all relevant statutory requirements.

Site stripping will be kept to a minimum in line with recommendations made within the Verde Phase 2 Environmental Due Diligence Report (2021) and the Construction Environmental and Waste Management Plan (2021) prepared by PHM Consulting.

Recommendations included within the Construction Environmental and Waste Management Plan in this regard include the following;

- Site clearance not to be undertaken during wet conditions when rainfall of more than 1mm/hr is forecast within the next 24 hour period.
- Erosion and sediment traps to be provided as detailed in Section 4 prior to outfall to the Canal.
- Hydrocarbon separation to be provided for all surface water prior to outfall to the Canal.
- Fuels, Lubricants, hydraulic fluid, solvents and oils to be carefully handled and spill kits provided. All such fluids to be stored in bunded containment to minimum 110% capacity.
- Accidental spillages to be immediately contained and contaminated soil removed from site.
- Waste fluids to be collected and removed from site.
- Dedicated wash down area to be provided for concrete trucks.
- The proposed surface water head wall is to be preformed of precast concrete and to be installed during low water period with no work within/adjacent the Canal to be done within the period October to June.

Construction of New Buildings

The proposed development includes apartment units, student accommodation, houses, retail units and creche and facilities building. In addition, it is proposed to provide substantial communal and private landscaped open green area including play areas. All buildings will be constructed in accordance with current building regulations and certified by an appropriate Architect during and upon construction completion. Construction materials will be sourced locally where possible.

Traffic

In accordance with recommendations contained within the Construction Environmental and Waste Management Plan and the Traffic and Transportation Chapter of this EIAR, the following measures should be implemented during construction phase in relation to traffic entering and exiting the development site;

- The contractor will be required to implement the following measures in relation to traffic and transportation during construction:
- All trucks entering and exiting the site will be covered with tarpaulin;
- Adequate parking will be provided to avoid queuing at the site entrance and prevent disruption to neighbouring business. Construction vehicles will not be allowed to park on the public road either outside the site or on ant of the approach roads leading to the site;
- All trucks entering the site will be restricted to suitable speed limits and will be directed to the relevant area by the Site Manager;
- Trucks entering the site will switch off engines to avoid unnecessary fuel usage and noise;
- All trucks exiting the site will be required to pass through a wheel wash. A lance will be provided to clean down the bodies and sides of the trucks prior to leaving site;
- All site staff including drivers will be required to abide by the normal rules of the road;
- The contractor will prepare a Detailed Construction Traffic Management Plan (CTMP) covering all construction stages that takes into account other potential construction works in the area including the proposed Park Road Bridge and New School;
- The CTMP will include a detailed consultation plan to deal with third party queries from both residents and commercial operators. The CTMP will require agreement with both Limerick City and County Council and An Garda Síochána. The contractor will appoint a single point of contact to facilitate the communication of the various traffic management plans and the preparation of a project specific website to aid communication would also be beneficial;
- As part of the CTMP a Mobility Management Plan will be prepared to ensure access to the site by sustainable travel modes is encouraged.

Waste Management

A specific Construction and Demolition Waste Management Plan has been prepared by AWN Consulting and is included within this EIAR as Appendix 12.2. This report includes measures to be undertaken to minimise the quantity of waste produced at the site and the measures to handle the waste in such a manner as to minimise the effects on the environment.

Adherence to the Waste Management Plan will ensure that the management of waste arising is dealt with in compliance with the provisions of the Waste Management Acts 1996 – 2015 and amendments. The waste management hierarchy to be adopted will be as follows:

1. Prevention and Minimisation

2. Reuse of Waste

3. Recycling of Waste

4. Disposal

The Construction Manager will have overall responsibility for ensuring that procedures put in place in relation appropriate waste management requirements are adhered to on site at all times.

Please refer to Chapter 12 of this EIAR for further detail.

Noise and Vibration

Chapter 9 of this EIAR provides a full assessment of the potential impacts in terms of Noise and Vibration during construction phase of the overall development. Recommendations are made in this chapter based on best practice operational and control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2 including recommendations in relation to construction site practices including:

- selection of quiet plant;
- control of noise sources;
- screening (boundary, and or localised plant screening);
- hours of work;
- liaison with the public, and;
- monitoring.

Please refer to Chapter 9 below for further information in this regard.

Good Housekeeping

Full details of the good housekeeping measure to be implemented on site during construction phase are set out within the Construction Environmental & Waste Management Plan (2021) prepared by PHM Consulting and included in this application under a separate cover. These measures include;

- General maintenance of working areas and cleanliness of welfare facilities and storage areas;
- Provision of site layout map showing key areas such as first aid posts, material storage, spill kits, material and waste storage, welfare facilities etc.;
- Maintain all plant, material and equipment required to complete the construction work in good order, clean and tidy;
- Keep construction compounds, access routes and designated parking areas free and clean of excess dirt, rubbish piles, scrap wood, etc. at all times;
- Details of site managers, contact numbers (including out of hours) and public information signs (including warning signs) will be provided at the boundaries of the working areas;
- Provision of adequate welfare facilities for site personnel;
- Installation of appropriate security, lighting, fencing and hoarding at each working area;
- Effective prevention of oil, grease or other objectionable matter being discharged from any working area;
- Provision of appropriate waste management at each working area and regular collections to be arranged;
- Excavated material generated during construction will be reused on site, if deemed acceptable
- Maintenance of wheel washing facilities and other contaminant measures as required in each working area;
- No discharge of site run-off or water discharge without agreement of the relevant authorities.
- No discharge of site run-off or water discharge will be acceptable on to public roads or into third party lands.

3.5 OPERATIONAL STAGE

The most significant environmental effects are expected to arise during the construction phase. The operational phase of the proposed Project – which will entail aspects associated with the standard operation of a large-scale, residential development with public realm and crèche, small scale retail outlets and residential amenity areas – is therefore relatively benign. Relevant aspects of the operational phase are discussed in the respective specialist chapters, as appropriate.

4.0 POPULATION AND HUMAN HEALTH

4.1 INTRODUCTION

This section of the Environmental Impact Assessment Report (EIAR) describes the potential impacts of the proposed development on human beings, population and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA) in 'in particular the Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, August 2017). The full description of the proposed development is provided in Chapter 3 of this EIAR.

One of the principal concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. Ultimately, all the impacts of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this section of the EIAR include population, human health, employment and economic activity, land-use, tourism, noise and health and safety.

4.2 METHODOLOGY

The assessment considers attributes and characteristics associated with population, community and residential settlement, economic activities and employment, community infrastructure and tourism and recreation. It has been carried out in accordance with the following guidance, and tailored accordingly based on professional judgement:

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessments (Department of Housing, Planning and Local Government – August, 2018);
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, Draft August 2017);
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2002);
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment (European Union, 2017);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DHPLG, 2018).

An extensive desktop study was carried out to characterise the environment in relation to human beings including the receiving population, to identify neighbouring industry and dwellings and to assist in the characterisation of land use. The following sources were referred to:

- Central Statistics Office (CSO). Census data from 2011 and 2016;
- CSO Small Area Population (SAP) Statistics;
- ESRI (2021) - Quarterly Economic Commentary, Winter 2020
- DoHPLG (2017) - Rebuilding Ireland – Action Plan for Housing and Homelessness
- Google Maps and Places (2021)

A Childcare Demand Analysis Report (2022) prepared by RW Nowlan & Associates is submitted under separate cover as part of the planning application and has been referred to in the preparation of this Chapter.

This assessment has also considered the potential indirect and direct socio-economic impacts of the construction and operation of the proposed Project.

Receptors were identified and assessed for sensitivity, magnitude and significance to provide an appropriate and adequate assessment of how they could be impacted by the construction and operational Phases of the proposed project. Impacts have been characterised in terms of quality, significance and duration, in accordance with the definitions set out in Section 1.6 in Chapter 1, as per the EPA 2017 EIAR guidelines.

4.3 CHARACTERISTICS OF PROPOSED DEVELOPMENT

The subject site (4 ha.) is a vacant site near Limerick city centre which has been zoned for mixed use development in the Limerick City Development Plan. It is bounded to the north by the canal plus walking/cycling route and to the south by Pa Healy Road. The proposed development is for a predominantly residential, high density, mixed use scheme of ‘build to rent’ apartments, houses, a student accommodation block and retail units, plus community facilities building including creche. Vehicular access to the scheme will be from Pa Healy Road.

The proposed development is set out in the statutory notices as follows;

A ten year permission for a strategic housing development at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;

A. Demolition of existing 530m2 warehouse building on site.

B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

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I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;

J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;

K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;

L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development.

The proposed housing mix is set out in Table 4.1 below.

Unit Type	**Studio**	**1 Bed**	**2 Bed**	**3 Bed**	**4 Bed**	**Total**
Apartment	66	67	230	-	-	363
Houses	-	-	-	-	18	18
Student Accommodation	-	-	9 (18)	37 (111)	15 (60)	61 (189 no. bedspaces)

Table 4.1: Proposed Dwelling Mix

The application for the proposed development seeks a ten year planning permission. Having regard to the large scale of the development and the number of units in the overall scheme, it is considered that this such a duration is appropriate.

Given the large scale of the proposed development, it is vital to ensure that human health and safety is a priority through all stages of development. In this regard, it was deemed necessary to set out the baseline environment below before examining the potential impact of the proposed development. This Chapter has been informed by the following other Chapters contained within this EIAR;

Chapter 6: Land, Soil, Geology and Hydrogeology

Chapter 7: Water and Hydrology

Chapter 8: Air Quality and Climatic

Chapter 9: Noise and Vibration

Chapter 10: Landscape and Visual Impact Assessment

Chapter 11: Traffic and Transportation

Chapter 12: Material Assets: Waste

4.4 RECEIVING ENVIRONMENT

In order to assess the likely significant impacts of the proposed development on population and human health, an analysis of recent Census data was undertaken relating to the economic, demographic and social characteristics of the study area. For the purposes of this demographic analysis, the study area comprises 2 No. distinct enumeration areas identified by the Central Statistics Office (CSO) of relevance to the subject development, as follows:

The local Electoral Division (ED) study area to which the subject site belongs and the 9 no. other ED's within 1km radius of the site (ED Study Area comprised of Abbey B to which the site belongs, Abbey A, Abbey C, Abbey D, Singland A, Singland B, Market, Custom House, John's B, and John's C) and

2) The larger combined Limerick City and County Local Authority administrative boundary.

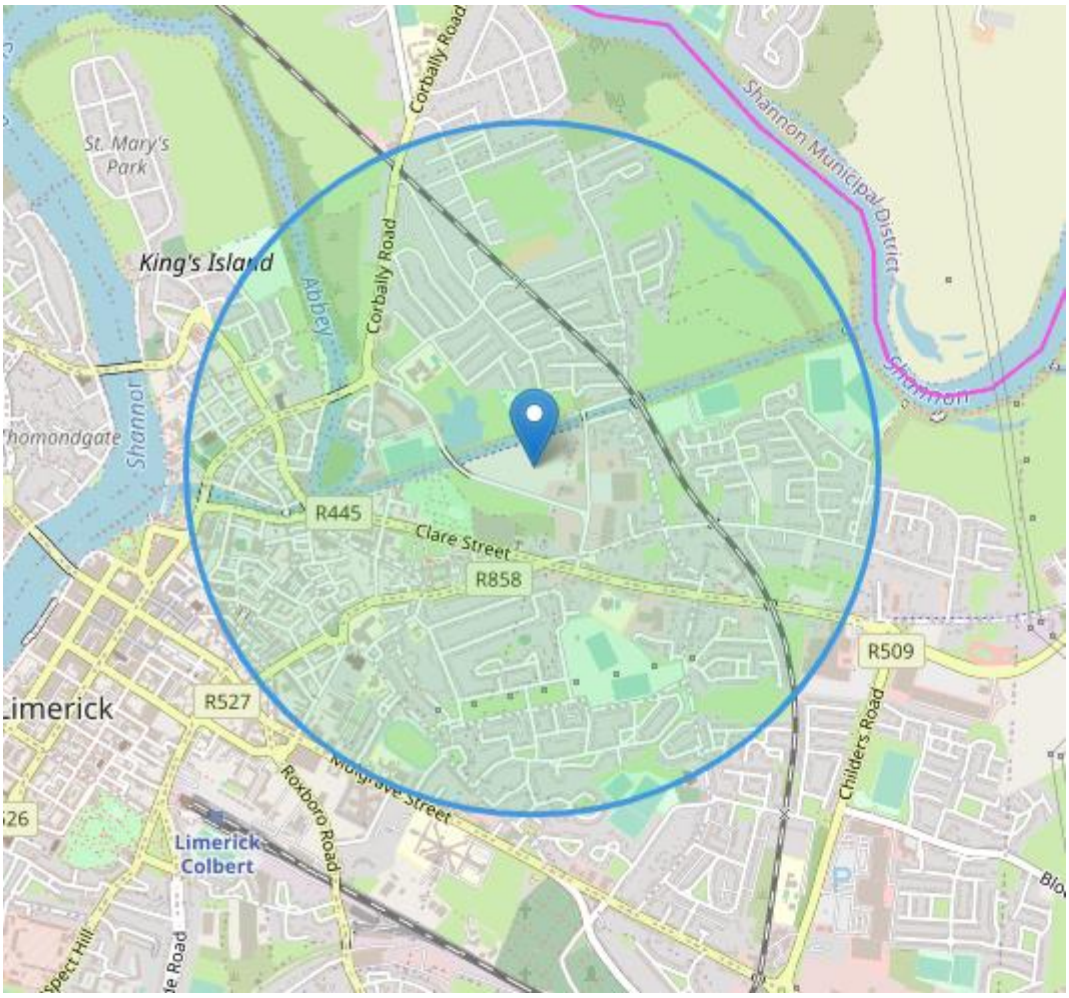

Figure 4.1: 1km Radius from Subject Site

Population Trends

The CSO Census data illustrates that the population of the Irish State increased between 2011 and 2016 by 3.8%, bringing the total population of the Irish State to 4,761,865 (see Table 4.2 below). The rate of growth slowed from 8.2% in the previous census, attributable to the slower economic activity in the early part of the Census period resulting in a reduced level of immigration, albeit offset to a degree by strong natural increase. The economy has recovered in recent years with consequent population growth predominantly attributed to natural increase, greater economic activity, increased job opportunities and continued immigration.

Area	2011 Population	2016 Population	% Change
State	4,588,252	4,761,865	+3.8%
Limerick City and County	191,809	194,899	+1.6%
Study Area	18,355	19,124	4.1%

Table 4.2: Demographic Change from 2011 to 2016

The age breakdown within the study area is largely the same as that seen at the County Level with the exceptions that the 25-64 age cohort is higher in the study are and the 65+ age cohort is lower in the study area as shown in Table 4.3 below.

Age	Study Area (2016)		Limerick City and County (2016)	
Population	**Population**	**% Total**	**Population**	**% Total**
Preschool (0-4 years)	1,247	6%	13,135	7%
Primary (5-12 years)	2,091	11%	21,500	11%
Secondary (13-18 years)	1,488	8%	15,243	8%
Young Adult (19-24 years)	1,714	9%	15,550	8%
Adults (25-64 years)	10,326	54%	102,053	52%
Older Adults (65+ years)	2,258	12%	27,418	14%
Total	19,124	100%	194,899	100%

Table 4.3: Population by Age

Land Use and Settlement Patterns

The subject site of the proposed project is largely an undeveloped site with basic infrastructure (roads and services) in place, bounded by hoarding and not in use by the public.

The proposed development will ensure that all excavations are filled with soil and stone, and the entire site is left in a safe state. Once complete the landscaped areas will offer a useful amenity area for residents as well as for people in the locality. The proposed new development will provide much needed housing stock for the city of Limerick. The land is zoned within the Limerick City Development Plan 2010-1016 for residential development

The site is triangular in shape and is bounded by the following;

North - The site is bounded by the Park Canal to the north. The canal banks are a public walkway and are part of the Lough Derg Way (walking/hiking trail) which starts in Limerick City to the west of the site. The other side of the canal has been designated as a Special Area of Conservation by the National Parks and Wildlife Services–Site Code002165–Lower River Shannon SAC.

South - A single warehouse of Clancy Lewis fruit distribution is located to the south east of the site. Pa Healy Road borders the site to the south which is bounded by commercial properties, undeveloped land recreational grounds of O'Brien's Park.

East - The eastern boundary of the site is bordered by the Park Road, which is further bounded by a mixture of commercial (Musgraves Cash & Carry, Park Road Recycling Centre, David Mead Fitted Furniture) and detached residential premises.

West - The site narrows down towards the west. There is a bridge crossing the canal located to the west of the site. Sport grounds are located further West.

Economic and Employment Activity

The Economic and Social Research Institute's (ESRI) Quarterly Economic Commentary (Winter 2020) suggested that there would be significant recovery in the Irish economy in Q3 of 2021, as COVID-19 restrictions are eased and the vaccination program ramps up for the general population. At the beginning of the COVID-19 crisis, it was unclear how the supply and demand sides of the economy would be impacted in comparison to the previous financial crisis of 2008.

The unemployment rate was expected to settle around 20% at the end of 2020, an increase from the average of 5% at the start of the year; however, the GDP was expected to increase by 3.4 per cent as a result of strong export performance bolstered by medicinal and pharmaceutical products and ICT services. There is also potential for recovery of domestic sources of growth in 2021 due to increased consumption, which could result in an overall output growth of nearly 5% when combined with continued growth of the exports sector.

In the last census (2016), the status of the population in the Study Area aged 15+ was relatively similar to that of Limerick City and County. The exceptions to this are that there were a lower percentage of the population recorded as at work in the study are at 46% than in Limerick City and County which was recorded as 50%. Subsequently, there was a higher percentage of the population in the study area recorded as unemployed at 10% than in Limerick City and County which was recorded at 7%. The unemployment rate in Limerick was in line with that recorded within the State in 2016.

Status	Limerick City and County Council	% of total	Study Area	% of total
At work	77,185	50%	7,053	46%
Looking for first regular job	1,481	1%	241	2%
Unemployed having lost or given up previous job	11,454	7%	1,518	10%
Student	20,161	13%	2,045	13%
Looking after home/family	12,677	8%	1,268	8%
Retired	23,139	15%	1,987	13%
Unable to work due to permanent sickness or disability	8,494	5%	1,124	7%
Other	714	1%	64	1%
Total	155,305	100%	15,300	100%

Table 4.4: Status of Population Aged 15+. Source: CSO.ie

It must be noted that the figures recorded in Table 4.4 at the last census are likely to have significantly changed in light of the ongoing Covid 19 pandemic and as such, must be taken as a representation of the average difference recorded between Limerick City and County and the Study Area.

Travel Patterns

The subject site is served by 4 no. bus routes with stops within a five minute walk from the site. The bus routes serving the subject site are the number 308 provided by Transport for Ireland and the number 304A,323 and 323X provided by Bus Eireann. Table 4.5 details the travel modes recorded within the study area and Limerick City and County within the last census (2016) for the population over aged 5 years.

Mode	Limerick City and County	%	Study Area	%
On Foot	17,537	14%	3,134	27%
Bicycle	1,888	2%	393	3%

Bus, Minibus or Coach	8,611	7%	765	7%
Train, Dart or Luas	221	>1%	15	>1%
Motorcycle or Scooter	234	>1%	28	>1%
Car Driver	52,228	43%	3,820	33%
Car Passenger	26,130	21%	2,277	20%
Van	5,053	4%	271	2%
Other (Incl. Lorry)	524	>1%	13	>1%
Work from Home	3,912	3%	146	1%
Not Stated	5,826	5%	682	6%
Total	122,164	100%	11,544	100%

Table 4.5: Travel Modes Recorded in 2016 Source: CSO.ie

While the above Table 4.5 shows that travels modes are similar between Limerick City and County and the study area in most regards, there are two striking differences;

The percentage of the population recorded as walking to their employment or school was recorded in Limerick City and County at 14% whereas in the study area, this figure was much higher at 27%. This is a positive difference in relation to the location of the subject site as it can be asserted that a high proportion of the local population are living and working/attending school in the immediate area rather than having to travel longer distances which would require an alternative travel modality.

The percentage of car based commuting to employment or school was recorded in Limerick City and County at 43% whereas within the study area it was recorded at a much lower percentage of 33%. This can be attributed to the figures discussed in point 1 above where more residents are walking to work/school and avoiding a necessity to travel by car. It is considered positive that residents in the study area are recorded as less reliant on car based travel on a daily basis than in the wider Limerick community.

Social Infrastructure

The subject site is considered well served in terms of services and local infrastructure to support the proposed development. There are a wide variety of services within easy walking distance to support the additional population. The current social infrastructure provision is highlighted in Figure 4.2 and also discussed below under a number of headings.

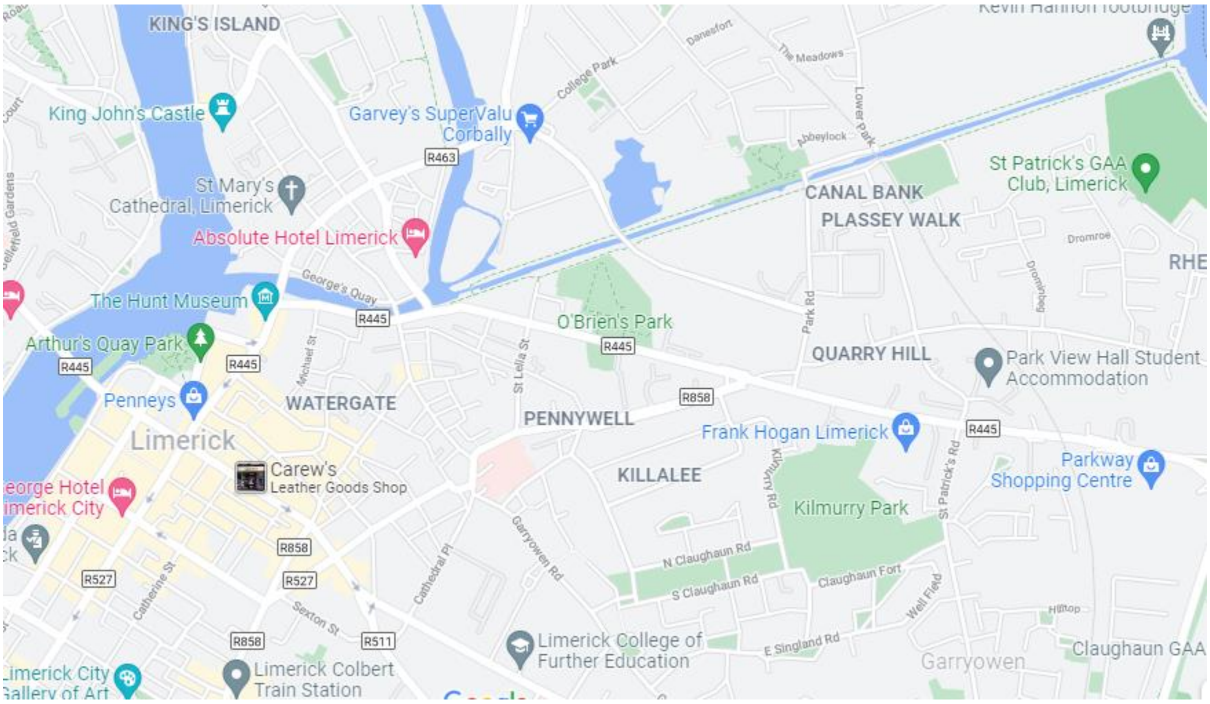

Figure 4.2: Social Infrastructure in the Vicinity of the Subject Site

Retail and Grocery – There are many options in relation to grocery shopping in close proximity to the subject site. To the north of the subject site is Garvey's Supervalu Corbally supermarket (5 minute walk) and Moldova Stores (5 minute walk), Dunnes Stores is located to the south (10 minute walk. In relation to other retail services, to the south of the subject site are the Parkway Shopping Centre (5 minute walk), Currys (5 minute walk) and TK Maxx (5 minute walk). To the east, there are a large number of retail outlets within Limerick City core but these offerings may require other modes of transport such as bus/bicycle/car based travel.

Services – There are a number of services within easy walking distance of the site including; Frank Hogan Limerick (car sales), Donkey Ford's (restaurant), Griffin's Funerals, Rossi's Italian and Grill (restaurant), hair and beauty salons, Energie Fitness, and Clancy's Garage.

Religious – St Mary's Cathedral Limerick and St John's Cathedral are both within walking distance of the subject site (approx. 10 minutes)

Medical – The subject site is located mere minutes from Saint Joseph's Hospital to the south of the site. The University Maternity Hospital Limerick, St Camillus' Hospital and Ennis Road Medical Centre are all located 1.2km to the west of the subject site.

Sport – St Patrick's GAA Club is located less than a 5 minute to the east of the subject site, St Mary's Rugby Football Club is located within a 5 minute walk to the north of the subject site.

Open Space – While the proposed developed would provide large areas of high quality open space for the enjoyment of the new residents and existing local population, there are a number of other open space opportunities currently available in the immediate area. These include; Canal walkway directly adjacent to the development site, Kilmurry Park, Arthur's Quay Park and O'Brien's Park.

4.5 POTENTIAL IMPACT

Do Nothing Impact

If the proposed residential development were not to proceed, there would be no change to the existing environment. The potential for additional investment and employment in the area in relation to the construction and operation of the proposed residential site would be lost. It is considered that the 'Do Nothing' impact would be permanent, negative, and slight as the proposed development site is zoned for residential development and will contribute to the much-needed housing stock of Limerick.

Population

Construction Phase

During the construction phase of the proposed project, it is unlikely that there will be any significant impact upon the local population. The construction phase will result in a number of workers at the site, however, it is not envisaged that their place of residence will change as a result of the development, it is envisaged that construction workers would travel from their existing place of residence rather than moving, temporarily, to the area surrounding the site.

As a result, the impact on the local population during the construction phase is considered to be neutral, not significant and temporary in nature and therefore, no significant impacts are expected to arise in this regard.

Giving consideration to local residents, it is predicted that there may be some impacts which are likely to be associated with construction traffic, nuisance and disturbance. Such impacts are dealt with separately and assessed elsewhere in the EIAR and are considered to be short term, negative impacts. The level of impact predicted above is considered to align with the normal disturbance associated with the construction industry where a site is efficiently, sensitively and properly managed in the context of surrounding existing neighbouring development.

Operational Phase

The proposal includes 363 no. apartment units, 18 no houses and 189 no student bedspaces. Table 4.6 below shows the breakdown of unit type proposed. Based on the Average household size identified in the 2016 Census of 2.75, the projected population for the new development is estimated as 1,048 for the build to rent and housing elements. When the student bedspaces are included, the total projected population is 1,237 no. residents.

Unit Type	Studio	1 Bed	2 Bed	3 Bed	4 Bed	Total
Apartment	66	67	230	-	-	363
Houses	-	-	-	-	18	18
Student Accommodation	-	-	9 (18)	37 (111)	15 (60)	61 (189 no. bedspaces)

Table 4.6: Breakdown on Unit Type by Size

The above estimated additional residents will be a significant increase to the existing local population. The development will provide much needed residential accommodation in the Limerick area in line with current Local, Regional and National planning policies.

The introduction of additional residents to the local area will support the existing community and social infrastructure. The proposed childcare facility, designed to accommodate the projected demand for childcare places resulting from the development, will mitigate any pressure upon existing childcare facilities. Please refer to the Childcare Demand Analysis submitted under a separate cover in this application for further details on projected childcare demand resulting from the proposed development.

As such, it is considered that the proposed project will have a positive, significant and permanent impact on the local population.

Land Use and Settlement Patterns

Construction Phase

The proposed development complies with zoning policies contained within the Limerick City Development Plan 2010-2016 (as amended) as well as National and Regional policies relating to land use, compact development and provision of housing.

The construction phase will comprise of earthworks and construction works and will not have any impact on the residential amenities, rights of way or existing pedestrian and cycling routes. There will be some short term negative impact in terms of visual amenity as discussed further in the Landscape and Visual Amenity chapter in this EIAR but this is considered standard to construction activities and will only occur during the construction phase of development.

Operational Phase

The subject site is largely undeveloped at present with the exception of a vacant warehouse unit and associated services on the eastern side of the site.

The site is zoned for residential development within the Limerick City Development Plan 2010-2016 and the proposed development would enable 363 no. built to rent units, 18 no. houses and 189 no. student bedspaces to be provided in a prime location.

As such, it is considered that the proposed development, once complete, will positively impact on land use and settlement patterns in the area through provision of much needed housing on a prime site that is zoned for such development and underutilised at present.

Economic and Employment Activity

Construction Phase

The construction phase of the development will have a positive impact in terms of economic and employment activity in the local area. The most notable benefit will be to the construction and building service sectors. The positive impact to these sectors is predicted to last for the duration of the construction stage over the three phases as outlined in Chapter 3 above. There will also be indirect economic benefits to local service and retail sectors during this time.

The number of workers on site is predicted to fluctuate during different stages of the development process but the construction manager and their team will be present on site during the whole process.

Overall, it is considered that proposed development will result in a positive, short term benefit in terms of economic and employment activity within the local area.

Operational Phase

The operational phase of the development will result in 363 no. apartment units, 18 no houses and 189 no student bedspaces, a creche and small scale retail units. This will likely result in increased spending in the local economy and utilisation of local services. The creche and retail units will also provide a small number of employment opportunities.

It is considered that the operational phase of the development will result in a long term, positive impact on economic and employment activity in the local area.

Social Infrastructure

Construction Phase

It is not anticipated that any social infrastructure will be provided on the site during the construction phase of development. As such, it is considered that there is a neutral impact in terms of social infrastructure in this case.

It is possible that workers on site may utilise local social infrastructure during this time but it is not anticipated that this will be frequent or cause any negative impact.

Operational Phase

As discussed above, the subject site is well served by existing social infrastructure within 5 minutes walking distance. Residents within the proposed development would support local businesses and provide a boost to the local economy. It was assessed within the Childcare Demand Analysis report submitted under a separate cover in this application that a childcare facility should be provided within the development so as not to burden the local existing facilities which are recorded as close to capacity at present.

It is considered that the proposed development would result in a positive long term impact for the local social infrastructure through increased business and local participation.

Human Health

Construction Phase

The EPA Draft Guidelines (2017) sets out how human health should be considered through assessment environmental pathways through which health could be affected.

The relevant pathways in relation to human health during the construction phase are considered to be air quality, noise and vibration, water and soil. The expected air quality effects are detailed in Chapter 8 along with proposed mitigation measures to ensure the protection of human health. Similarly, the potential noise and vibration related impacts arising from the construction phase and associated mitigation measures are contained in Chapter 9.

As with all construction projects, there will be inherent health and safety risks at this stage of the development. In order to manage this, a Construction Environmental and Waste Management Plan has been prepared by PHM Consulting for the application and is submitted under a separate cover, to ensure that the relevant health and safety legislation is complied with at all stages of the construction process.

Operational Phase

Given the nature of the proposed project, it is not likely that any significant impacts on health and safety will arise during the operational phase. The development has been designed to provide a safe environment for future occupiers and visitors. The public realm, inclusive of pedestrian paths, cycle paths, roads and communal open spaces, have been designed in accordance with the best practice and relevant planning policy standards.

Similarly, the proposed residential units are all designed in accordance with the relevant guidelines and standards and are capable of meeting all relevant building standards and regulations. Having regard to the above, it is considered that the proposed project will result in a high standard of health and safety for all residents and visitors.

Once operational, the proposed project will not result in any significant impact on human health and safety.

4.6 MITIGATION

Construction Phase

The potential impacts upon human environment relate to other environmental factors such as air quality, noise and vibration and traffic. Where required, the related mitigation measures are dealt with in the corresponding chapters of this EIAR. Other than this, no significant adverse effects will arise in respect of the population during the construction or operational phase of this development.

Operational Phase

Once development is complete, the operational phase of the development is predicted to have a positive impact through provision of additional housing stock, a creche facility, small retail units and additional open space.

No risks to human health have been identified during the operation phase of the development. A management company will be put in place upon completion of development to manage the day to day maintenance of the development and ensure health and safety is prioritised within the development for the long term.

4.7 PREDICTED IMPACTS

Adherence to the mitigation and monitoring measures referred to above and throughout this EIAR will ensure that the proposed project will not give rise to significant adverse effects upon population and human health during the construction and operational phases of the proposed project. It is considered that once complete, the proposed development will have a positive impact for the local area.

5.0 BIODIVERSITY

5.1 INTRODUCTION

SLR Consulting (Ireland) Ltd. was commissioned by Lawlor, Burns & Associates, on behalf of Revington Developments Ltd. in June 2020, to prepare a Biodiversity chapter which forms part of the Environmental Impact Assessment Report (EIAR) prepared in support of the proposed Strategic Housing Development (SHD), the Canal Bank Development, at Pa Healy Road and Park Road in Limerick City.

5.1.1 Background

Revington Developments Ltd intend to apply to An Bord Pleanála (ABP) under the Planning and Development Act 2000 (as amended by the Residential Tenancies Act 2016) for a strategic housing scheme located in Canal Bank, Co. Limerick. The application is being made under the Strategic Housing Provisions of the Planning and Development (Housing) and Residential Tenancies Act, 2016, and this Biodiversity Chapter forms part of the documentation to support the application for permission.

5.1.2 General Description of the Site

The development site ("the Site") is located within Canal Bank, Limerick City, centred at approximate Irish Transverse Mercator (ITM) Grid Reference 58833, 57523, approximately 1 km northeast of the city centre. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east. The Site has a relatively flat topography and access can be gained from Park Road, Pa Healy Road and the canal path.

The Site has recently been used for storage of building materials and construction machinery. There is a commercial warehouse at the eastern extent of the Site within the Site boundary. The canal was built in the late 18th century to transport goods to and from Limerick City. Now closed to navigation, it provides a walking amenity area. There are a number of recreational spaces in the area surrounding the Site. O'Brien's Park is located to the west of the site, on the opposite side of Pa Healy Rd. In addition, there are sports pitches, St Mary's RC and Abbey Rovers AFC, to the north of the site along the opposite bank of the canal. The area surrounding the site to the south, east and west is largely urban, dominated by buildings and artificial surfaces with small areas of amenity grassland and landscaping.

5.1.3 Brief Project Description

The project is a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3 no. retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

The total number of residential units will be 442, comprised of i) build to rent apartments - 363 (66x studio, 67 x one bedroom, 230 x two bedroom), ii) student apartments - 61 (9 x two-bedroom, 37 x three bedroom and 15 x four bedroom, totalling 189 student bed spaces), built in seven blocks and iii) 18 dwelling houses.

The overall gross floor area of development proposed is 45,478.65m^2 on the site of ca. 4ha.

A detailed project description is given in Section 5.5 of this report.

5.1.4 Purpose of this Report

The purpose of this biodiversity chapter is to inform the application for ten-year planning permission for the proposed SHD, the Canal Bank Development, at Pa Healy Road and Park Road in Limerick City. This chapter forms part of the EIAR that will be submitted with the application for permission to assist the competent authority, in this case An Bord Pleanála (ABP) to carry out an Environmental Impact Assessment (EIA) of the proposed SHD.

5.1.5 Evidence of Technical Competence and Experience

The ecological surveys required for this report were carried out by SLR ecologists Dr Úna Nealon, Owen Twomey and Michael Bailey. A tree survey was carried out by Anne Merkle.

Michael Bailey prepared this report, and the technical review of the report was carried out by Technical Director Richard Arnold BSc MRes MCIEEM CEnv.

Úna Nealon holds a BSc (Hons) Environmental Science from NUI Galway and a PhD in Ecology from University College Dublin. Úna has prepared ecological reports, including Biodiversity chapters, Ecological Impact Assessments, Appropriate Assessment Screening Reports and Natura Impact Statements, for a range of projects in the residential, commercial, renewable energy and public infrastructure sectors.

Owen Twomey has worked in ecological consultancy since 2016. Owen holds a BSc in Environmental Science (Zoology) and a Postgraduate Diploma in Ecological Assessment. Owen has prepared Ecological Impact Assessment and Appropriate Assessment reports for a number of projects.

Michael Bailey holds a BSc (Hons) in Biology and Ecology from the University of Ulster, and an MSc in Quantitative Conservation Biology from the University of the Witwatersrand, Johannesburg, South Africa. Michael is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). He has prepared Appropriate Assessments and Ecological Impact Assessments for a wide range of projects in Ireland and the UK.

Richard Arnold is a Technical Director with SLR. Richard has 23 years of experience as a consultant ecologist, which has included preparing and overseeing assessments under the Habitats Regulations/Directive for multiple projects, including small and large infrastructure projects.

Anne Merkle holds a Technician's Certificate in Arboriculture and is a Technicians' member of the Arboricultural Association.

5.1.6 Legislation and Policy

Legislation

The following legislation are relevant to this report:

- The EIA Directive (2014/52/EU);
- The Habitats Directive (92/43/EEC);
- The Birds Directive (2009/147/EC);
- European Communities (Birds and Natural Habitats) Regulations, 2011 - 2015.
- The Wildlife Acts 1976 as amended;
- Wildlife (Amendment) Act, 2000, 2010, 2012;
- The Flora (Protection) Order 2015.
- The Planning and Development Acts 2000 to 2020 - PART XAB.
- The details of these legislation are summarised in Appendix 5.1 of this report.

Local Planning Policy

The relevant local planning policies have been extracted from the Limerick City Development Plan 2010-2016 (as extended) and are presented in Appendix A of this report. These policies are specific to "*Chapter 11: Landscape, Biodiversity & Recreation*" of the city development plan and are concerned with the policies and objectives relating to biodiversity and designated sites. The draft Limerick Development Plan 2022 – 2028 (currently at the public consultation stage) was also consulted for reference to any amendments to the planning policy.

5.2 METHODOLOGY

The methods used to carry out the survey of the Site, to evaluate the ecological value and to prepare the biodiversity chapter is outlined in this section. The assessment methodology for this proposal was developed using the standard professional impact assessment guidance published in 2018 by the Chartered Institute of Ecology and Environmental Management (CIEEM).

5.2.1 Scope of the Chapter

The scope of this Biodiversity Chapter is to identify potential impacts likely to occur as a result of the proposed Strategic Housing Development (SHD), the Canal Bank Development, at Pa Healy Road and Park Road in Limerick City, and to determine if the effects on biodiversity are significant in the absence of mitigation. The scope of the report includes the provision of mitigation, compensation and enhancement measures as required.

5.2.2 Zone of Influence

The 'zone of influence' for a project is the area over which ecological features may be subject to significant effects because of the proposed project and associated activities. This is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries. The zone of influence will vary for different ecological features depending on their sensitivity to an environmental change (CIEEM, 2018).

The 'zone of influence' for the project can be identified through review of the nature of the proposed development / works, the presence / absence of surface water receptors, the presence of ecological connectivity to the wider landscape and distance from known ecologically sensitive sites.

5.2.3 Desk Study

A desk study was carried out to collate the available existing ecological information on the Site. The Site and the surrounding area were viewed using existing available satellite imagery using Google maps[1] and Bing maps[2] .

The National Parks and Wildlife Service (NPWS)[3] and the National Biodiversity Data Centre (NBDC)[4] online resources were accessed for information on sites designated for nature conservation and on protected habitats and species known from the 2 km grid square R55Y. Only records for the past 10 years are considered within this report as older records are unlikely to still be relevant given their age and the changes in land management that is likely to have occurred in the intervening period. Environmental Protection Agency (EPA) Maps[5] were accessed for other environmental information, such as surface water features, relevant to preparation of this report.

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[1] https://www.google.ie/maps (last accessed 24 June 2021)

[2] https://www.bing.com/maps (last accessed 24 June 2021)

[3] https://www.npws.ie/(last accessed 24 June 2021)

[4] https://maps.biodiversityireland.ie/ (last accessed 24 June 2021)

[5] http://gis.epa.ie/(last accessed 24 June 2021)

Limerick City and County Council's website[6] was accessed for information on relevant planning policy, while the planning portal[7] was accessed for information on other proposed or permitted developments within the Site and immediate surrounding area.

Birds of Conservation Concern in Ireland (BoCCI), published by BirdWatch Ireland and the RSPB NI, is a list of priority bird species for conservation action on the island of Ireland. The BoCCI lists birds which breed and/or winter in Ireland and classifies them into three separate lists; Red, Amber and Green; based on the conservation status of the bird and hence their conservation priority. Birds on the Red List are those of highest conservation concern, Amber List are of medium conservation concern and Green List are not considered threatened. The BirdWatch Ireland website[8] was accessed for information on birds of conservation concern.

All bird species are protected under the Wildlife Acts 1976 – 2018 but for the purposes of this report only records of species within the last 10 years that are Red or Amber-listed on BoCCI or listed on Annex 1 of the Birds Directive are included from records held by the NBDC and NPWS web searches (see Table 5.1).

The conservation status of mammals, amphibians, reptiles, fish and protected flora within Ireland and Europe was determined using one or more of the following documents: Wildlife Acts (1976 - 2012), the Red List of Terrestrial Mammals (Marnell *et al*., 2009), Ireland Red Lists No.5: Amphibians, Reptiles and Freshwater Fish (King *et al*. 2011), The Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) and the EU Habitats Directive 92/43/EEC.

The documents reviewed to assist the preparation of this report include: the Natura Impact Statement for the project (SLR, 2021a), Tree Survey Report (SLR, 2021b), Environmental Due Diligence Report (Verde, 2019), Construction Environmental and Waste Management Plan (CEMP) (PHM Consulting, 2021) and design drawings and project information supplied by the client.

5.2.4 Field Surveys

Habitat Survey

The Site was visited on 15 June 2020 and a walkover survey was carried out by Dr Úna Nealon. Weather conditions were clear and dry with a gentle breeze. The temperature was ca. 21°C. The objective of the site visit was to describe and evaluate the ecological features within the Site.

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[6] https://www.limerick.ie/ (last accessed 24 June 2021)

[7] http://eplan.limerick.ie/searchtypes (last accessed 24 June 2021)

[8] https://birdwatchireland.ie/(last accessed 24 June 2021)

Habitats were identified and classified using '*A Guide to Habitats in Ireland'* (Fossitt, 2000) during the visit. The dominant plant species present in each habitat type were recorded. Species nomenclature follows Parnell & Curtis (2012) for scientific and English names of vascular plants.

Incidental sightings or evidence of birds, mammals or amphibians were also noted during the habitat survey and the habitats evaluated for their suitability to support such species.

The site was re-visited by SLR Ecologists Owen Twomey and Michael Bailey in April 2021 primarily to carry out a bat survey but also to note any changes habitats or utilisation of the site by other fauna.

Bat Surveys

An experienced bat worker, Dr Úna Nealon, carried out a Preliminary Roost Assessment (PRA) of the trees and building within the Site during the daytime on 15 June 2020. The habitats within the Site were also evaluated for their potential to support foraging, commuting and roosting bats using recognised good practice guidelines produced by the Bat Conservation Trust Guidelines (Collins, 2016)[9].

The daytime survey consisted of a visual inspection of the exterior and interior of the building and trees within the Site for potential features to provide opportunities for roosting bats. The trees within the Site were visually inspected from ground level for Potential Roost Features (PRF) such as holes and cavities, cracks and splits in major limbs, loose bark, ivy cover and dense epicormic growth. Examples of potential features in buildings include crevices, holes, attic spaces and loose or damaged tiles. Binoculars and a high-powered torch were used to search for the presence of potential roost features. The findings of the daytime visual inspection were used to assess the potential suitability of the Site for bats (See Appendix 5.2 for categories).

The PRA identified one building, a storage facility in the eastern side of the site which had some potential for bats. SLR Ecologists Owen Twomey and Michael Bailey carried out one evening bat emergence survey and a transect survey across the Site on 29 April 2021, and two bat monitors, one located on the outside of the building and one inside the building, were left in place for one week to determine whether any bats were roosting in the building.

Otter Survey

An otter survey of the City Canal and the wetland to the north of the canal was carried out on the 15 June 2020. The survey included otter habitat, defined as 10 m width of each bankside (NPWS, 2009).

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[9] These guidelines are recognised by CIEEM (professional body for ecologists) as good practice guidelines for use in the UK and Ireland.

The survey corridor extended 150 m upstream and downstream of the Site (NRA, 2008). The survey involved a search for otter signs such as holts, spraints, slides, trails and couches.

5.2.5 Limitations

Desk Study

Desk study data is unlikely to be exhaustive, especially in respect of species, and is intended mainly to set a context for the study. It is therefore possible that important habitats or protected species not identified during the data search do in fact occur within the vicinity of the site but have not been previously recorded. Interpretation of maps and aerial photography has been carried out using recent imagery, but it has not been possible to verify the accuracy of any statements relating to land use and habitat context outside of the field study area.

Field Surveys

There were no limitations encountered during the habitat survey. There were no barriers to Site access and the weather was not limiting. There were no seasonal limitations encountered during the survey as June is within the optimal period for vegetative surveys, and May is an optimal period for conducting bat emergence surveys.

Safe access could not be gained to all areas of the canal bank during the otter survey due to steep or unstable banksides and deep water. Where the banks could not be accessed, the survey was carried out from the opposite bank using binoculars. While it is possible that some smaller field signs such as prints may not have been visible, particularly in areas with dense vegetation, this is not considered a significant limitation.

5.3 ASSESSMENT METHODOLOGY

The ecological evaluation and assessment within this chapter has been undertaken with reference to relevant parts of the 2018 Guidelines for Ecological Impact Assessment in the UK and Ireland developed by the Chartered Institute of Ecology and Environmental Management (CIEEM, September 2018). Although this is recognised as current good practice for ecological assessment, the guidance itself recognises that it is not a prescription about exactly how to undertake an ecological impact assessment (EcIA); rather, they "*provide guidance to practitioners for refining their own methodologies*". For the full guidance, refer to https://www.cieem.net/data/files/ECIA%20Guidelines.pdf . The approach to impact assessment also has regard to advice set out in the EPA draft guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR) published in August 2017.

5.3.1 Important Ecological Features

Ecological features can be important for a variety of reasons and the rationale used to identify them is explained in the text. Importance may relate, for example, to the quality or extent of the site or habitats therein; habitat and / or species rarity; the extent to which such habitats and / or species are threatened throughout their range, or to their rate of decline.

5.3.2 Determining Importance

The importance of an ecological feature should be considered within a defined geographical context. The following frame of reference has been used in this case, relying on known/ published accounts of distribution and rarity where available, and professional experience:

- International (European).
- National (Ireland).
- Regional (Munster).
- County (Limerick).
- Townland (Park).
- Local (intermediate area between Site and Townland), and
- Site (the red line boundary of the development).

The above frame of reference is applied to the ecological features identified during the desk study and surveys to inform this report.

In assigning a level of value to a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. Examples of relevant lists and criteria include species of European conservation importance (as listed on Annexes II, IV and V of the Habitats

Directive or Annex 1 of the Birds Directive), species protected under the Wildlife Acts 1976 - 2020 and Birds of Conservation Concern in Ireland 4 (Gilbert *et al.* 2021).

The approach to impact assessment, as set out in CIEEM guidelines, only requires that ecological features (habitats, species, ecosystems and their functions/processes), that are considered to be important and potentially affected by the proposed development are carried forward to detailed assessment. It is not necessary to carry out detailed assessment of receptors that are sufficiently widespread, unthreatened and resilient to impacts from the proposed development and will remain viable and sustainable. Therefore, for the purposes of this report, only ecological features of Local importance or greater and/or subject to legal protection have been subject to detailed assessment.

5.3.3 Impact Assessment

Where appropriate the impact assessment process involves the following steps:

- identifying and characterising potential impacts.
- incorporating measures to avoid and mitigate (reduce) these impacts;
- assessing the significance of any residual effects after mitigation;
- identifying appropriate compensation measures to offset significant residual effects (if required); and
- identifying opportunities for ecological enhancement.

When describing impacts, reference has been made to the following characteristics, as appropriate:

- Positive or negative;
- Extent;
- Magnitude;
- Duration;
- Timing;
- Frequency; and
- Reversibility.

The impact assessment process considers both direct and indirect impacts: direct ecological impacts are changes that are directly attributable to a defined action, e.g. the physical loss of habitat occupied by a species during the construction process. Indirect ecological impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process or feature, e.g. the creation of roads which cause hydrological changes, which, in the absence of mitigation, could lead to the drying out of wet grassland.

Consideration of conservation status is important for evaluating the effects of impacts on individual habitats and species and assessing their significance:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area.
- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

5.3.4 Significant Effects

The 2018 CIEEM guidance sets out information in paragraphs 5.24 through to 5.28 of the guidance document which describes the concept of ecological significance. Significant effects are qualified with reference to an appropriate geographic scale, and the scale of significance of an effect may or may not be the same as the geographic context in which the feature is considered important.

A significant effect, for the purposes of EcIA, is defined as an effect that either supports or undermines biodiversity conservation objectives for '*important ecological features*' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local.

The nature of the identified effects on each assessed feature is characterised. This is considered, along with available research, professional judgement about the sensitivity of the feature affected, and professional judgement about how the impact is likely to affect the site, habitat, or population's structure and continued function. Where it is concluded that an effect would be likely to reduce the importance of an assessed feature, it is described as significant. The degree of significance of the effect takes into account the geographic context of the feature's importance and the degree to which its interest is judged to be affected.

5.3.5 Cumulative Effects

Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. Cumulative effects can occur where a proposed development results in individually insignificant impacts that, when considered in-combination with impacts of other proposed or permitted plans and projects, can result in significant effects.

Other plans and projects that should be considered when establishing cumulative effects are:

proposals for which consent has been applied but which are awaiting determination;

projects which have been granted consent, but which have not yet been started or which have been started but are not yet completed (i.e. under construction);
proposals which have been refused permission, but which are subject to appeal, and the appeal is undetermined;

- constructed developments whose full environmental effects are not yet felt and therefore cannot be accounted for in the baseline; or
- developments specifically referenced in a National Policy Statement, a National Plan or a Local Plan.

5.3.6 Avoidance, Mitigation, Compensation & Enhancement

Where potentially significant effects have been identified, the mitigation hierarchy has been applied, as recommended in the CIEEM Guidelines. The mitigation hierarchy sets out a sequential approach beginning with the avoidance of impacts where possible, the application of mitigation measures to minimise unavoidable impacts and then compensation for any remaining impacts. Once avoidance and mitigation measures have been applied, residual effects are then identified along with any necessary compensation measures, and incorporation of opportunities for enhancement.

It is important to clearly differentiate between avoidance mitigation, compensation and enhancement and these terms are defined here as follows:

Avoidance is used where an impact has been avoided, e.g. through changes in scheme design;
Mitigation is used to refer to measures to reduce or remedy a specific negative impact in situ;
Compensation describes measures taken to offset residual effects, i.e. where mitigation in situ is not possible; and
Enhancement is the provision of new benefits for biodiversity that are additional to those provided as part of mitigation or compensation measures, although they can be complementary.

5.4 BASELINE ECOLOGICAL CONDITIONS

This section sets out the baseline conditions for the ecological features considered within the Site using the findings of the desk study and field survey.

5.4.1 Zone of Influence

The City Canal is located approximately 30 m north of the Site boundary. The proposed development is connected to the Canal as it will discharge surface water to the canal during construction and operation.

The effects of the construction and operation of the proposed mixed-use development are likely to be localised in nature and would typically be limited to the Site or the area immediately adjacent to the

Site. However, given that the proposed development will discharge surface water to the canal, and there is a surface water pathway linking the Site to the sites designated for nature conservation, applying a precautionary approach a zone of influence of 2 km has been adopted for the purposes of this report. The sites designated for nature conservation within 2 km of the Site are shown on **Figure 5.1**.

5.4.2 Sites Designated for Nature Conservation

Natura 2000 Sites

The potential for effects on Natura 2000 sites is addressed in the AA screening report and NIS prepared for the proposed development (SLR, 2021). The City Canal is approximately 30 m north of the Site boundary and this forms part of the Lower River Shannon SAC (002165). The River Shannon and River Fergus Estuaries SPA (004077) is approximately 1.6 km south - west of the Site. Both of these Natura 2000 sites are considered to be within the potential zone of influence of the project as the proposed development will discharge surface water to the canal during construction and operation. All other Natura 2000 sites are considered to be sufficiently distant from the project and / or have no landscape or ecological connectivity with the Site such that they are not likely to affected by the project.

The potential impacts of the development that could affect the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA identified in the NIS are as follows:

- Discharge of surface water to the canal during construction and operation of the development.
- Disturbance of species due to noise and lighting associated with construction and operation of the development.

The potential reduction in water quality is not likely to affect the availability of prey species, e.g. lamprey and salmon, or the habitat that supports them given that species such as lamprey and salmon are not likely to be found in the canal due to an access restriction from the canal lock gates, and the distance between the Site and the SPA. Therefore, there is no potential for effects on the River Shannon and River Fergus Estuaries SPA during the construction and operational phases of the project as a result of discharge of surface water from the Site to the City Canal.

The AA screening report identified potential for effects on otter, a mobile qualifying interest of the Lower River Shannon SAC, due to disturbance during construction and operation of the proposed development. There are no other qualifying interests of the SAC or SPA likely to be affected.

Following implementation of appropriate mitigation measures, as described in the NIS, the proposed development is not predicted to give rise to adverse effects on the integrity of the Lower River Shannon

SAC or the River Shannon and River Fergus Estuaries SPA, either alone or in-combination with other projects or plans.

The NIS concludes that the proposed development, either individually or in combination with other plans or projects, will not have an adverse effect on the integrity of any Natura 2000 sites. Therefore, Natura 2000 sites are excluded from any further consideration in this report.

Proposed Natural Heritage Areas / Natural Heritage Areas

There are no Natural Heritage Areas (NHA) located within the zone of influence for the project. There is one proposed Natural Heritage Area (pNHA) within 2 km of the Site and therefore, within the zone of influence.

The Fergus Estuary and Inner Shannon, North Shore pNHA is located approximately 0.83 km southwest of the Site. This pNHA is located along the north shore of the Shannon. A detailed site synopsis is unavailable for the site. However, the site designation is concurrent with the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA. Potential impacts on Natura 2000 sites and therefore on this pNHA, have been addressed in the NIS for the development.

There is no potential for impacts on the pNHA given the nature and scale of the proposed development, the localised nature of any potential impacts and the distance between the Site and the pNHA. Therefore, proposed Natural Heritage Areas/Natural Heritage Areas are scoped out and excluded from any further consideration in this report.

Rare and Protected Flora and Fauna

The NBDC database was searched for records within the 2 km grid square R55Y within which the Site is located. The records returned are of varying ages so for the purposes of preparing this report only the relevant records dated within the last 10 years, are listed in Table 5.1 below.

The absence of recent (within 15 years) records of species from the NBDC database does not necessarily imply that a species does not occur within the search area rather it has not formally been recorded as present. Similarly, the presence of a record for a protected species within the 2 km grid squares does not mean that the species is present within the Site.

5.4.3 Field Survey

The habitats and species recorded within the existing site are described, classified and evaluated in this section of the report, and described further in the sections below.

5.4.3.1 Habitats

Habitats present within the Site, as recorded during the walkover survey, are described in this section. Habitat classification follows that of '*A Guide to Habitats in Ireland*' (Fossitt, 2000).

Dry Meadows and Grassy Verges (GS2)

The dominant habitat within the Site is Dry Meadows and Grassy Verges (GS2) (Plates 5.1 and 5.2), available at the end of this report). The dominant grasses are false oatgrass *Arrhenatherum elatius*, Cock's foot *Dactylus glomerata* and Yorkshire fog *Holcus lanatus*, with frequently occurring crested dog's tail *Cynosurus cristatus*, creeping bent-grass *Agrostis stolonifera* and perennial rye grass *Lolium perenne.* Other plant species include meadow buttercup *Ranunculus acris,* creeping buttercup *Ranunculus repens*; red clover *Trifolium pratense*; creeping cinquefoil *Potentilla reptans,* oxeye daisy *Leucanthemum vulgare,* Germander speedwell *Veronica chamaedrys,* common vetch *Vicia sativa,* greater bird's foot trefoil *Lotus pedunculatus,* smooth hawk's beard *Crepis capillaris* and daisy *Bellis perennis.*

Substantial disturbance was noted throughout the grassland habitat, in particular at the former yard area and several unsealed tracks (Plate 5.2). In these areas, bare ground is evident, and species include common ragwort *Jacobaea vulgaris,* cat's ear *Hypochaeris radicata*, dandelion *Taraxacum officinale agg.*, bristly oxtongue *Helminthotheca echioides,* black medick *Medicago lupulina*, scarlet pimpernel *Anagallis arvensis*, greater plantain *Plantago major*, weld *Reseda luteola* and red valerian *Centranthus ruber.* Nettle *Urtica dioica*, broad-leaved dock *Rumex obtusifolius* and creeping thistle *Cirsium arvense* are the dominant species in small overgrown areas of disturbed ground within the habitat

In some areas of the grassland, impeded drainage is evident. Species recorded include hard rush *Juncus inflexus,* false fox sedge *Carex otruba* and field horsetail *Equisetum arvense.* Common reed *Phragmites australis* was also noted in isolated patches.

This habitat is modified, disturbed and commonly occurring in abandoned urban areas. The grassland present within the Site is a poor example of this habitat type. This habitat is evaluated as important at the Site level.

Scrub (WS1)

Scrub (WS1) is present in several areas within the Site (Plate 5.3). Black willow *Salix viminalis*, grey willow *Salix cinerea* and other willows dominate with some instances of silver birch *Betula pendula,* ash *Fraxinus excelsior,* pedunculate oak *Quercus robur*, wild cherry *Prunus avium*, elder *Sambucus nigra*, hawthorn *Crataegus monogyna,* common gorse *Ulex europaeus*, dog rose *Rosa canina*, fuchsia *Fuchsia magellanica*, butterfly bush *Buddleja davidii* and bramble (*Rubus fruticosus*).

The scrub within the Site is a poor example of this habitat type due to the lack of diversity in plant species and aerial photography indicates that it has formed relatively recently (<10 years). Scrub habitat within the Site is evaluated as important at the Site level.

Mixed Broadleaved Woodland (WD1)

Mixed Broadleaved Woodland (WD1) is present along the northern boundary of the Site (Plate 5.4). Willow species including black willow *Salix viminalis*, grey willow *Salix cinereal* and *Salix* sp. dominate. Other species recorded included sycamore *Acer pseudoplatanus*, pedunculate oak *Quercus robur* and hawthorn *Crataegus monogyna.* The field layer includes bramble *Rubus fructicosus agg.*, ivy *Hedera helix,* bracken *Pteridium aquilinum* and hart's tongue *Asplenium scolopendrium.*

The Tree Survey Report prepared for the proposed development (SLR, 2020b) states that no trees are visible in the area covered by the current woodland in the aerial photography on the GeoHive Map Viewer from 2005 but are present in another aerial photograph taken some time between 2005-2012. The woodland must therefore have developed between 2005 and 2021 and this would indicate that the woodland is a maximum of 16 years old.

The area of mixed broadleaved woodland within the Site is small, with low diversity of species. This habitat type is commonly occurring throughout Ireland although in the urban setting less so. Mixed broadleaved woodland habitat within the Site is evaluated as important at the Site level.

Buildings and Artificial Surfaces (BL3)

There is an area of built surfaces on the east of the site comprising a commercial warehouse and an associated paved car park (Plate 5.5).

This habitat is heavily modified and artificial in nature and would be evaluated as not important. This habitat is scoped out of further consideration in this report.

5.4.3.2 Species

Rare and Protected Species

The NBDC database was searched for records of rare and/or protected species from the 2 km grid square R55Y within which the Site is located. The records of rare and/or protected species are presented in Table 5.1 below.

Table 5.1. Rare and/or Protected Species Recorded Within 2 km Grid Square R55Y

Species recorded	Date of last record	No. Records	Conservation Status	Dataset
Barn Owl	2013	1	BoCCI- Red- List	NBDC

Species recorded	**Date of last record**	**No. Records**	**Conservation Status**	**Dataset**
Tyto alba				Bioblitz 2013
Common Coot *Fulica atra*	2013	1	BoCCI-Amber List	NBDC Bioblitz 2013
Great Cormorant *Phalacrocorax carbo*	2014	1	BoCCI-Amber List	NBDC Birds of Ireland
House Martin *Delichon urbicum*	2014	1	BoCCI: Amber List	NBDC Birds of Ireland
House Sparrow *Passer domesticus*	2014	1	BoCCI: Amber List	NBDC Birds of Ireland
Little Grebe *Tachybaptus ruficollis*	2013	1	BoCCI: Amber List	NBDC Bioblitz 2013
Mew Gull *Larus canus*	2013	1	BoCCI: Amber List	NBDC Bioblitz 2013
Sand Martin *Riparia riparia*	2014	1	BoCCI: Amber List	NBDC Birds of Ireland
Short-eared Owl *Asio flammeus*	2011	1	Birds Directive: Annex I BoCCI: Amber List	NBDC Bird Atlas 2007 - 2011
Barn Swallow *Hirundo rustica*	2014	3	BoCCI: Amber List	NBDC Birds of Ireland
Black-headed Gull *Larus ridibundus*	2013	3	BoCCI- Red- List	NBDC Bioblitz 2013
Common Starling *Sturnus vulgaris*	2016	3	BoCCI: Amber List	NBDC Birds of Ireland
Mute Swan *Cygnus olor*	2014	3	BoCCI: Amber List	NBDC Birds of Ireland
Daubenton's Bat *Myotis daubentoniid*	2013	1	Habitats Directive: Annex IV	NBDC Bioblitz 2013
Leisler's Bat *Nyctalus leisleri*	2013	1	Habitats Directive: Annex IV	NBDC Bioblitz 2013
Common Pipistrelle *Pipistrellus pipistrellus*	2013	1	Habitats Directive: Annex IV	NBDC Bioblitz 2013
Lesser Horseshoe Bat *Rhinolophus hipposideros*	2015	4	Habitats Directive: Annex II & IV	National Lesser Horseshoe Bat Database

Protected Flora

A review of the Lower River Shannon SAC Conservation Objectives supporting document for 'Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' (NPWS, 2012) revealed records of opposite-leaved pondweed *Groenlandia densa* within the City Canal.

However, there was no evidence of this plant seen during the field survey of the canal, i.e. during the survey for otter 150m up and downstream of the Site. Also, there have been no records for this species registered on the NBDC database since 1986.

A recent study by BEC Consultants (2012) found *Groenlandia densa* to be a successful pioneer species which responded well to dredging operations in the Royal and Grand Canal where large numbers of plants re-occurred within the years immediately following dredging. While no *Groenlandia densa* was observed in the canal during the recent field survey there may be suitable habitat present, and the plant may re-emerge if the canal was dredged.

The proposed development will connect into the public sewerage system and will only discharge clean surface water run–off into the canal, and this will not affect the water quality in the canal. Therefore, there is no potential for effects on opposite-leaved pondweed within the canal and it is scoped out of further consideration within this report.

Amphibians

Common frog *Rana temporia* and smooth newt *Lissotriton vulgaris* are protected under the Wildlife Acts 1976 as amended. Species protected under the Wildlife Act are those listed on Schedule 5. Since the publication of the Wildlife Act 1976, the list of Schedule 5 species has been extended through the publication of Wildlife Act 1976 (Protection of Wild Animals) Regulations in 1980 and 1990. Common frog and smooth newt were added to the Wildlife Act 1976 as amended by regulations made in SI 282/1980.

While suitable habitat for common frog and smooth newt is present within the nearby canal and wetland to the north, no evidence of these species was recorded within the Site. The drain located within woodland along the northern boundary was dry and carpeted in ivy when inspected during the walkover survey, offering no potential amphibian habitat.

As the proposed project is not likely to affect the water quality in the canal, there should be no effect on the local amphibian population. Amphibians are scoped out and not considered further in this report.

Birds

Birds recorded during the field survey in June 2020 included wood pigeon *Columba palumbus,* hooded crow *Corvus cornix, m*agpie *Pica pica,* robin *Erithacus rubecula,* blackbird *Turdus merula, s*ong thrush *Turdus philomelos* and starling *Sturnus vulgaris.* All species recorded during the field visit are typical in a wide range of habitats, are commonly occurring throughout Ireland and allare Green-listed (least concern) species on BoCCI. The only exception was the starling which is Amber-listed. The bird assemblage of the Site would be evaluated as important at the Site level.

<u>*Mammals*</u>

Otter

Otters, and their breeding and resting places, are protected under the Wildlife Acts. Otter is also listed in Annex II and Annex IV of the EU Habitats Directive.

The drain located within the woodland along the northern boundary of the Site was inspected during field surveys. No evidence of otter was recorded, and the drain is not suitable for use by otter.

The canal, 150 m up- and down-stream of the site, and wetland area to the north were also surveyed for signs of otter activity. Evidence of otter activity was recorded along the canal bank. A potential otter couch was identified on the southern bank (ITM Grid Reference: 558864, 657658) and numerous otter spraints were recorded at bridges crossing the canal to the northwest and northeast of the Site.

Otter signs were recorded along the City Canal (approx. 30 m north of the Site) although the Site itself would be evaluated as not important for otter.

Bats

Habitats within the site were evaluated for bat foraging, commuting and roosting suitability using criteria developed by the BCT (See Appendix 5.2).

The warehouse building in the east of the site was evaluated for bat roosting potential. The large building is of concrete construction with a corrugated sheet roof. Multiple uncovered windows are located throughout the building. The warehouse was evaluated as low suitability for roosting bats due to the lack of appropriate conditions such as suitable light and temperature levels.

As the building was assessed as having low suitability for roosting bats and in line with BCT guidelines, a separate bat survey of the building and the surrounding habitat was conducted in late April/early May 2021 to determine if bats are utilising the building.

Trees within the proposed site were also evaluated for their potential to support roosting bats. Trees inspected were not of sufficient size and age and lacked potential roost features that may be used by bats. Trees within the Site were evaluated as negligible suitability to support roosting bats (see also SLR *Tree Survey Report 2021*).

Woodland and scrub habitats within the Site are moderately suitable for foraging and commuting bats. These habitats provide connectivity with the wider landscape as does the canal which is likely to be used by foraging bats.

The 2021 bat survey revealed that bats were utilising the habitats on the Site, but no bats were found to be roosting in or utilising the warehouse building.

The bat assemblage of the Site would be evaluated as important at the Local level.

Other Mammals

Fox *Vulpes vulpes* scat was recorded within the Site but no other signs of fox were noted. Fox is not legally protected in Ireland and is a commonly occurring species in a wide range of habitats.

There were no other mammal signs noted within the Site and other mammals, such as badger *Meles meles*, are excluded from further consideration in this report.

Invasive Species

The NBDC database was searched for records of invasive species within the 2 km grid square R55Y within which the Site is located. Multiple records, dated within the last 3 years, were returned for the following plant species listed under the Third Schedule of the EC Birds and Natural Habitats Regulations 2011:

- Indian Balsam *Impatiens glandulifera*;
- Giant Hogweed *Heracleum mantegazzianum*;
- Japanese Knotweed *Fallopia japonica*.

No plant or animal invasive species listed under the Third Schedule of the Habitats Directive and subject to restrictions under Regulations 49 and 50 were observed during the ecological site walkover in June 2020. Invasive species are scoped out of further consideration in this report.

5.4.4 Summary of Important Ecological Features

Important ecological features to be carried forward for detailed assessment are summarised below. The importance of these features is summarised along with their legal status.

Otter

Otter is protected under the Wildlife Acts 1976 as amended and Annex II & IV of the EU Habitats Directive. The otter population of the Site would be evaluated as not important but given the proximity of the Site to the City Canal otter is carried forward for detailed assessment.

Bats

Bats are protected under the Wildlife Acts 1976 as amended and the Habitats Directive. The bat assemblage of the Site would be evaluated as important at the Local level.

5.5 DETAILED DESCRIPTION OF THE DEVELOPMENT

The development will consist of a 4 ha. area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick. It is a strategic housing development consisting of:

A. Demolition of existing 530m2 warehouse building on site.

B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

G. Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

H. Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;

I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;

J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;

K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;

L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.
Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

Surface water

Surface water run-off from the construction phase and the completed development will be collected in a piped system (with manholes containing silt traps) and passed through a hydrocarbon interceptor before being discharged to City Canal. The discharge volume will be restricted to pre-development run-off volumes and there is attenuation storage incorporated into the project design through the inclusion of two retention basins below ground storage.

Wastewater

All wastewater from the development will be directed to the existing Main Drainage sewerage network and will be conveyed to the Limerick City and Environs WWTP for treatment prior to discharge.

Lighting Plan

A Lighting Plan has been prepared for the project and submitted under a separate cover. Lighting has been designed such that light intensity within the development footprint has been minimised and there will be no light spill onto the canal, so it reduces the effect on bats and otters.

Landscape Plan

The Landscape Plan includes the retention of existing mature trees. In addition, the project includes the planting native trees and shrubs. Grasslands to the north bordering the canal walkway will be planted with meadow grass feed with native wildflowers and early flowering bulbs.

Contaminated Ground

To address concerns raised following site investigations relating to contaminated ground, the following working methods will be carried out (Verde, 2021):

- To minimise the potential risks posed by contaminated soil by removal of the source of contamination, including soil: excavation, storage and transportation of in the areas of identified and quantified contamination (Note: There are no underground storage tanks present on the site that require removal).
- Material excavation, segregation and removal should be managed and supervised by a competent person to ensure correct procedures are followed and that wastes are appropriately logged and tracked according to waste management requirements and legislation.
- Encapsulation of contaminated soils by the importation of suitable clean fill material onto the site.
- Backfilling the service trenches with material considered to be clean and not contaminated.
- Where off-site disposal of contaminated soils (waste) is required, all lorry loads will be sheeted once loaded and before leaving site to reduce dust generation.
- Any stockpiles containing contaminated soils will be placed on an impermeable surface while awaiting the results of validation testing. The stockpiles will be sheeted to minimise dust emissions and also to minimise the potential for leaching rainwater and run off contaminating clean areas.
- Adequate precautions will be taken during site works to prevent surface water run-off from the site affecting the local surface waters and drainage network; and
- Dust monitoring and dust suppression will be carried out during any remedial works. As a minimum this will include visual inspections to identify dust generating activities and damping down such sources as when required.

Construction, Environmental and Waste Management Plan

A Construction, Environmental and Waste Management Plan (PHM Consulting, 2021) has been developed and will be implemented prior to the redevelopment of the site. The CEWMP seeks to:

Provide a basis for achieving and implementing the construction related mitigation measures identified in the various reports accompanying this application as listed below.
Comply with all relevant conditions attached to the Planning Permission.
Promote best environmental on-site practices for the duration of the construction phase.

The CEWMP is to be read in conjunction with the Civil Engineering Report.

The CEWMP has been prepared in consultation with the:

- SLR – Appropriate Assessment Screening Report
- SLR – Ecological Impact Assessment Report
- SLR - Natura Impact Statement
- SLR – Tree Survey Report
- Precision – Asbestos R&D Survey Report
- RW Nowlan – EIA Screening Statement
- Verdé – Phase 2 Environmental Due Diligence Report

with particular reference to Mitigation of Potential Impacts on Qualifying Interests.

5.6 ASSESSMENT OF EFFECTS AND MITIGATION MEASURES

The potential effects resulting from the proposed development and proposed mitigation measures are discussed in the following sections. The following design principles and "designed-in" mitigation have informed the assessment of impacts.

Within the design of the project, good practice environmental and pollution control measures are employed with regard to current best practice guidance such as, but not limited to, the following:

- CIRIA C532, 'Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors' (CIRIA, 2001).
- CIRIA C741, 'Environmental Good Practice on Site Guide' (CIRIA, 2015).

There is no surface water or groundwater connection between the Site and the City Canal and there will be no discharge of untreated water to the canal during construction or operation.

Lighting has been designed such that light intensity within the development footprint has been minimised and there will be no light spill onto the canal (Appendix 5.3 – Design Drawings).

The Landscape Plan prepared for the development has been designed to recreate and enhance the natural conditions on the Site insofar as is possible (Appendix 5.3 – Design Drawings).

Taking the above into account, the principal potential impacts of the proposed development are outlined in the following sections.

5.6.1 Do Nothing Impact

In the absence of the proposed development, it is likely that the site would continue to be unmanaged and to become further overgrown with willow scrub vegetation.

5.6.2 Potential Impacts and Effects

Otter

The Site itself is evaluated as not important for otter and direct effects on otter are not considered likely. However, the City Canal is ca. 30 m north of the Site and otter activity was recorded along the canal during the June 2020 survey. Otter is typically a crepuscular[10] species but is also known to forage and move along watercourses in the daytime. There is potential for the proposed development to result in indirect effects on otter as a result.

During the construction phase activities such as increased artificial lighting and increased human presence on the site could have the potential to disturb otter. However, as the otter is mainly crepuscular it is likely to avoid the site during the working hours and therefore any impact will be low and will be temporary.

The completed development has the potential to see increased the numbers of people using the canal bank for amenity. While an increase in people walking or running along the bank may increase disturbance, it is the likely increase in the presence of dogs that may pose the highest risk disturbance to otter. However, as the otter is mainly crepuscular it is likely to avoid the canal area during ay and while the increase in day-time disturbance may be permanent, the impact will be slight.

Lighting for the project has been designed such that there will be no increase in light intensity along the canal that may cause disturbance. In addition, the nature of the completed development (i.e. largely residential with a creche, café and some retail units) is not likely to result in a perceptible increase in noise levels along the canal (see Chapter 9 Noise and Vibration - AWN).

The discharge of water from the development that has become contaminated by hydrocarbons or silt has the potential to reduce the quality of the water and could affect prey species or aquatic plants that otter rely on.

There will be no significant effect on otter within the Site but discharge of water from the Site along with construction activities causing increased noise, light and human presence and increased recreational use of the canal pathway along the City Canal by residents and their dogs may cause negative effects on otter associated with the SAC through disturbance.

The effect of the proposed development on otter would be significant at the Local level.

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[10] Activity peaks at dusk and dawn https://www.vincentwildlife.ie/species/otter (last accessed 30/06/2020)

Mitigation Measures

The following measures will be employed to minimise potential disturbance to otter:

- At the project outset, the construction site will be fenced off and no construction activities will be permitted outside designated works area. No access will be gained from the construction site to the canal.
- Noise and vibration control will follow BS 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites.
- Work will be completed during daylight hours. There will be no constant artificial lighting of the construction site at night. Motion triggered security lighting may be used but this will be directed downwards and sited so as to avoid any light spill onto the tow path and canal.
- All plant will be regularly maintained to minimise unnecessary noise.
- Machines which are used intermittently will be shut down or throttled back to a minimum during those periods when they are not in use.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be of the “sound reduced” models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Surface water and groundwater encountered during excavations will be treated using appropriate measures in advance of discharge to the canal. If contaminated groundwater is encountered these measures would include those set out in the Verde (2021) report and in Section 5.5 above. Mitigation measures to prevent discharge of contaminated and / or silt laden water will include, but are not limited to, hydrocarbon interceptors, silt barriers, settlement ponds / tanks[11] and silt traps. The equipment used in the management of surface water will be subject to weekly checks and a regular maintenance schedule.
- Design and construction of attenuation measures shall be in line with current good practice. Guidance such as that produced by CIRIA shall be used to inform the development of such measures. Guidance to be considered, but not limited to, includes:

  Drainage of development sites - a guide (X108) (CIRIA, 2004).

  The SuDs Manual (CIRIA, 2015)

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[11] These systems are an example of what could be used https://www.siltbuster.co.uk/

The surface water drainage design for the development incorporates silt traps, a hydrocarbon interceptor (Kingspan NSBE040 Class I Interceptor or similar) and hydrobrake to control surface water run-off from the development to the canal during the operational phase, refer to the Drainage – General Arrangement included in Appendix 5.3 – Design Drawings.

During the operation phase, the following measures will be employed to minimise potential disturbance due to increased human activities and lighting:

- During the operational phase, access to the canal walkway will limited to daylight hours. The development's management company will be responsible for locking pedestrian access gates each day.
- Signage will be put in place at the egress points of the Site to the canal walkway, requesting that dogs are kept on leads at all times.
- Information boards will be installed at the egress points to the canal, providing information on the ecology of the canal with particular focus on local otter populations.
- The lighting design for the development provides for reduced effect of lighting on wildlife, while meeting current safety standards. The lighting design for the development includes low luxe and directional lighting that will avoid any light spill. External security lighting will be set on motion-sensors and short (1min) timers.

Significance of Residual Effects

With best practice incorporated into the project design and the above mitigation implemented, residual effects of disturbance on nearby otter populations is not considered significant.

<u>*Bats*</u>

Construction of the proposed development will result in the loss of bat foraging and commuting habitat in the form of scrub and a small area of woodland removal. This is not considered to be a significant effect, given the small scale of habitat loss and the availability of suitable alternative habitat along the canal and the wider landscape.

Any negative effects arising from loss of foraging and commuting habitat will be temporary due to the provision of landscaping measures, such as planting of native trees and shrubs, that should offset any loss of foraging/commuting habitat. Connectivity with the wider landscape will be maintained.

No potential roosts were identified within the Site and there is no potential for effects on roosting bats.

Mitigation Measures

Specific mitigation measures are not required as no significant effect on bats is predicted to occur as a result of the proposed development.

However, while specific mitigation for bats is not required the following mitigation measures are proposed:

- A pre-construction survey of the building will be carried out in advance of demolition to ensure that no bats have moved into or started using the building in the period between the pre-planning survey and the grant of permission. The pre-construction survey will be carried out during the optimal survey season (May – September) by an appropriately experienced ecologist and the building should be dismantled / demolished as soon as possible after it has been confirmed that there are no bats present.

If bats, or signs of bats, are discovered during the pre-construction survey of the building then works should not commence until all necessary bat surveys are complete and, if required, a derogation licence has been granted.

Significance of Residual Effects

There will be no significant residual effect on bats as a result of the proposed development.

5.6.3 Cumulative Effects

Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. Cumulative effects can occur where a project results in individually insignificant impacts that, when considered in-combination with impacts of other proposed or permitted plans and projects, can result in significant effects (CIEEM, 2018).

The following plans were reviewed for strategies and objectives that may act in-combination with the project:

- Limerick City Development Plan 2010 – 2016 (as extended).
- Draft Limerick Development Plan 2022 – 2028 (currently at the public consultation stage)
- Limerick City Biodiversity Plan 2011 – 2016.

The draft Limerick Development Plan 2022 – 2028 contains an amendment for a change to the zoning on the P. Downes Site, Pa Healy Road from '*Community and Education*' land use to '*Mixed Use'*. This 1.7ha site which lies west of the Canal Bank site on the southern side of Pa Healy Road.

There are no strategies or objectives in the City Development Plan, the Biodiversity Action Plan, or the draft Limerick Development Plan 2022 – 2028 that are likely to result in significant effects when considered in-combination with the proposed housing development.

Limerick City and County Council planning portal was accessed to examine planning applications in the vicinity of the Site for potential to act in-combination with the project. The planning applications in the Canal Bank area consist of; use of a site for the storage of Titan Storage containers for self-storage uses; the construction of a new post primary school to include six teaching blocks; change of use of an existing crèche facility to apartments; regeneration of the Opera site, Limerick for mixed use development comprising office, retail, culture, licenced premises and other ancillary uses, and, construction of a new canal bridge to provide two-way traffic flow between Canal Bank, Park Road and Lower Park Road.

The only proposed development within 250 m of the Canal Bank site is the container storage facility which will not result in significant residual effects such as surface or ground water effects. All the other proposed developments are sufficiently distant from the Canal Bank site and therefore there is no potential for cumulative or in-combination effects with these plans and projects.

5.6.4 Proposed Monitoring

The proposed development is not likely to result in significant residual effects and monitoring is not required.

5.7 CONCLUSIONS

The habitats present within the Site are commonly occurring throughout Ireland and are evaluated to be either important at the Site level or not important. The proposed development will not result in any significant effects on the biodiversity of the Site and provided the recommended best practice and mitigation is implemented it is considered that development will not result in any residual significant effects on the biodiversity of the Site.

5.8 REFERENCES

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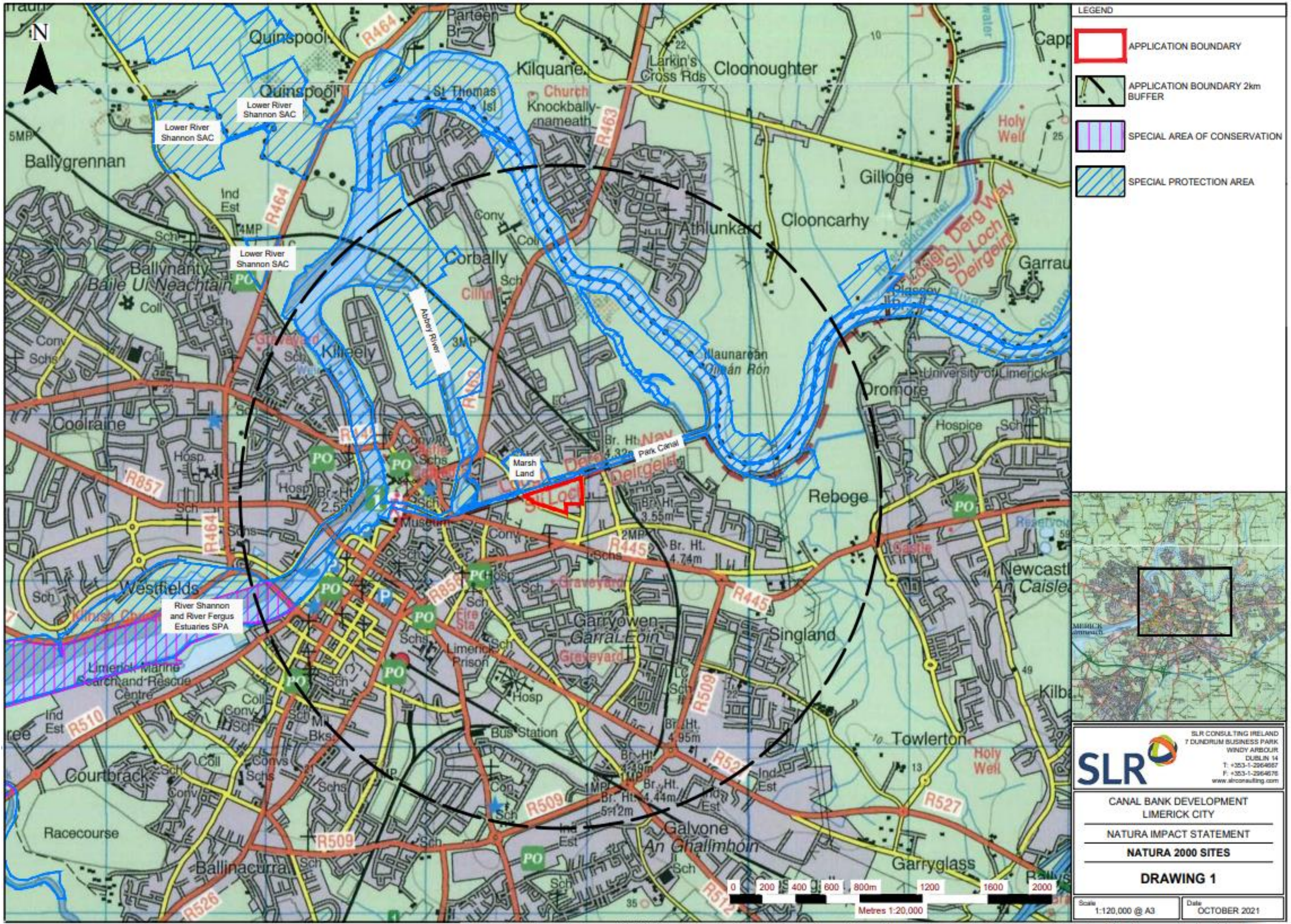
Figure 1: Natura 2000 Sites within 2km of the Site



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CANAL BANK DEVELOPMENT
LIMERICK CITY

NATURA IMPACT STATEMENT

NATURA 2000 SITES

DRAWING 1

Scale
1:120,000 @ A3

Date
OCTOBER 2021

PLATES

Plates 5.1 – 5.5

Plate 5.1: Dry Meadows and Grassy Verges (GS2) - photographed in the north-west corner of the application site.

Plate 5.2: Dry Meadows and Grassy Verges (GS2) – disturbed ground present in the centre of the Site.

Plate 5.3: Scrub (WS1) in southeast corner of application area

Plate 5.4: Mixed Broadleaved Woodland (WD1) present along northern boundary of application area

Plate 5.5: Buildings and Artificial Surfaces (BL3) present in the east of the application site.

Appendix 5.1: Relevant Legislation and Planning Policy

Relevant Legislation[12]

EIA Directive

The EIA Directive, Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment as amended by Council Directive 97/11/EC of 3 March 1997, Directive 2003/35/EC of 26 May 2003 and Directive 2009/31/EC of 23 April 2009, now codified in Directive 2011/92/EU of 13 December 2011 and amended in Directive 2014/52/EU of 16 April 2014, is designed to ensure that projects likely to have significant effects on the environment are subject to a comprehensive assessment of environmental effects prior to development consent being given. The EIA Directive was first transposed into Irish law by the European Communities (Environmental Impact Assessment) Regulations, 1989 (S.I. No. 349 of 1989) which amended the Local Government (Planning and Development) Act, 1963 (and other legislation) to provide for environmental impact assessment.

Habitats and Birds Directive

The Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora was adopted in 1992 and aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.

The Natura 2000 network of protected areas is known as Special Areas of Conservation (SAC) and Special Protection Areas (SPA). In general terms, they are considered to be of exceptional importance in terms of rare, endangered or vulnerable habitats and species within the European Community. The requirements of the Habitats Directive have been transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I. No. 477/2011]. This legislation affords protection to both Special Protection Areas and Special Areas of Conservation.

Special Areas of Conservation (SAC) are designated under the Conservation of Natural Habitats and of Wild Fauna and Flora Directive 92/43/EEC (Habitats Directive) which is transposed into Irish law by the EC (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). Special Protection Areas (SPA) are

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[12] Please note that the summary of relevant legislation provided here is intended for general guidance only. The original legislation should be consulted for definitive information.

classified under the Birds Directive (2009/147/EC on the Conservation of Wild Birds). Article 6(3) of the Habitats Directive requires an 'appropriate assessment' to be undertaken for any plan or project that is likely to have a significant effect on the conservation objectives of a Natura 2000 site. An 'appropriate assessment' is an evaluation of the potential impacts of a plan or project on the integrity of a Natura 2000 site, and the incorporation, where necessary, of measures to mitigate or avoid negative effects.

National Legislation

Flora and fauna in Ireland are protected at a national level by the Wildlife Acts 1976 to 2018 and the Floral (Protection) Order 2015. Natural Heritage Areas (NHA) are areas that are considered to be important for the habitats present or for the species of plants and animals supported by those habitats. Under the Wildlife Amendment Act 2000, NHAs are legally protected from damage from the date they were formally proposed for designation. Section 19(1) of the Act states that 'Where there is a subsisting natural heritage area order in respect of any land, no person shall carry out, or cause or permit to be carried out, on that land any works specified in the order or any works which are liable to destroy or to significantly alter, damage or interfere with the features by reason of which the designation order was made'.

In addition, a list of proposed NHAs (pNHAs) was published in 1995 but to date these have not had their status confirmed. Prior to statutory designation, pNHAs are subject to limited protection under various agri-environment and forestry schemes and under local authority planning strategies such as County Development Plans.

Relevant Planning Policy

The planning policy and legislation that is relevant to the development.

Limerick City Development Plan 2010-2016 (as extended)

The relevant local planning policies have been extracted from Volume 1 of the Limerick City Development Plan 2010-2016 (as extended). These policies are specific to "*Chapter 11: Landscape, Biodiversity & Recreation*" and are concerned with the policies and objectives relating to biodiversity.

Biodiversity Plan

Policy LBR.7 It is the policy of Limerick City Council to adopt and implement a Limerick City Biodiversity Plan within the lifetime of this Draft Development Plan providing scope for all designated areas and

Protected Species within Limerick City and any relevant additional actions relating to natural heritage in the Heritage Plan.

Designated Areas & Protected Species

Policy LBR.8 It is the policy of Limerick City Council to apply the precautionary principle in relation to proposed development in environmentally sensitive areas to ensure all potential adverse impacts on any designated natural heritage area and any NATURA 2000 sites arising from any proposed development or land use activity are avoided, remedied or mitigated.

The Shannon River Basin Management Plan

Policy LBR.9 It is the policy of Limerick City Council to ensure that proposals along the River Shannon and other waterways associated with the River Shannon catchment within Limerick City will achieve an appropriate balance of uses commensurate with the sensitivity of the natural environment and avoiding adverse impacts on European conservation sites and sensitive natural receptors associated with the River Shannon.

Trees & Urban Woodlands

Policy LBR.10 It is the policy of Limerick City Council:

To protect and maintain existing important individual and groups of trees from development risk, provide additional tree planting of native deciduous trees and other appropriate plantings through planning permissions in order to benefit local biodiversity;

To strengthen the protection of trees in the City and protect tree lined settings;

To preserve, maintain and increase the general tree cover in the City by extending planting at identified locations and identifying new sites suitable for the creation of small woodland areas;

To make use of tree preservation orders to protect important trees or groups of trees which may be at risk;

To protect and maintain existing important wetland habitats from development risk, encroachment of incompatible uses, and proposals for filling to ensure sustainability, enhancement of local biodiversity and retention of flood plain storage areas.

Amenity Walkway Routes

Policy LBR.16 It is the policy of Limerick City Council to develop a network of high quality amenity walkway routes, particularly along waterways, linking existing parks and public open spaces and providing for strategic creation of new public open spaces.

Appendix 5.2 - Bat Conservation Trust Guidelines for assessing the potential suitability of proposed development sites for bats

Guidelines for assessing the potential suitability of proposed development sites for bats

Suitability	Description of Roosting Habitats	Description of Communing and Foraging Habitats
Negligible	A building, structure, tree or other feature with negligible habitat features likely to be used by bats.	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	A building or structure with one or more potential roost features that could be used by individual bats opportunistically, but do not provide enough space, shelter, protection or appropriate conditions (for example temperature, humidity, height above ground, light levels, levels of disturbance) and/or suitable surrounding habitat to be used on a regular basis, or by larger numbers of bats. Buildings in this category are unlikely to support a maternity colony or be used by hibernating bats. A tree of sufficient size and age to contain potential roost features but with none seen from the ground, or features seen with only very limited roosting potential (i.e. some small cracks or crevices, low ivy cover).	Habitat that could be used by small numbers of commuting bats such as a gappy hedgerow or un-vegetated stream, but isolated and not very well connected to the surrounding landscape by other habitat and/or features. Suitable but isolated habitat that could be used by small numbers of foraging bats.

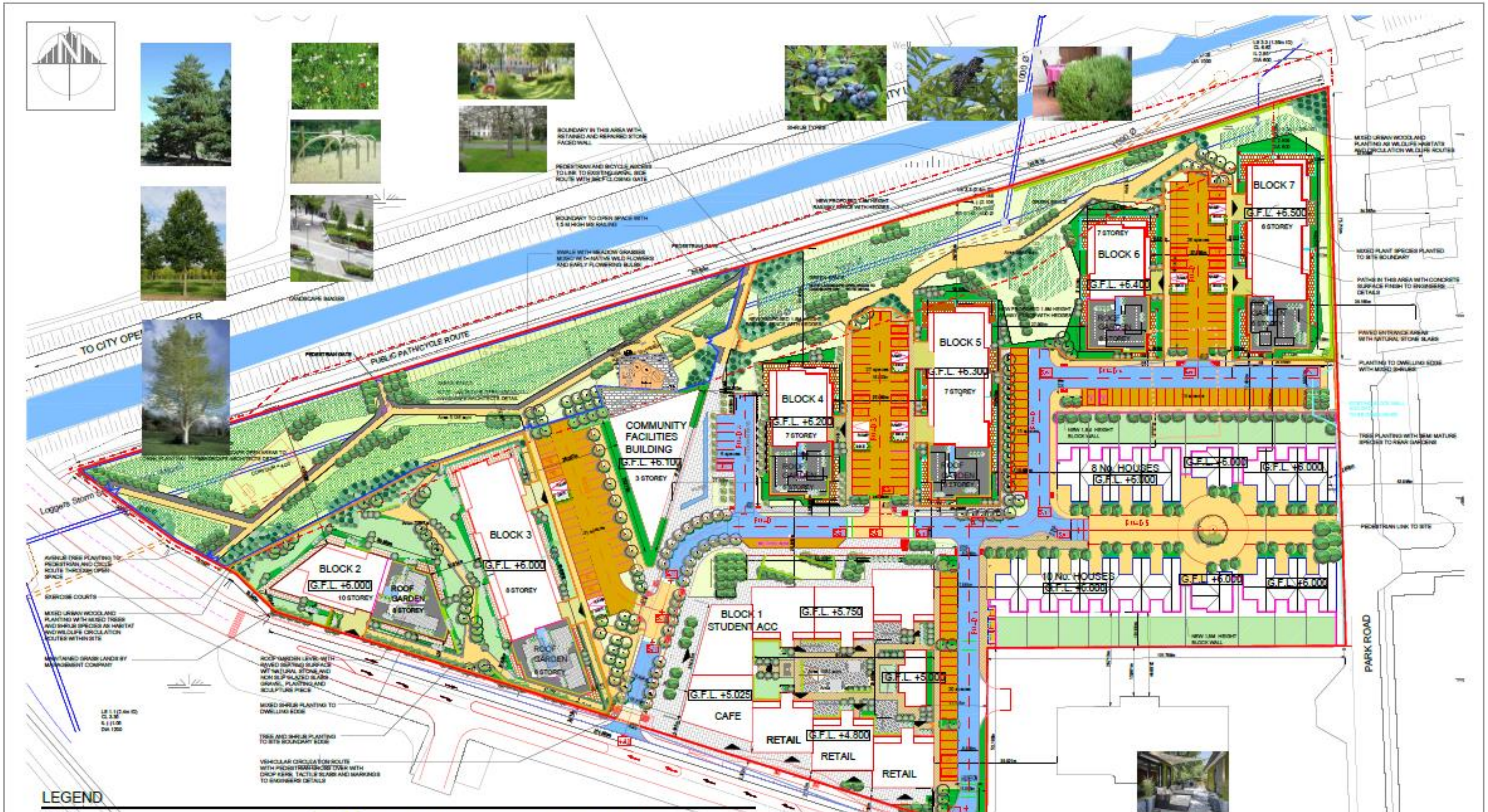
Suitability	Description of Roosting Habitats	Description of Communing and Foraging Habitats
Moderate	A building, structure, tree or other feature with one or more potential roost sites that could be used by bats due to their size, shelter, protection or appropriate conditions (for example temperature, humidity, height above ground, light levels, levels of disturbance) and surrounding habitat but unlikely to support a roost of high conservation value status. Buildings, structures and trees falling into this category would not be expected to support a maternity colony, or significant hibernation or transitory roost.	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	A building, structure, tree or other feature with one or more potential roost sites that are obviously suitable for use by large numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection or appropriate conditions (for example temperature, humidity, height above ground, light levels, levels of disturbance) and surrounding habitat. Buildings, structures and trees falling into this category may be expected to support a maternity colony, or significant hibernation or a significant transitory roost.	Continuous high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such a broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roost.

Appendix C: Design Drawings

1 Landscape Layout

2 External Lighting Plan

3 Drainage Layout



LEGEND

- PROPOSED TREE PLANTING WITH MEDIUM TO LARGE GROWING TREES SET INTO PREPARED PITS WITH DOUBLE STAKES,CROSS RAIL AND PATENT TIE PAINTED TO SELECTED COLOUR TREES PLANTED AS SEMI MATURE SPECIES
- PROPOSED TREE PLANTING WITH MEDIUM TO LARGE GROWING TREES SET INTO PREPARED PITS WITH DOUBLE STAKES,CROSS RAIL AND PATENT TIE PAINTED TO SELECTED COLOUR TREES PLANTED AS ADVANCED STANDARD SPECIES
- PROPOSED PLANTING WITH LOW TO MEDIUM GROWING TREES TREES PLANTED INTO PREPARED PITS WITH DOUBLE STAKES, CROSS RAIL AND PATENT TREE TIE PAINTED TO SELECTED COLOUR
- PLANTING WITH LARGE GROWING SHRUB SET INTO BOTTOMLESS POT
- PLANTING WITH MIXED WOODLAND SPECIES TO SITE BOUNDARY PLANTING TO CONTAIN SHRUBS AND LOW TO MEDIUM GROWING TREES
- INDICATES MAINTAINED GRASSED AREAS TO OPEN SPACE AREAS WITH MEADOW GRASSES ON CULTIVATED SOIL 350 DEEP ON CULTIVATED SUB SOIL
- INDICATES MAINTAINED GRASS AREAS TO PRIVATE AND AREAS WITHIN MANAGEMENT COMPANY
- GRASSED AREA WITH MEADOW GRASS SEED, MIXED WITH NATIVE WILD FLOWERS AND EARLY FLOWERING BULBS INDICATES AREAS WITH MIXED SHRUB PLANTING WITH BARK MULCH ON CULTIVATED SOIL 450 DEEP ON SUBSOIL
- INDICATES AREA WITH NATIVE WILD FLOWERS MIX WITH EARLY FLOWERING BULBS
- INDICATES HEDGE PLANTING WITH SELECTED SPECIES
- JUNIOR PLAY AREA WITH BARK OR WOODCHIP FINISH ON TERRAM SHEET ON BLINDED HARDCORE
- SEATING COURT WITH BENCH SEAT, PAVING SLABS AND LED UPLIGHTERS
- STAINLESS STEEL BICYCLE STANDS
- PAVED AREA WITH NATURAL STONE SLABS GRANITE OR SIMILAR WITH 300 X 300 SIZED SLABS
- INDICATES POSITIONS OF MOVABLE STAINLESS STEEL BOLLARDS WITH REFLECTIVE TAPE
- GRAVEL SURFACE FINISH WITH GALVANISED STEEL EDGING GRAVEL LAID IN PATENT RETAINING SHEETS
- INDICATES 1.5 M HIGH MILD STEEL RAILING WITH POWDER COATED FINISH
- VEHICULAR ROUTE WITH ASPHALT SURFACE REFER TO ENGINEERS DETAILS
- PAVING TO ENTRANCE DOORWAY WITH FALL-OUT PAVING WITH STAINLESS STEEL PATENT ACO DRAIN AT DOORWAY
- SURFACE FINISH WITH BUFF COLOURED ANTI SKID GRIT SURFACE APPLIED TO ASPHALT ROAD SURFACE
- RED COLOURED ANTI SKID GRIT APPLIED TO ASPHALT ROAD SURFACE
- SCULPTURE PIECE REFLECTING LOCAL HISTORICAL LINK OF SITE - SET ON VISUAL LINE OF PEDESTRIAN ROUTE
- GLAZED PAVING SLABS WITH NON SLIP SURFACE AND UNDER SLAB LIGHTS
- PAVING WITH NATURAL STONE SLABS 600 X 300 X 30 LAID ON MORTAR BED - STRETCHER BOND PATTERN
- MILD STEEL SELF CLOSING MILD STEEL GATES WITH POWER COATED FINISH
- PEDESTRIAN ROUTE 1.8 M WIDE WITH MACADAM FINISH BICYCLE ROUTE 1.5 M WIDE WITH GRIT SURFACE ON MACADAM SURFACE
- JUNIOR PLAY AREA WITH PATENT SPRINGER UNIT, TREE TRUNKS AND LOGS, HOP SCOTCH BEDS, BENCH SEATS, STAINLESS STEEL BIN, GAMES TALE, GAMES BOARD, CONTOUR SLIDE, JUNIOR SWING AND GRAFFITI WALL AND BASKETBALL THROWING AREA

LANDSCAPE STRATEGY PROPOSALS

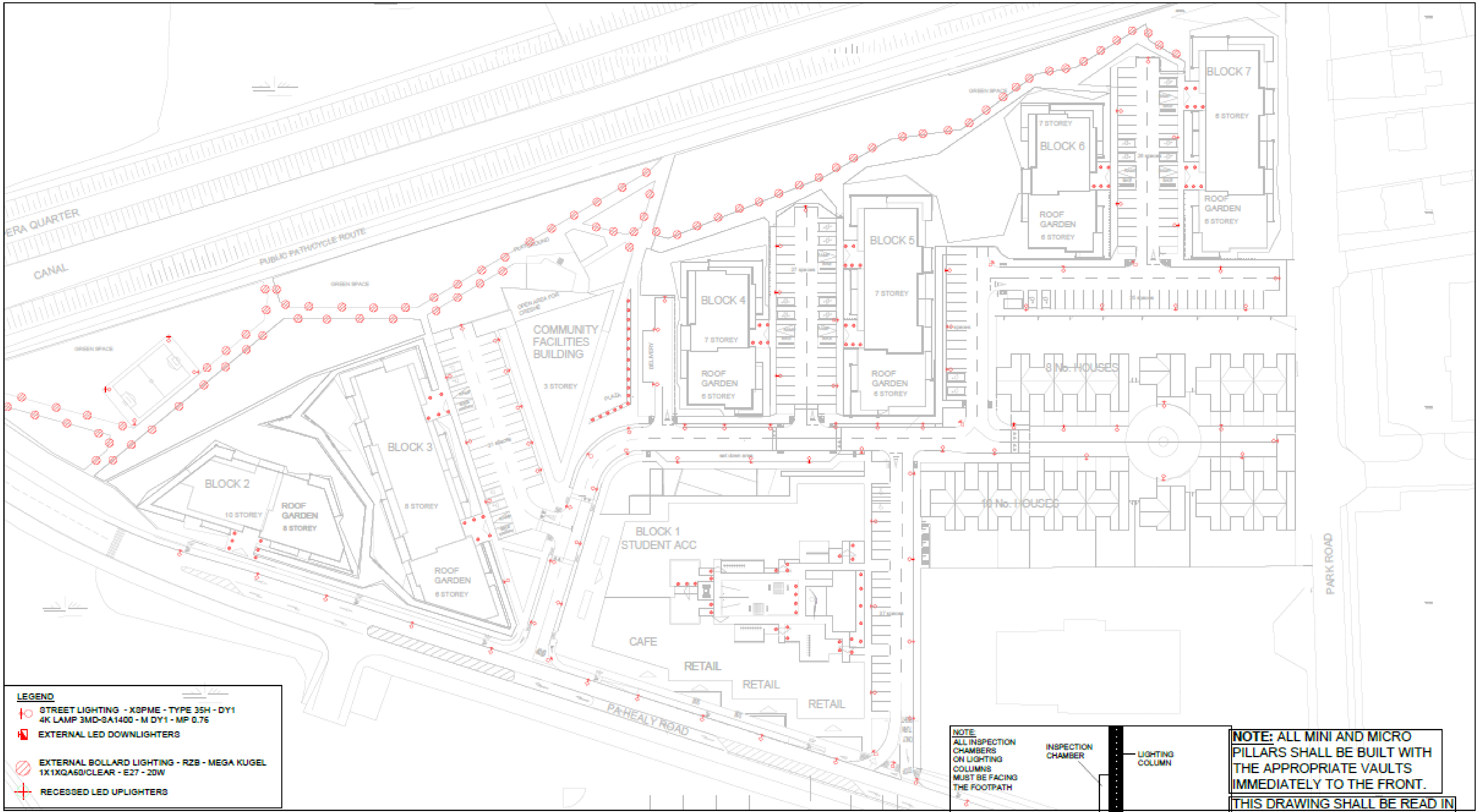
CANAL BANKS
PA HEALY ROAD AND CANAL ROAD
LIMERICK

REVINGTON DEVELOPMENTS LIMITED

Roche

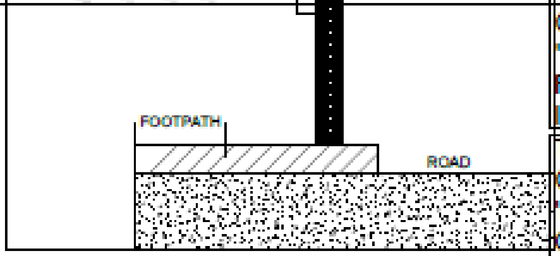
43 Seafield Road West, Clontarf, Dublin 3
t. [illegible] e. [illegible] [illegible]

scale: 1/1000 date: Jan 2020 dwg no: 1453 - 6010



LEGEND

⊣O	STREET LIGHTING - XSPME - TYPE 35H - DY1 4K LAMP 3MD-SA1400 - M DY1 - MP 0.76
◧	EXTERNAL LED DOWNLIGHTERS
▨	EXTERNAL BOLLARD LIGHTING - RZB - MEGA KUGEL 1X1XQA60/CLEAR - E27 - 20W
+	RECESSED LED UPLIGHTERS



NOTE:
ALL INSPECTION CHAMBERS ON LIGHTING COLUMNS MUST BE FACING THE FOOTPATH

NOTE: ALL MINI AND MICRO PILLARS SHALL BE BUILT WITH THE APPROPRIATE VAULTS IMMEDIATELY TO THE FRONT.

THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE 'NATIONAL CODE OF PRACTICE FOR CUSTOMER INTERFACE' ISSUED BY ESB

THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE 'ELECTRICAL SERVICES GUIDEBOOK' ISSUED BY ESB.

NOTE: THIS DRAWING IS INDICATIVE ONLY AND SHOULD **NOT BE USED** FOR CONSTRUCTION. ESB WILL PROVIDE SITE DESIGN LAYOUT.

Notes:

1. All external lighting to be controlled by external photocell and time clock.
2. The electrical services specialist shall be fully responsible for all on-site co-ordination of their services with all other services.
3. Exact position of all luminaires/switches etc. shall be finally positioned in accordance with the final & agreed room layouts from the Architect & Engineer prior to first fix installation.
4. Lamp colour temperatures are to be agreed with engineer prior to installation on site.
5. All luminaires shall be suitably labeled with their circuit reference.
6. All emergency luminaires shall be suitably labeled with unique reference.
7. Contractor to note that the distribution board reference & subsequent circuit references are for information only. Exact identification of dist board shall be agreed on site with the engineer.
8. Emergency lighting to be in full accordance with IS3217 : 2013.
9. External lighting to be switched using time clock & hand/off/auto manual switch located at reception. External lighting to be 24hr operation with photocell over-ride.
10. All PIRS to be installed c/w isolation switches.
11. All lighting circuits shall be supplied from the local sub-distribution centre.
12. The General Lighting scheme shall comply with IS EN 12464-1(2011).
13. Final positions of light control points, PIRS, photocells to be designed by M&E engineers in conjunction with the architects drawings.
14. This drawing shall be read in conjunction with the specification, luminaire schedule & all other drawings.
15. All lighting circuits, unless stated otherwise, shall be installed utilising 10A MCB 2.5mm LSF cables enclosed in trunking/conduit & generally concealed surface mounted Car Park in Plant areas. All surface mounted conduits shall run parallel & at 90° only to the building lines & shall be agreed with the engineer prior to installation.

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND STRUCTURAL ENGINEERS CONSTRUCTION ISSUE DRAWINGS AND MECHANICAL & ELECTRICAL SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING IS REPRESENTATIVE ONLY.
3. ALL DIMENSIONS ARE IN MILLIMETERS (mm), UNLESS OTHERWISE STATED.
4. THE EXACT LOCATION OF SERVICES AND FITTINGS TO BE AGREED ON SITE WITH THE ARCHITECT AND STRUCTURAL ENGINEER PRIOR TO INSTALLATION.
5. MECHANICAL & ELECTRICAL SERVICES TO BE CO-ORDINATED WITH ALL OTHER TRADES, AND TO BE AGREED ON SITE PRIOR TO INSTALLATION. ADDITIONAL COSTS INCURRED BY THE CONTRACTOR DUE TO THE LACK OF CO-ORDINATION, WILL NOT BE ENTERTAINED.

REVISION	DATE	DESCRIPTION	DRG.	CHK.
P	16.12.19	ISSUED FOR PLANNING	N.K.	R.B.

DATE:	SCALE:	DRG BY:	CHK BY:
16.12.19	1:100 @ A1	N.K.	R.B.

CLIENT:

ARCHITECT: OCA ARCHITECTS

PROJECT MGR:

DESCRIPTION: PLANNING

PROJECT:
PROPOSED RESIDENTIAL SITE,
PA HEALY ROAD, CANAL BANK,
CO. LIMERICK

TITLE:
EXTERNAL LIGHTING

JOB No.:	DRAWING No.:	REV:
20-104	60-00	P

R.M.BREEN ASSOCIATES
Sustainable Building Services Design, Project Management

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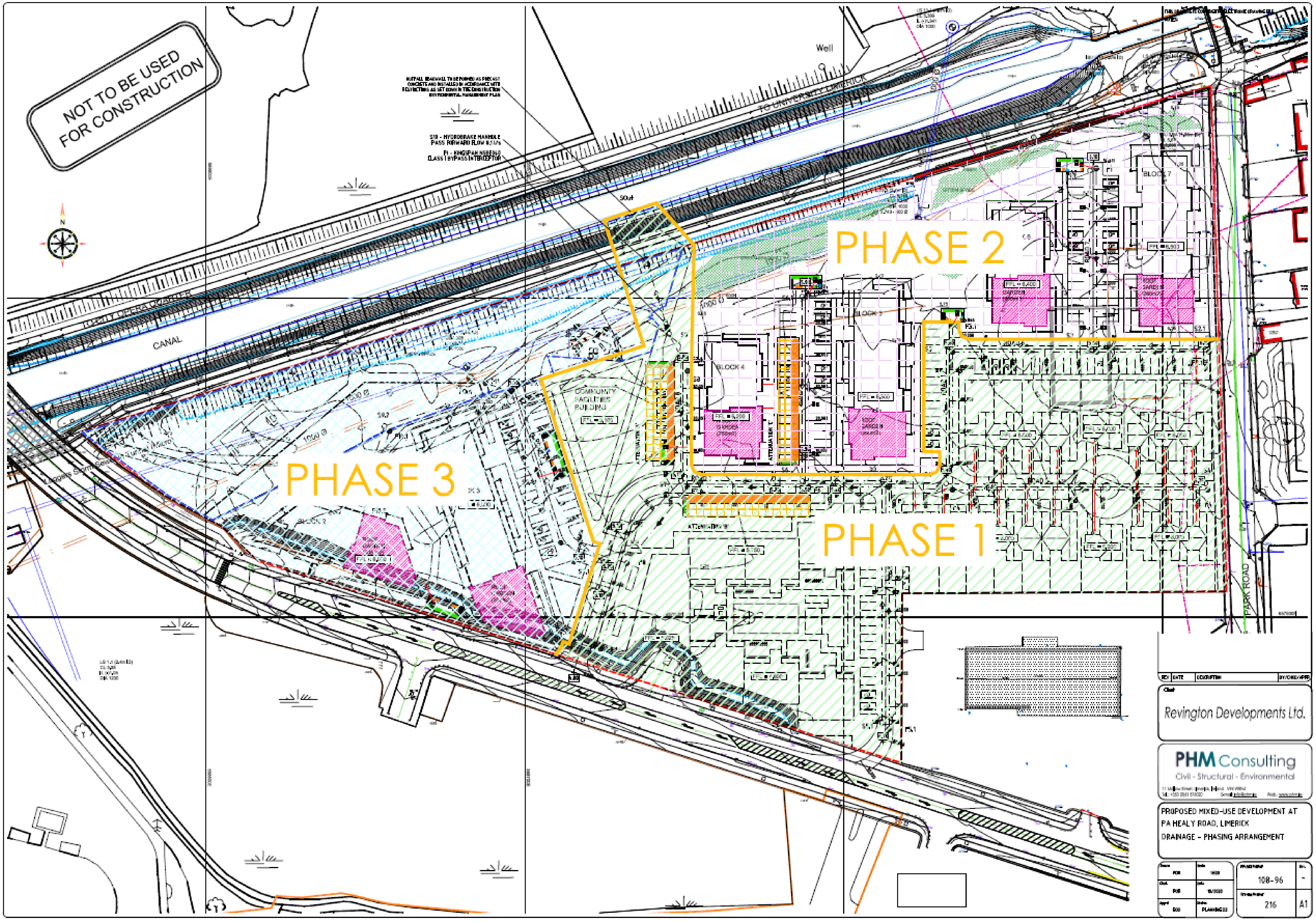


REV	DATE	DESCRIPTION	BY/CHKD/APPR

Client

Revington Developments Ltd.

PHM Consulting
Civil - Structural - Environmental

PROPOSED MIXED-USE DEVELOPMENT AT
PA HEALY ROAD, LIMERICK
DRAINAGE - PHASING ARRANGEMENT

Project Number: 108-96
Drawing Number: 216
A1

6.0 LAND, SOIL, GEOLOGY AND HYDROGEOLOGY

6.1 INTRODUCTION

This chapter of the EIAR covers land, soils (& geology) and hydrogeology (groundwater) and it has been prepared to support an application for strategic housing development (SHD) at Canal Bank, Pa Healy Road / Park Road, Limerick. It has been prepared by SLR Consulting on behalf of Revington Developments Ltd.

This Chapter was undertaken by Peter Glanville (PGeo. EurGeol.) of SLR Consulting.Peter is a Professional Geologist and is a Technical Director in the Water (Hydrology and Hydrogeology) team in SLR's Dublin office. He has over twenty years' experience in environmental consulting including hydrology, flood risk, geomorphology and geology. Peter's specialist experience is in the field of hydrology and hydrogeology and includes undertaking Environmental Impact Assessments and preparing Environmental Impact Assessment Reports for a range of development types including infrastructure, mining, minerals and power related projects. His range of experience also includes discharge licencing and consents, flood risk assessments, Peat Landslide Hazard Risk Assessments, the preparation of Construction and Environmental Management Plans, baseline water monitoring, Quaternary Geomorphology and Subsoils.

6.2 METHODOLOGY

Available information on the land, soils (& geology), and hydrogeology (groundwater) of the Canal Bank area and its surrounds was collated and evaluated. The scope of this section includes:

- An assessment of the existing land, soils (& geology) and hydrogeology (groundwater) conditions at and close to the site;
- An assessment of the impact of the development on land, soils (& geology) and hydrogeology (groundwater) conditions; and
- Recommendations for measures to reduce or eliminate any potential impacts on the land, soils (& geology) and hydrogeology (groundwater) identified from the assessment.

The methodology used follows the guidelines and advice notes provided by the Environmental Protection Agency on environmental impact assessments and with due regard to the guidelines published by the Institute of Geologists of Ireland's (IGI) in 2013.

The methodology involved in the assessment of the land, soils and hydrogeology at the application site can be summarised as follows:

- A desk study in which existing data and relevant regional data sources for the site and surrounding area were examined;
- Assessment of technical reports pertaining to the site including:
- Phase 2 Environmental Due Diligence Report, Canal Bank Project, Verde, 2021;
- Natura Impact Statement, Canal Bank Development (SLR Consulting, 2021);
- Civil Engineering Report, Mixed Use Development, Pa Healy Road, report reference 108-96/17c, PHM Consulting, 2021, and;
- Construction, Environmental & Waste Management Plan, Mixed Use Development, Pa Healy Road, report reference 108/96/17c/CEMP_P1, PHM Consulting, 2021.
- Assessment of groundwater level monitoring and testing of groundwater samples taken at the site; and
- An analysis of the information gathered.

The desk study involved the examination of several datasets to determine the geological and hydrogeological setting of the area, as detailed in Table 6.1 below.

Data	Dataset	Data Type/ Scale
Soil and Geology	GSI Groundwater Data Viewer – Teagasc Soils	Digital
	GSI Groundwater Data Viewer – Teagasc Subsoils	Digital
	GSI Groundwater Data Viewer – Bedrock Geology	Digital
Groundwater	GSI bedrock aquifer mapping, groundwater body description documents, Environmental Protection Agency and Water Framework Directive mapping	Digital
Elevation	OSi Discovery Series Mapping	1:50,000
Protected Areas, Environmental Pressures	Environmental Protection Agency	Digital

Table 6.1 Regional Data Consultation

6.3 REGULATORY BACKGROUND

6.3.1 Legislation

The key European Directives / European Union Legislation which apply to this Chapter of the EIAR and the land, soils and hydrogeology assessment presented herein are:

- Environmental Impact Assessment Directive (2011/92/EU); and
- Directive of the European Parliament and of the Council amending Directive 2011/92/EU on assessment of effects of certain public and private projects on the environment (2014/52/EU).

- Other European Directives to which this EIAR makes reference, or has had regard, are listed in Appendix 6.1.
- Irish Government Acts, National Legislation and Regulations which apply to this Chapter of the EIAR and the land, soils and hydrogeology assessment presented herein are also listed in Appendix 6.1.

Most notably, under Regulation 4 of the Groundwater Regulations 2010, a duty is placed on public authorities to promote compliance with the requirements of the regulations and to take all reasonable steps including, where necessary, the implementation of programmes of measures, to:

"(a) prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater;

(b) protect, enhance and restore all bodies of groundwater and ensure a balance between abstraction and recharge of groundwater with the aim of achieving good groundwater quantitative status and good groundwater chemical status by 2015 or, at the latest, by 2027;

(c) reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater;

(d) achieve compliance with any standards and objectives established for a groundwater dependent protected area included in the register of protected areas established under Regulation 8 of the 2003 Regulations [S.I. No. 722 of 2003] by not later than 2015, unless otherwise specified in the Community legislation under which the individual protected areas have been established."

6.3.2 Planning Policy and Development Control

There are no planning policy and development control regulations that specifically apply to this land, soils and hydrogeology assessment.

6.3.3 Guidelines and Technical Standards

The following key guidelines apply to this assessment:

- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, April 2013; and
- National Roads Authority, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Additional guidelines and technical standards which apply to this Chapter of the EIAR and the land, soils and hydrogeology assessment presented herein are listed in Appendix 6.1.

6.4 RECEIVING ENVIRONMENT

6.4.1 Study Area

For the purposes of this assessment, the study area comprises the application site the surrounding area up to 2 km radius around the site boundary and is increased to 5km reflect the sensitivity of the subsurface, for example where karst systems are present. This is in line with the Institute of Geologists of Ireland's (IGI) guidelines (2013). Unmitigated potential impacts on land, soils and hydrogeology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed. The identified potential impacts are then re-assessed assuming the identified mitigation measures in place.

6.4.2 Topography, Physical Features, and Land-use

The proposed development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick. The site is mostly vacant; however there is a steel frame warehouse present in the eastern part of the site. The central part is occupied by remaining structures of former storage yard. The northern edge of the site, along the Park Canal is overgrown with semi-mature trees. The central-western portion of the site is overgrown with young trees and bushes. There are several small stockpiles present on site comprising mainly of demolition material including concrete and brick.

Currently the entrance to the site is from Park Road to the concrete yard in front of the warehouse. The warehouse is utilised by the neighbouring furniture fitting company to store the materials. The historic use of the warehouse is unknown, however the recent asbestos survey of the warehouse reviled a presence of a cold room within the building. The warehouse area is separated from the rest of the site by chain link fence and metal gate. The entrance from the Pa Healy Road is currently blocked with a mound of soil and Kelly blocks.

The topography of the site is currently generally flat with a slight gradient towards the west. The site topography is expected to be significantly altered by historic deposition of various type of fill material.

6.4.3 Soils and Geology

Soils and Subsoils

The Environmental Protection Agency (EPA) website publishes soil and subsoil maps created by Spatial Analysis Unit, and Teagasc in collaboration with the Geological Survey of Ireland. The Teagasc soils map describe the soils underlying the site as made ground described as made ground / built ground with marine/estuarine silts and clays located in the north western corner, as shown in Figure 6.1.

Subsoils at the site are also described as made ground and marine/estuarine silt and clays in the north western corner, see Figure 6.2.

Bedrock Geology

According to GSI data, the majority of the site is located on top of Dinantian undifferentiated Visean limestones. The south west corner of the site is underlain by volcanoclastic rocks, described as volcaniclastic rocks among the Dinantian limestones. The bedrock geology is shown on Figure 6.3.

6.4.4 Groundwater– Hydrogeology

Aquifer Characteristics

According to GSI data, the bedrock aquifer underlying the majority of the site is classified as Lm, Locally Important aquifer which is generally moderately productive, see Figure 6.4. The south west corner of the site is classified as LI, Locally Important Aquifer - bedrock which is moderately productive only in local zones.

The GSI data shows that the average groundwater recharge for most of the site is between 105-108mm/year. The north western corner of the site has an average groundwater recharge of 37mm/year.

Limerick City East Groundwater Body

The site is located within the Limerick City East Groundwater Body (GWB), and a summary of initial characterisation report for the GWB has been published by the GSI – see Appendix 6.2. The report states that the groundwater body is bounded to the north by the River Shannon. The terrain is gently undulating over much of the GWB. Groundwater flow occurs along fractures, joints and faults in the limestones and volcanic rocks. There is likely to be an epikarstic layer at the top of the limestones, which acts to redistribute recharge in the subsurface and, in high water table conditions, is a very high transmissivity layer. The aquifers have low storativity.

Groundwater flux in the limestone aquifer will be concentrated in an approximately 30 m zone at the top of the bedrock. This zone comprises an epikarstic layer of a few metres, below which is a network of joints, fractures and faults. Deeper groundwater flow can occur along permeable fault zones or deeper fractures. The flow regime in the volcanic aquifer is similar, excepting the epikarstic layer.

The aquifers in the GWB are unconfined in the main. Near rivers and streams, the water table is close to the surface. Depending upon topography, the water table can vary between 2 metres up to ~15 m below ground surface. Water table fluctuations in discharge areas will be relatively low (on the order of 1-2 m).

Flow path lengths are generally long (up to 1500 m). In discharge zones, flow paths will be much shorter, at around 100–300 m. On a local scale, groundwater discharges to the streams and smaller rivers crossing the aquifer. Local groundwater flow directions are determined by topography and local drainage patterns. Regional groundwater flow directions are roughly E-W to northwards, oblique to the major N-S rivers.

Groundwater discharges to the gaining rivers crossing the GWB, and the Shannon at the north of the GWB.

Local Groundwater Supplies

According to the GSI database, there are two groundwater supply wells within 2km of the site, shown on Figure 6.5. The nearest groundwater supply well approximately 0.39km to the south west of the site (GSI reference 1415SEW047). The well was drilled in 1978 by Shamrock to a depth of 73.2m. This well produces good yields of approximately 288m^{3}d and is defined as being of industrial use. The next groundwater well is located approximately 1.5km to the east south-east (GSI reference 1415SEW001). The well was drilled in 1973 and is also listed at 73.2m. The yield is moderate, at 54.5m^{3}d.

Groundwater Quality

Under Ireland's obligations for the Water Framework Directive, the status of groundwater bodies nationally has been assessed, both on the basis of their quality and availability. The Limerick City East groundwater body is classified as being Good 2013-2018 under the WFD (www.catchments.ie).

Groundwater Vulnerability

The GSI classification of the bedrock aquifer beneath the majority of the site is described as having a vulnerability rating of (L) Low, as presented in Figure 6.6. The eastern boundary has a vulnerability rating of (M) Moderate.

6.4.5 On Site Investigations

Site investigations were undertaken by Verde in 2019 and details are provided in the Phase 2 Due Diligence report and the locations are shown in Diagram 6.1 below. The trial pit and borehole logs are presented in Appendix 6.3.

Trial Pits

Fifteen trial pits were excavated across the site with four of these trial pits located within the footprint of the proposed buildings (TP101, TP106, TP110 & TP113). The trial pits encountered a significant layer of made ground comprising sandy clay or clayey sand with abundance of demolition concrete, frequent red brick fragment and occasional limestone cobbles, metal and glass fragments. These anthropogenic deposits were underlain by natural deposits of peaty clay, peat and sandy or silty clay.

During trial pit excavation entries of shallow groundwater were observed in the man-made deposits and natural sand and clay at depths between 0.7 and 2.8mbgl. In one location (TP-109) water entry was observed at 0.2mbgl and can be associated with surface water lodging in the permeable surface fill material. Volumes of encountered shallow groundwater were significant in some locations including TP-106 and TP-110.

Groundwater Monitoring Wells

Four groundwater monitoring wells were drilled in the limestone bedrock aquifer (MW101 to MW104) to a maximum depth of 10.8mBGL with a slotted screen installed in the bottom 0.55-1.0 metres to capture the groundwater present in the bedrock aquifer.

The general ground conditions encountered during drilling comprised man made deposits of grey gravels and cobbles with some addition of concrete and red brick fragments to a maximum depth 4.0mbgl. The made ground deposits were underlain by brown peaty clay followed by light grey or brownish-grey silty clay to a maximum depth of 8.8mbgl. Weathered, grey limestone bedrock was encountered during drilling at depths between 6.2mBGL and 8.7mbgl.

Small groundwater strikes were observed during drilling in the overburden at depths between 2.5 and 3.5mbgl, at the interface between the overburden and the bedrock or in the bedrock at the depths between 6.2 and 10.2mbgl.

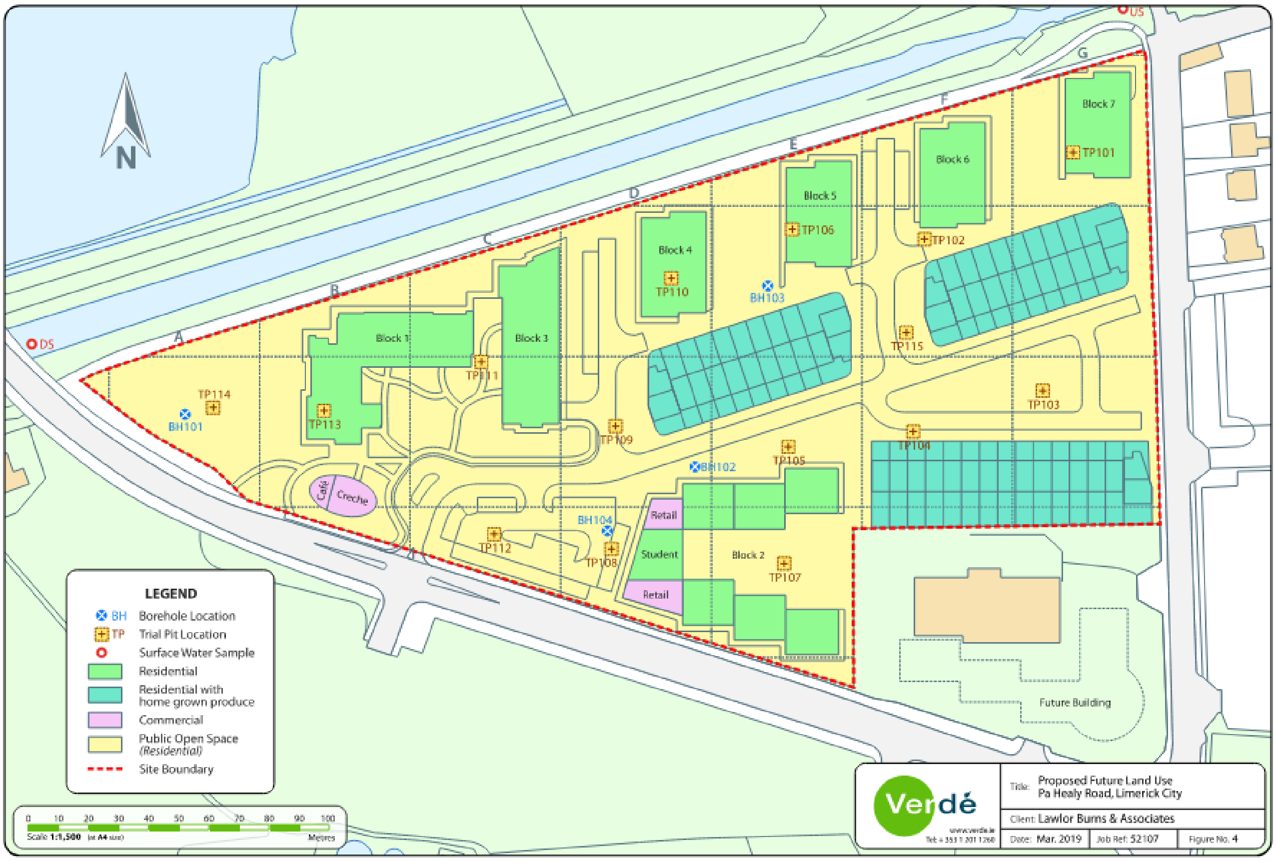
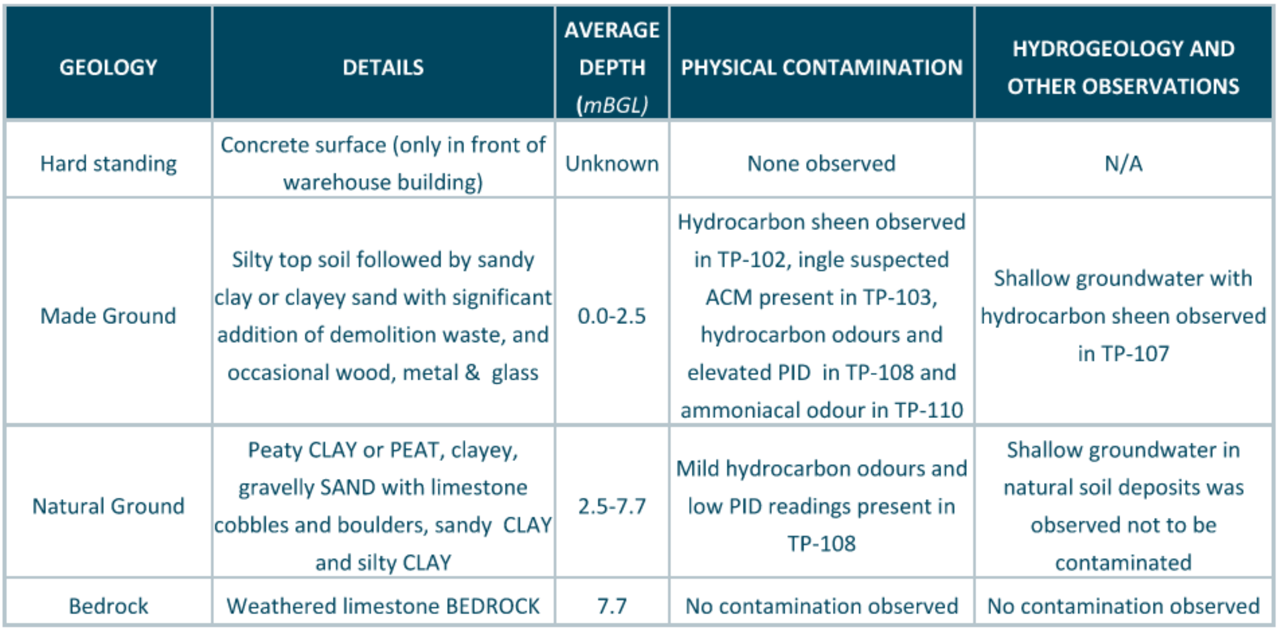


Diagram 6.1 Site Investigation Locations (Verde)

Evidence of Contamination

A summary of visual and olfactory evidence of contamination encountered during the site investigations is presented in Table 6.2 below.



GEOLOGY	DETAILS	AVERAGE DEPTH (*mBGL)*	PHYSICAL CONTAMINATION	HYDROGEOLOGY AND OTHER OBSERVATIONS
Hard standing	Concrete surface (only in front of warehouse building)	Unknown	None observed	N/A
Made Ground	Silty top soil followed by sandy clay or clayey sand with significant addition of demolition waste, and occasional wood, metal & glass	0.0-2.5	Hydrocarbon sheen observed in TP-102, ingle suspected ACM present in TP-103, hydrocarbon odours and elevated PID in TP-108 and ammoniacal odour in TP-110	Shallow groundwater with hydrocarbon sheen observed in TP-107
Natural Ground	Peaty CLAY or PEAT, clayey, gravelly SAND with limestone cobbles and boulders, sandy CLAY and silty CLAY	2.5-7.7	Mild hydrocarbon odours and low PID readings present in TP-108	Shallow groundwater in natural soil deposits was observed not to be contaminated
Bedrock	Weathered limestone BEDROCK	7.7	No contamination observed	No contamination observed

Table 6.2 Summary of Contamination Encountered (Verde)

Groundwater and Bedrock Levels

The groundwater and bedrock levels are tabulated in Table 6.3. The borehole logs provided in the Verde report show that the top of the bedrock was encountered between 6.2m bgl to 8.8m bgl. Groundwater strikes in the bedrock were encountered at the interface of the overburden and bedrock at MW102 – MW104. At MW101, in the western corner of the site, a small groundwater strike was encountered at the interface and a large groundwater strike was encountered at almost 2m below the interface, at 10.2m bgl. The groundwater strike elevations varied between -0.68m OD to -3.4m OD, as shown in Table 6.3.

As can be seen in Table 6.3, following the groundwater strike in the bedrock the groundwater levels in the limestone bedrock rose a number of meters to between 3.25 to 4.02m btoc. Groundwater levels were also recorded in October 2021.

Groundwater Flow Direction

The groundwater flow follows the regional and local topography and is in a north-westerly direction towards the River Abbey. Groundwater levels recorded in both January 2019 and October 2021 showed the same groundwater flow direction.

Groundwater Wells	OD Elevation (mtoc)	Top of Bedrock (mbgl)	Groundwater Strike in Bedrock (mbgl)	Approx top of bedrock (mOD) *	Groundwater Strike in Bedrock (mOD) *
MW101	5.059	8.5	10.2	-3.441	-5.141
MW102	5.393	8.8	8.8	-3.407	-3.407
MW103	5.839	7.3	7.4	-1.461	-1.561
MW104	5.523	6.2	6.2	-0.677	-0.677

** results of ground level elevation not reported, assume toc at or near ground level*

Groundwater Wells	Groundwater Level (mbtoc)	Groundwater Level (mOD)	Groundwater Level (mbtoc)	Groundwater Level (mOD)
	21st January 2019		14th October 2021	
MW101	3.25	1.81	3.28	1.779
MW102	3.56	1.83	3.60	1.793
MW103	4.02	1.82	4.05	1.789
MW104	3.68	1.84	3.71	1.813

Table 6.3 Groundwater and Bedrock Levels

Groundwater Quality

Groundwater quality samples were also taken by Verde on 21st January 2019 from the limestone bedrock. The results are presented in Appendix 6.4. The groundwater was retested by Verde in October 2021. Groundwater in the limestone bedrock beneath the site was found to be of good quality with the exception of elevated concentrations of barium and localised elevated arsenic. Barium and arsenic groundwater compounds are confined to the bedrock aquifer and considered not to interfere with proposed development plans. Groundwater in the bedrock beneath the site is free of volatile substances.

Barium and localised elevated Arsenic concentrations are considered to occur naturally in the nearby volcanic bedrock and have migrated in groundwater into the limestone bedrock.

Soil Sampling

Verde carried out soil sampling and screened the results against human health generic assessment criteria (GAC). The results identified local exceedances of lead, TPH and PAH human health GACs, to be managed by capping with a suitable layer of clean soils to act as a barrier to receptors. Presence of asbestos fibres in soils was also identified, which is also to be managed / addressed d by importing of clean soils and capping off the existing soil surfaces.

6.4.6 Protected Areas

Protected areas are outlined in the Natura Impact Statement (NIS, SLR 2021). The NIS identifies two sites which are considered to be within the Zone of Influence of the project site. To the north, the site is adjacent to the Lower River Shannon SAC, in the form of the Park Canal 30m from the site boundary and a large area of wetland habitat to the north of the canal. The canal is raised in relation to the site, and groundwater from the therefore passes underneath it as it moves north-west. The base of the canal is expected to be at approximately 1m OD, whilst groundwater strikes in bedrock are reported at approximately -0.68m OD to -5.1m OD. The River Shannon and River Fergus Estuaries SPA approximately 2km away.

Protected area	Location in relation to application site	Comment
Lower River Shannon SAC (002165)	30m north	Park Canal is at a higher level than the site and is not in continuity with groundwater in the bedrock.
River Shannon and River Fergus Estuaries SPA (004077)	2km west - southwest	The SPA is downstream of the Lower River Shannon SAC

Table 6.3 Protected Areas Assessment

6.4.7 Potential Receptors

Arising out of the baseline study therefore, the following land, soils and hydrogeology receptors have been identified:

- Locally important bedrock aquifer;
- Shannon River SAC / River Shannon and River Fergus SPA; and
- Groundwater supply wells.

For each identified receptor, the significance and sensitivity of the receptor is assessed in Table 6.4 below and a rating (High / Medium / Low / Negligible) applied, based on the methodology outlined in existing guidance and reproduced in Appendix 6.5.

No.	Existing Environment	Significance	Sensitivity	Existing Environment Significance / Sensitivity Rating (H/M/L/N)
1	Locally important bedrock aquifer	The limestone bedrock aquifer underlying the site is part of the Limerick City East GWB	The GWB is classified as being Good 2013-2018 under the WFD	**Medium – Attribute has a medium quality or value on a local scale**
2	Shannon River SAC / River Shannon and River Fergus SPA	The SPA is downstream of the Lower River Shannon SAC.	Park Canal is at height in relation to site and not expected to be in continuity with groundwater. A large area of wetland habitat is located to the north of the canal.	**High – Attribute has a high quality or value on a local scale**
3	Groundwater supply wells	The industrial wells are not associated with a groundwater drinking water source protection area.	Nearest well located c. 0.4 km from the site. No groundwater lowering / abstraction required as part of the proposed development .	**Low - Attribute has a low quality or value on a local scale**

Table 6.4 Existing Environment – Significance and Sensitivity / Importance

6.5 CHARACTERISTICS OF PROPOSED DEVELOPMENT

The proposed development consists of the construction of residential dwellings with and without private gardens, commercial properties, surface car parking and landscaped areas. The construction plan does not involve any excavations for basements. It is expected the redevelopment of the site will involve importing soils to raise levels on the site. The proposed development includes the demolition of the existing 530m^2 warehouse building on site.

6.6 POTENTIAL IMPACTS

6.6.1 Construction Stage Impacts (No Mitigation)

In the context of the proposed development, the construction stage in this case is taken to be the preparation of the site including demolition of the warehouse building on site and construction of the mixed use development, as well as the ancillary works.

Direct Impacts

During demolition of the warehouse building and construction of the mixed use development at the site, there is a risk of pollution of groundwater in the limestone bedrock and the supply wells, from the following potential sources in absence of mitigation:

accidental spillage of fuels and lubricants by construction plant during demolition of the warehouse building and construction of the development, with the potential for contaminated run-off entering the limestone aquifer.

increase in suspended solids and potential for run-off with suspended solids entering the limestone aquifer.

The significance of the identified potential impacts is assessed in Table 6.5 below**.** The limestone aquifer will be protected by the presence of overburden, with 2.5 – 7.7m of subsoils confirmed at the site.

Indirect Impacts

The potential risks detailed above could in turn have an indirect impact on the wetland habitat / Shannon River SAC. Any impact on the Shannon River SAC could also impact on the River Shannon and River Fergus SPA, located downstream of the Lower River Shannon SAC.

6.6.2 Operational Stage Impacts (No Mitigation)

The operational stage is taken to comprise the residential dwelling, commercial properties, surface car parking and landscaped areas. The site will be completed with designed capping layer, paved surfaces, engineered surface water and foul drainage including hydrocarbon interceptor all in place. In addition, the limestone aquifer will continue to be protected by the proposed capping layer and the presence of overburden, with 2.5 – 7.7m of subsoils confirmed at the site.

Direct Impacts

Due to the presence of the capping layer, paved surfaces and drainage, the potential risk of groundwater pollution described above during the construction phase will be minimised during the operational stage.

The significance of the identified potential impacts is assessed in Table 6.5 below**.**

Indirect Impacts

Any impact on the bedrock aquifer could have an indirect impact on the wetland habitat / Shannon River SAC and the River Shannon and River Fergus SPA, located downstream of the Lower River Shannon SAC.

6.6.3 Significance of Potential Impacts (Unmitigated)

A summary of potential impacts without mitigation is presented in Table 6.5 below. As outlined in Table 6.4 above, Shannon River SAC / River Shannon and River Fergus SPA has a significance and sensitivity / importance rated as "**high"**. The locally important aquifer receptor is rated as "**medium**" and local groundwater well supplies are rated at **"low"**.

No.	**Identified Potential Impact**	**Description of Impact** **(No Mitigation)**	**Significance of Impact** **(No Mitigation)**
Construction Stage – Direct			
1	Impact on groundwater in bedrock aquifer from accidental fuel leakage/ spillage	**Medium - Low** Potential to affect groundwater quality in underlying bedrock aquifer through vertical migration. Impact to groundwater is unlikely due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume. The limestone aquifer will be protected by the presence of overburden.	**Moderate - Slight**
2	Impact on groundwater in bedrock aquifer from increased suspended solids	**Low** - Potential to affect groundwater quality in underlying bedrock aquifer through vertical migration. Impact to groundwater is unlikely due to short term nature of works. The limestone aquifer will be protected by the presence of overburden.	**Slight**
3	Impact on groundwater quality on local groundwater supply wells from accidental fuel leakage/ spillage	**Low** - Potential to affect groundwater quality in local groundwater supply wells through vertical migration followed by lateral migration. Impact is unlikely due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume. The limestone aquifer will be protected by the presence of overburden.	**Not Significant**
4	Impact on groundwater quality on local groundwater supply wells from increased suspended solids	**Negligible** - Potential to affect groundwater quality in local groundwater supply wells through vertical migration followed by lateral migration. Impact to groundwater is highly unlikely due to	**Imperceptible**

No.	Identified Potential Impact	Description of Impact (No Mitigation)	Significance of Impact (No Mitigation)
		short term nature of the works. The limestone aquifer will be protected by the presence of overburden.	
Construction Stage – Indirect			
5	Impact on groundwater in bedrock aquifer and, in turn, Shannon River SAC from accidental fuel leakage/ spillage	**Low – Negligible** Potential to affect groundwater quality in underlying bedrock aquifer through vertical migration. Impact to groundwater is unlikely due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume. The limestone aquifer will be protected by the presence of overburden. **There is no direct pathway to the Shannon River SAC.**	**Slight – Not Significant**
6	Impact on groundwater in bedrock aquifer and, in turn, Shannon River SAC / River Shannon from increased suspended solids	**Low – Negligible** Potential to affect groundwater quality in underlying bedrock aquifer through vertical migration. Impact to groundwater is unlikely due to short term nature of works. The limestone aquifer will be protected by the presence of overburden. **There is no direct pathway to the Shannon River SAC.**	**Slight – Not Significant**
7	Impact on water quality in the River Shannon and River Fergus SPA	**Negligible** – Any impact on the Shannon River SAC could have an indirect impact on the River Shannon and River Fergus SPA, located downstream of the Lower River Shannon SAC. However, there is no direct pathway to the Shannon River SAC..	**Imperceptible**
Operation Stage – Direct			

No.	**Identified Potential Impact**	**Description of Impact** **(No Mitigation)**	**Significance of Impact** **(No Mitigation)**
8	Impact on groundwater in bedrock aquifer and, in turn, Shannon River SAC / River Shannon and River Fergus SPA.	**Negligible** Potential to affect groundwater quality in underlying bedrock aquifer through vertical migration. Impact to groundwater is unlikely due to site being fully developed with designed capping layer; engineered surface water management and foul water drainage systems (including hydrocarbon interceptor). In additional, the limestone aquifer will continue to be protected by the presence of overburden.	**Imperceptible**
9	Impact on groundwater quality on local groundwater supply wells	**Negligible** - Potential to affect groundwater quality in local groundwater supply wells through vertical migration followed by lateral migration. Impact to groundwater is unlikely due to site being fully developed with designed capping layer; engineered surface water management and foul water drainage systems (including hydrocarbon interceptor). In additional, the limestone aquifer will continue to be protected by the presence of overburden.	**Imperceptible**
Operation Stage – Indirect			
10	Impact on water quality in the River Shannon and River Fergus SPA	**Negligible** – Any impact on the Shannon River SAC could have an indirect impact on the River Shannon and River Fergus SPA, located downstream of the Lower River Shannon SAC. However, there is no direct pathway to the Shannon River SAC and the potential impact on the SAC is "slight".	**Imperceptible**

Table 6.5 Classification of Significance of Impacts (No Mitigation)

Table 6.5 indicates that if no mitigation measures are applied during the proposed development, there is potential for the activity to increase the risk of pollution to groundwater quality.

6.6.4 Potential Cumulative Impacts

Given the scale of the proposed development, it is not likely to give rise to any significant effects cumulatively or, in combination with, other developments in the area.

6.6.5 'Do-nothing Scenario'

If the proposed development did not proceed there would be no impact on the existing soils or hydrogeology of the site. It is envisaged that the land use would remain mostly vacant, with the steel frame warehouse present in the eastern part of the site.

6.7 MITIGATION

Mitigation and management measures incorporated into the proposed development will reduce the significance of potential impacts associated with the proposed development to **not significant** or lower to land, soils (& geology), and hydrogeology (groundwater)are identified.

These measures are detailed in the Construction Environmental and Waste Management Plan (PHM, 2021) and the Civil Engineering Report (PHM, 2021) and Environmental Due Diligence Report (Verde, 2021) that form part of the overall application documentation for the proposed development.

During the Construction Stage, the following Best Management Practices (BMPs) and Waste and Materials Pollution Control (WM) procedures will apply:

- WM-3 Stockpile Control;
- WM-4 Spill Prevention and Control, and;
- WM-7 Contaminated Soil Management;
- Water Pollution Control Best Management Practices (BMPs);
- Temporary Soil Stabilisation BMPs;
- Non Storm Water Management BMPs, and;
- Waste Management and Materials Pollution Control.

During the Operational Stage, the following will be in place:

- Engineered capping layer;
- Surface water collection and management system (including attenuation and hydrocarbon interceptor).

The Construction Environmental and Waste Management Plan (PHM, 2021) notes that the employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off or groundwater. The Construction Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and management of water pollution from construction sites, Control of Water Pollution from Construction Sites, guidance for consultants and contractors (Masters-Williams et al 2001). The guide is written for project promoters, design engineers and site and construction managers. It addresses the main causes of pollution of soil, groundwater and surface waters from construction sites and describes the protection measures required to prevent pollution of groundwater and surface waters and the emergency response procedures to be put in place so that any pollution, which occurs, can be remedied. The guide addresses developments on green field and potentially contaminated brownfield sites.

The construction management of the site will take account of the recommendations of the CIRIA guidance to minimise as far as possible the risk of soil, groundwater and surface water contamination. Site activities considered in the guidance note include the following:

- excavation
- earthmoving
- concreting operations

Additional specific guidance is provided in the CIRIA technical guidance on Control of Water Pollution from Linear Construction Projects (Murnane et al 2006). Surface run-off from wheel washing areas can contain pollutants such as:

- detergents
- oil and fuel
- suspended solids
- grease

Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters include:

- Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded.
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.
- Where at all possible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together.
- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access.
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land.
- Minimise the use of cleaning chemicals.
- Use trigger-operated spray guns, with automatic water-supply cut-off.
- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt.
- Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference.
- The above measures will be implemented, as appropriate along with the following site specific measures:
- Fuel, oil and chemical storage on site will be secure.
- Site storage will be on an impervious base within a secondary containment system such as a bund.
- A spill kit with sand, earth or commercial products that are approved for the stored materials will be kept close to the storage area. Staff will be trained on how to use spill kits correctly.
- Damaged, leaking or empty drums will be removed from site immediately and disposed of via a registered waste disposal contractor.
- Mobile plant will be refuelled in a designated area, on an impermeable base away from drains or watercourses.
- A wheel wash will be installed for use by all construction vehicles leaving site.

- A road sweeper will be used to remove dirt and debris from roads.
- Silt traps will be located around the site to collect run off, with settled solids removed regularly and water recycled and reused where possible.
- A filter drain and silt pits will be located at the base of all embankments, settled solids will be removed from the silt pits regularly.
- A bypass petrol interceptor will be installed in the car park drainage network prior to connection to the existing drainage network to prevent any hydrocarbon spills from entering the surrounding drainage network.

The Verde Due Diligence report outlines the following measures to be employed on site, which relates to land, soils and hydrogeology:

- Where off-site disposal of contaminated soils (waste) is required, all lorry loads will be sheeted once loaded and before leaving site to reduce dust generation. Provision will be made for washing vehicles' wheels at the site entrance to prevent any mud being deposited on local roads, and;
- Any stockpiles, compounds and treatment areas will be positioned so as to minimise impact on neighbouring properties. In particular any stock piles containing contaminated soils will be placed on an impermeable surface while awaiting the results of validation testing. The stockpiles will be sheeted to minimise dust emissions and also to minimise the potential for leaching rainwater and run off contaminating clean areas.

6.7.1 Assessment of Impacts with Mitigation Measures in Place

With the above mitigation measures in place at the application site, it is predicted that the following reduction in the assessed significance of impacts will result:

- Reduction of the potential impacts listed below from **Slight – Moderate** to **Slight**.
- Impact on groundwater in bedrock aquifer from accidental fuel leakage/ spillage during the construction stage (impact no. 1).
- All other potential impacts will be reduced to **Not Significant** or **Negligible**.

6.8 PREDICTED IMPACTS

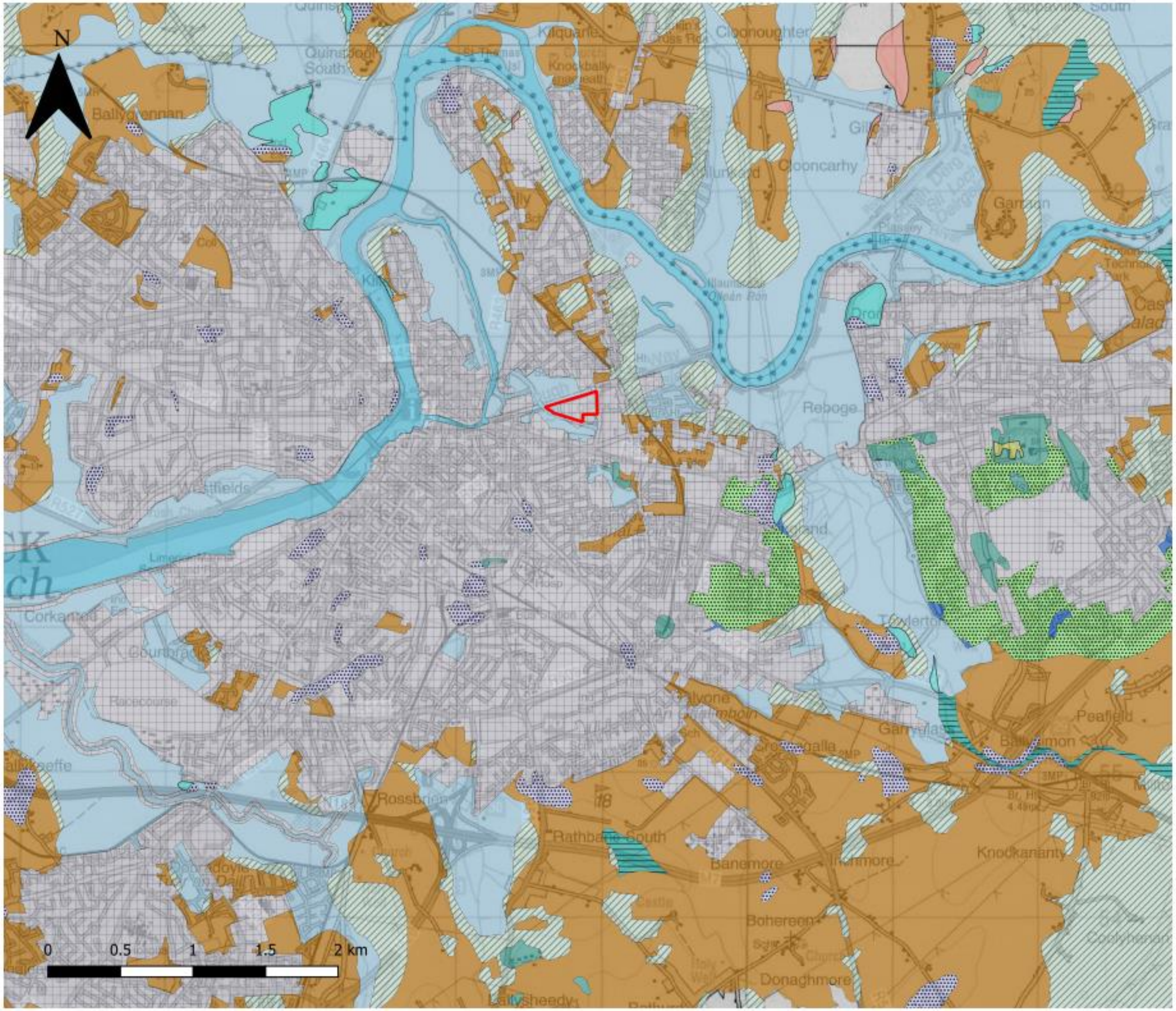
6.8.1 Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to land, soils (& geology) and hydrogeology (groundwater) during the construction stage.

6.8.2 Operational Stage

Examination of the identified potential impacts on the receiving environment indicates there are no significant residual impacts with respect to land, soils (& geology) and hydrogeology (groundwater) during the operational stage of the proposed development.

Figure 6.1 Teagasc Soil Map



NOTES

Soils data © Teagasc
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LEGEND

🟥	Proposed Planning Application Area
▦	Made Ground
▨	Marine Sediments
🟫	Grey Brown Podzolics and Brown Earths
🟩	Acid Brown Earths & Podzolics
▨	Lithosols & Regosols
▨	Surface & Ground Water Gleys
▨	Water

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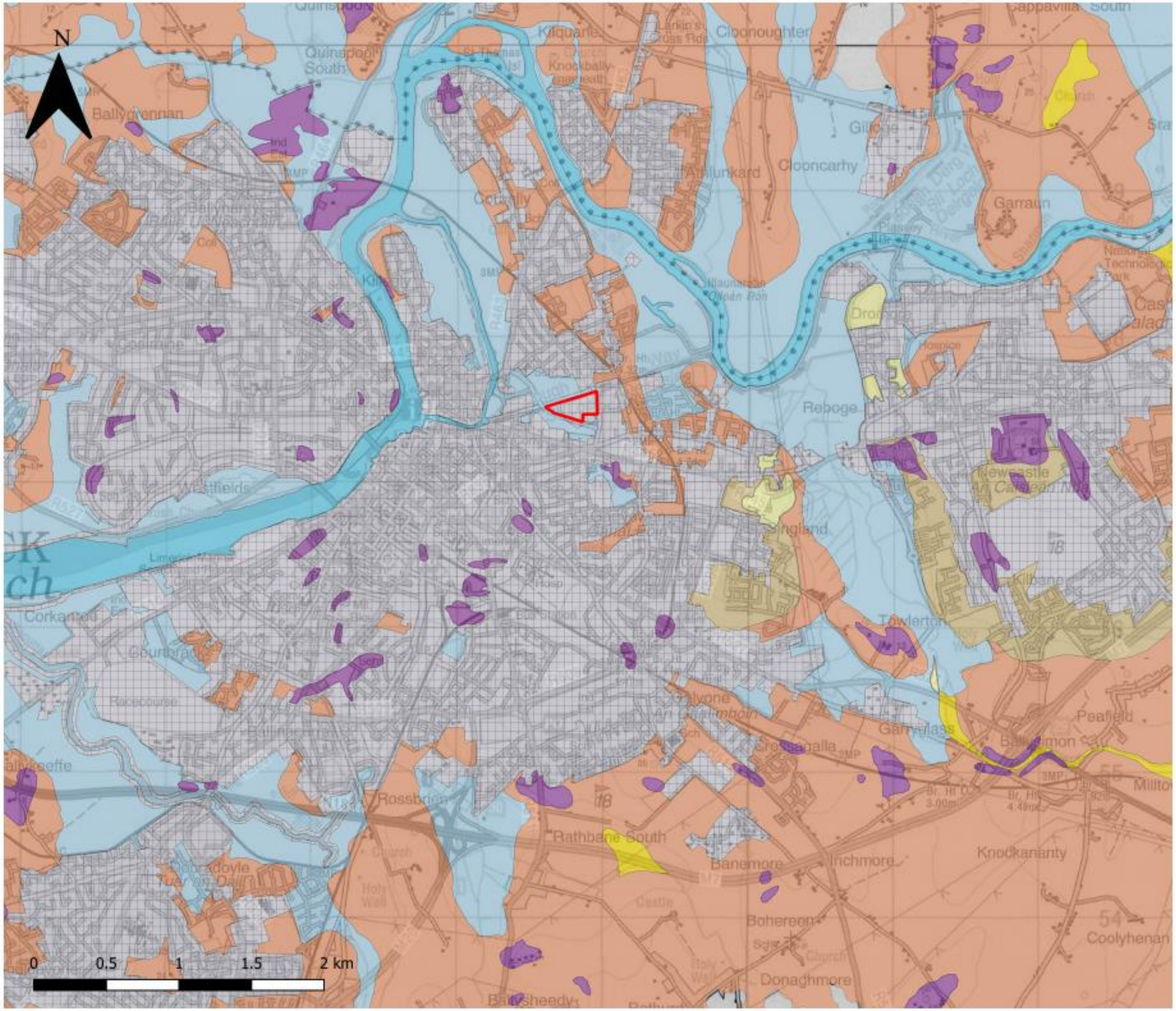
TEAGASC SOILS MAP

FIGURE 6-1

Scale	Date
1:25,000 @ A3	NOVEMBER 2021

Figure 6.2 Subsoils Map



NOTES

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LEGEND

— Proposed Planning Application Area

🟨 Alluvium
🟨 Gravels derived from Limestone
▦ Made Ground
🟦 Marine/Esturarine Sediments
🟪 Rck
🟫 Till derived from Basic Igneous Rock
🟧 Till derived from Limestone
🟦 Water

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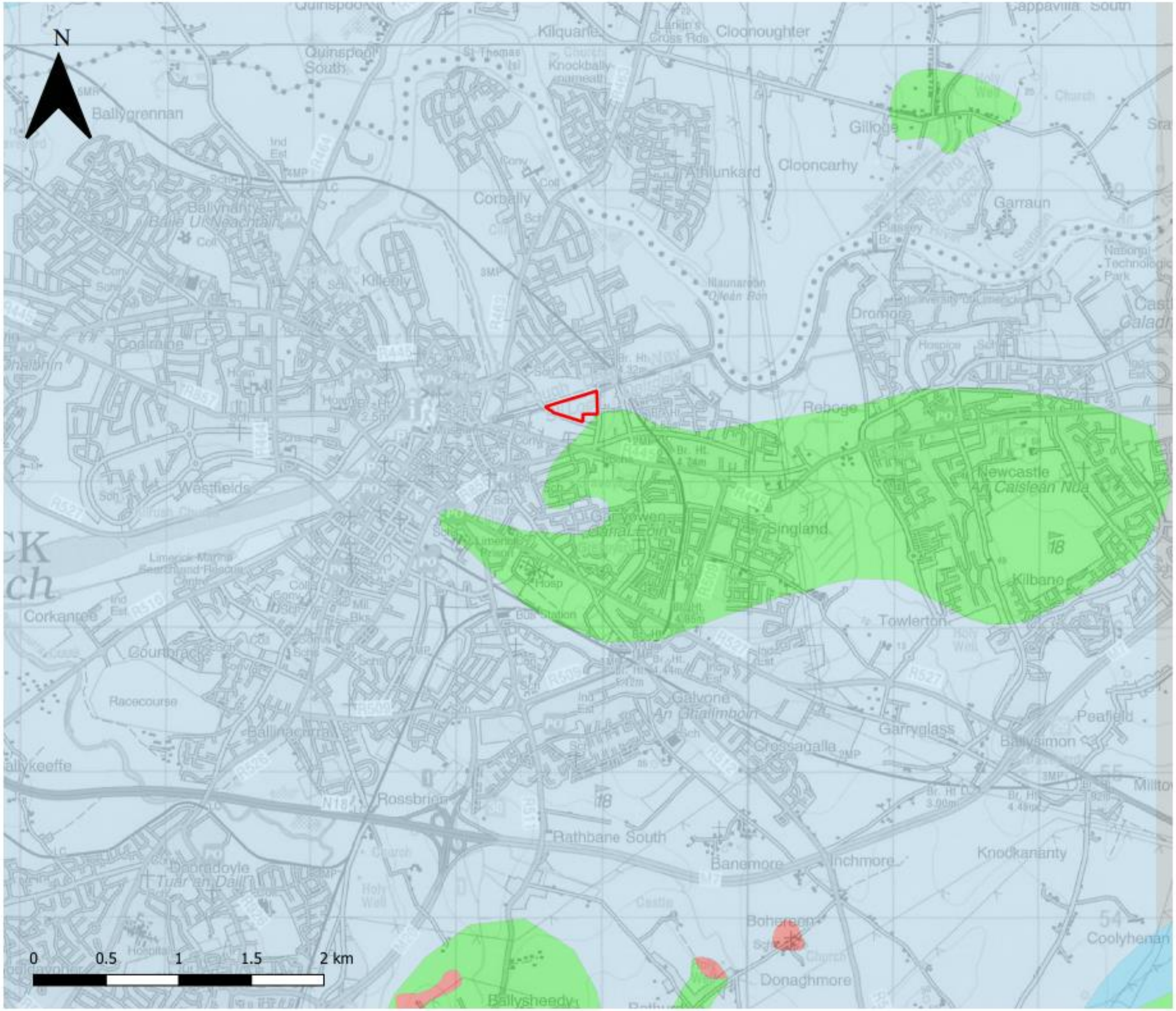
TEAGASC SUBSOILS MAP

FIGURE 6-2

Scale
1:25,000 @ A3

Date
NOVEMBER 2021

Figure 6-3 Bedrock Geology Map



NOTES

Bedrock Geology data © Geological Survey of Ireland
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LEGEND

—	Proposed Planning Application Area
🟥	Basalt
🟦	Lough Gur Formation
⬜	Rathkeale Formation
⬜	Visean Limestones (undifferentiated)
🟩	Volcaniclastic Rocks
🟦	Waulsortian Limestones

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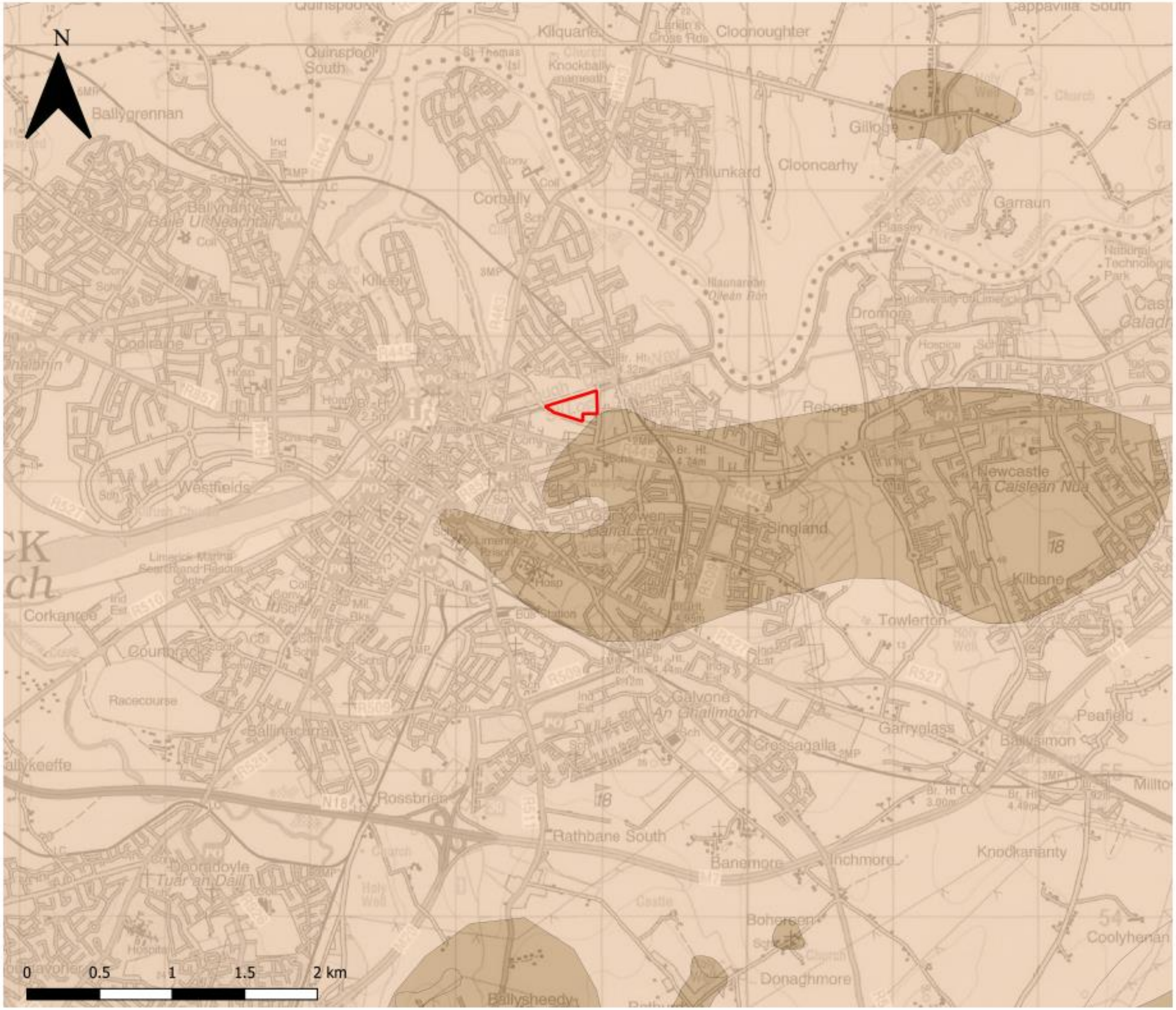
BEDROCK GEOLOGY MAP

FIGURE 6-3

Scale
1:25,000 @ A3

Date
NOVEMBER 2021

Figure 6.4 Bedrock Aquifers Map



NOTES

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LEGEND

— Proposed Planning Application Area

▢ Locally Important Aquifer - Bedrock Generally Moderately Productive

▨ Locally Important Aquifer - Bedrock Moderately Productive only in Local Zones

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AQUIFER MAP

FIGURE 6-4

Scale	Date
1:25,000 @ A3	NOVEMBER 2021

Figure 6.5 GSI Well Locations

NOTES

Well data © Geological Survey of Ireland
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LEGEND

— Proposed Planning Application Area

● GSI Groundwater Supply Well

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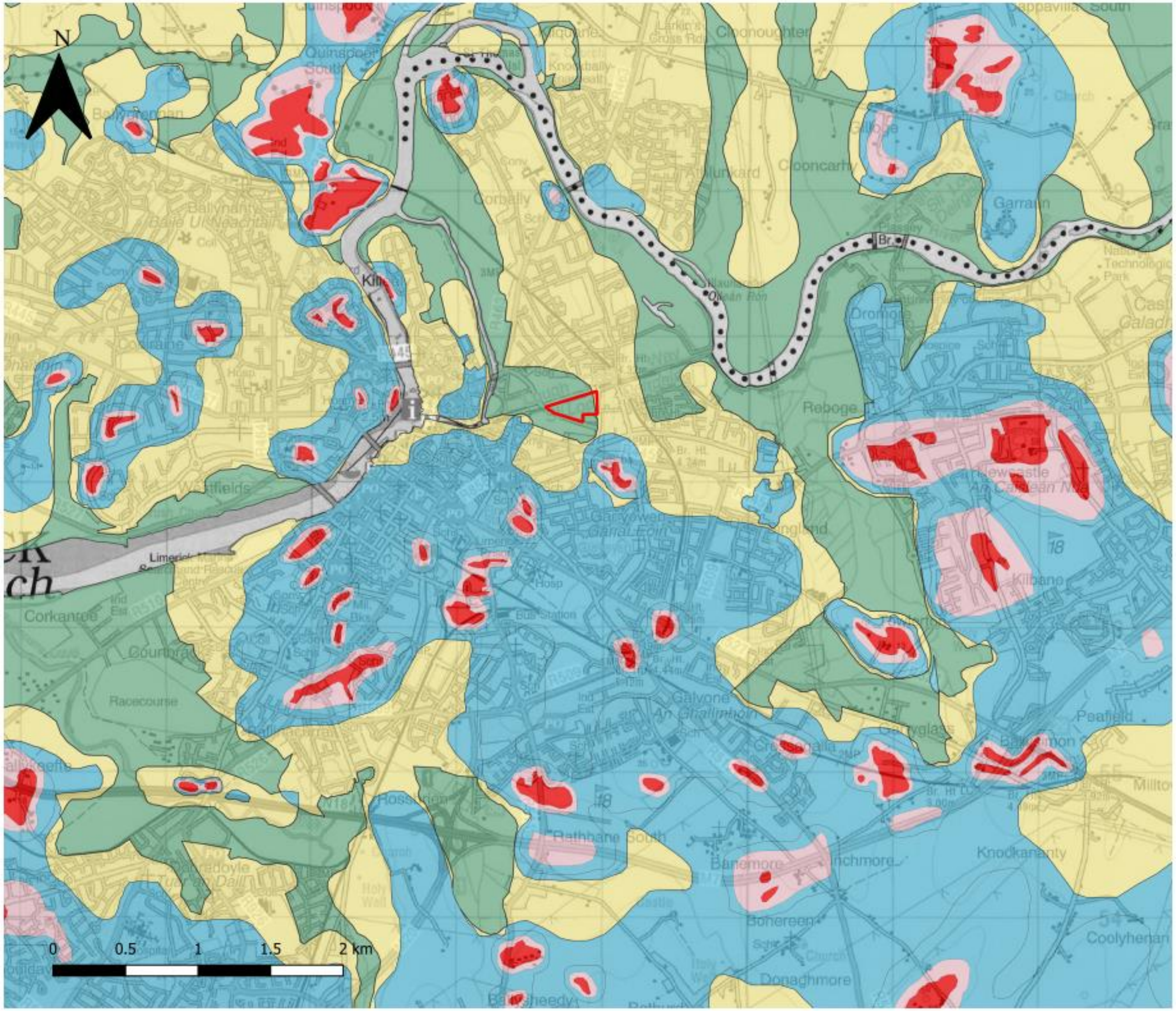
GROUNDWATER SUPPLY WELLS (GSI)

FIGURE 6-5

Scale	Date
1:25,000 @ A3	NOVEMBER 2021

Figure 6.6 Groundwater Vulnerability Map



NOTES

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LEGEND

— Proposed Planning Application Area
🟥 Rock at or near surface or karst
▨ Extreme Vulnerability
🟦 High Vulnerability
🟨 Moderate Vulnerability
🟩 Low Vulnerability

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GROUNDWATER VULNERABILITY MAP

FIGURE 6-6

Scale
1:25,000 @ A3

Date
NOVEMBER 2021

7.0 WATER AND HYDROLOGY

7.1 INTRODUCTION

SLR Consulting Ireland (SLR) was requested to undertake a surface water (hydrology) assessment of the site and proposed development at the Canal Bank site on Pa Healy Road, Limerick. This Chapter was prepared by Dominica Baird (CGeol) of SLR Consulting. Dominica is a Chartered Hydrogeologist with twenty years' consultancy experience. Dominica has practised hydrogeology, groundwater risk assessment and contaminated land in London, Edinburgh and Dublin and leads groundwater monitoring, water resources and due diligence projects. Key competencies include hydrogeological assessments and aquifer characterisation, developing conceptual site models, quantitative and qualitative groundwater risk assessments and groundwater investigations. Has presented findings of hydrogeological assessments at oral hearings and prepared briefs of evidence. Dominica has project managed numerous water sections for EIARs, which included assessment of potential impacts on the water environment.

This chapter of the EIAR provides a description of the surface water conditions in the application area within the context of the Site and regional setting and assesses the potential impacts that the proposed development will have on surface water. Mitigation measures are proposed, where required.

Available information on the hydrology and hydrogeology of the Canal Bank area and its surrounds was collated and evaluated. See Chapter 3: Description of Proposed Development for details of the site and a detailed description of the proposed development.

Unmitigated potential impacts on surface water are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed, and then the identified potential impacts are reassessed assuming mitigation measures are in place to identify predicted impacts.

The site is located within the urban environment of Limerick City and is bound to the north by Park Canal and associated walkway/cycle path, to the west and south by Pa Healy Road and to the east by Park Road. There are two commercial properties along the east of the site comprising of large warehouses, one warehouse is included within the site. The site, and the surrounding area, have a relatively flat topography.

7.2 METHODOLOGY

Available information on the surface water and hydrology of the Canal Bank site and its surrounding area was collated and evaluated. The scope of this section includes:

- An assessment of the surface water conditions at and close to the site;

- An assessment of the impact of the development on surface water conditions; and
- Recommendations for measures to reduce or eliminate any potential impacts on the surface water identified from the assessment.

The methodology used follows the guidelines and advice notes provided by the Environmental Protection Agency on environmental impact assessments and with due regard to the guidelines published by Transport Infrastructure Ireland (TII) the Institute of Geologists of Ireland's (IGI) in 2013.

The methodology involved in the assessment of the surface water at the application site can be summarised as follows:

- A desk study in which existing data and relevant regional data sources for the site and surrounding area were examined;
- Assessment of site specific technical reports including:
- Site specific Flood Risk Assessment for the proposed development, Pa Healy Road Flood Risk Assessment Report - Technical Report, JBA November 2021;
- Phase 2 Environmental Due Diligence Report, Canal Bank Project, Verde, Updated October 2021;
- Civil Engineering Report, PHM Consulting, 2021;
- Construction, Environmental & Waste Management Plan, PHM Consulting, 2021.
- Surface water sampling undertaken by Verde as part of their site due diligence; and
- An analysis of the information gathered.

The desk study involved the examination of several datasets to determine the geological and hydrogeological setting of the area, as detailed in Table 7.1 below.

Data	Dataset
Surface Water	OSi Discovery Series mapping; Environmental Protection Agency; Water Framework Directive; and Current County Development Plan.
Flooding	Office of Public Works Flood Mapping
Climate	Met Eireann
Protected Areas, Environmental Pressures	Environmental Protection Agency, National Parks and Wildlife Service

Table 7.1 Regional Data Sources

7.3 REGULATORY BACKGROUND

7.3.1 Legislation

The key European Directives / European Union Legislation which apply to this Chapter of the EIAR and the surface water assessment presented herein are:

- Environmental Impact Assessment Directive (2011/92/EU); and
- Directive of the European Parliament and of the Council amending Directive 2011/92/EU on assessment of effects of certain public and private projects on the environment (2014/52/EU).
- Other European Directives to which this EIAR makes reference, or has had regard, are listed in Appendix 7.1.
- Irish Government Acts, National Legislation and Regulations which apply to this Chapter of the EIAR and the assessment presented herein are also listed in Appendix 7.1.

7.3.2 Planning Policy and Development Control

There are no planning policy and development control regulations that specifically apply to this surface water assessment.

7.3.3 Guidelines and Technical Standards

The following key guidelines apply to this assessment:

- National Roads Authority, 2008 (now TII). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and
- The Planning System and Flood Risk Management: Guidelines for Planning Authorities, November 2009, OPW and DEHLG.

7.4 RECEIVING ENVIRONMENT

7.4.1 Study Area

For the purposes of this assessment, the study area comprises the application site the surrounding area up to 2 km radius around the site boundary, this is in line with the Institute of Geologists of Ireland's (IGI) guidelines (2013). Unmitigated potential impacts on water and hydrology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed. The identified potential impacts are then re-assessed assuming the identified mitigation measures in place.

7.4.2 Topography, Physical Features, and Land-use

The proposed development will consist of a 4 ha. area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick. The site is mostly vacant; however there is a steel frame warehouse present in the eastern part of the site. The central part is occupied by remaining structures of former storage yard. The northern edge of the site, along the Park Canal is overgrown with semi-mature trees. The central-western portion of the site is overgrown with young trees and bushes. There are several small stockpiles present on site comprising mainly of demolition material including concrete and brick.

The northern part of the site is at 5 mOD to 5.5 mOD, the top of the canal bank between the site and the Park Canal is at c. 5.94 mOD, while the canal surface water level is at c. 2.6 mOD.

The Park Canal is an engineered watercourse and will have been lined with impermeable material, soils / clay in order to prevent any leakage and loss of water.

The Limerick Main Drainage System foul sewer traverses the site along its northern edge parallel with the Canal and comprises a 1000 mm diameter sewer with access chambers provided within the site. There is an existing Wayleave over the sewer and this will be preserved with no structures proposed within the said wayleave.

Currently the entrance to the site is from Park Road to the concrete yard in front of the warehouse. The warehouse is utilised by the neighbouring furniture fitting company to store the materials. The historic use of the warehouse is unknown, however the recent asbestos survey of the warehouse reviled a presence of a cold room within the building. The warehouse area is separated from the rest of the site by chain link fence and metal gate. The entrance from the Pa Healy Road is currently blocked with a mound of soil and Kelly blocks.

The topography of the site is currently generally flat with a slight gradient towards the west. The site topography is expected to be significantly altered by historic deposition of various type of fill material.

7.4.3 Surface Water - Hydrology

7.4.3.1 Surface water

The existing site surface water drainage comprises of road gullies located on the open yard in front of the warehouse building. No surface water drainage was observed in the remaining portion of the site according to the Verde due diligence report; therefore, storm runoff across the remainder of the site must percolate to the ground.

The Park Canal runs along the northern boundary of the site and the surface water level of the canal is at c. 2.6 mOD. The Park canal connects the Abbey River to the River Shannon at its western end. The Abbey River is located approximately 580 m to the west of the site and flows in a southerly direction joining the River Shannon Lower approximately 1.1km to the west of the site.

The site is located in the Lower Shannon catchment, Water Framework Directive (WFD) catchment ID 25D.

The River Shannon and Abbey River to the west of the site are tidal waters and are classified as Transitional Waters under the WFD.

7.4.3.2 Surface water quality

Surface water sampling in the adjacent Park Canal was carried out by Verde as part of the site due diligence; two surface water samples were taken from the canal on the 21st January 2019, one up gradient of the site and one down gradient of the site in the canal waterbody. The water levels were retested in late 2021.

The water samples were obtained from the canal with a telescopic sampling pole. Water samples taken were then placed into laboratory supplied containers and stored at less than 9°C prior to dispatch to the laboratory for analysis. The surface water samples were tested for the following water quality parameters:

- Heavy Metals;
- Anions;
- Speciated Total Petroleum Hydrocarbons (TPH-CWG);
- MTBE & BTEX;
- Free and Total Cyanide;
- Polyaromatic hydrocarbons (PAHs);
- Volatile Organic Compounds - including Tentatively Identified Compounds (TICs);
- Semi-volatile Organic Compounds - including Tentatively Identified Compounds (TICs);
- Total Alkalinity;
- Chemical Oxygen Demand (COD);
- pH;
- Electrical Conductivity; and
- Total Organic Carbon (TOC).

The Verde report assessed the water quality results against the Inland Surface Water Regulations for water quality (Environmental Quality Standards – SI No. 272 of 2009 & SI No. 386, 2015) due to the proximity of the Park Canal, Abbey River and Lower River Shannon to the site.

A summary of the surface water quality results is presented in Table 7.2 below and the results are screened in Appendix 7.2 against the Surface Water EQS.

SW Parameter	Assessment
Metals	No elevated metals were reported in both surface water samples taken from the Park Canal.
Anions	Analysed anions included sulphate, chloride, nitrite, nitrate, ammonia, ortho phosphate, free & total cyanide and sulphide. Currently there are no available standards for concentrations of these parameters in the surface waters. A comparison of concentrations of above parameters in the upstream and downstream locations show that there is no significant change between the reported concentrations in both locations
Speciated Total Petroleum Hydrocarbons (TPH-CWG)	No elevated hydrocarbon concentrations were reported in both samples obtained from the Park Canal with all the concentrations reported below the LOD.
MTBE & BTEX	In all analysed surface water MTBE and BTEX compounds were reported below the LOD and available standards.
Polyaromatic hydrocarbons (PAHs)	Bothe surface water samples were free of PAH contamination with the reported concentrations below the LOD and all available standards.
Volatile Organic Compounds (VOCs)	All concentrations of VOCs were reported in both surface water samples below the LOD and available standards.
Semi Volatile Organic Compounds (SVOCs)	All concentrations of SVOCs were reported in both analysed surface water samples below the LOD and available standards.
Other Parameters	Total Alkalinity parameter analysed in the surface water samples on site ranged slightly between 164mg/l and 166mg/l. Chemical Oxygen Demand ranged between 22mg/l and 24mg/l The surface water pH measured on site ranged between 7.47 and 7.64, which is within acceptable range for surface water The electrical conductivity (EC) ranged between 395 µS/cm and 425µS/cm. Total Organic Carbon reported in surface water samples ranged between 9 mg/l and 10 mg/l.

Table 7.2 Summary Assessment of Surface Water Quality Results for the Park Canal

The Verde site due diligence report concluded that no contamination has been identified in surface water samples taken from The Park Canal. The site and the canal are not considered to be hydrologically connected as the surface water level in the canal is c. 0.8m above the groundwater level recorded at the site and the groundwater strikes were deeper in the underlying bedrock, refer to Chapter 6 of this EIAR for discussion on groundwater.

7.4.3.3 Site Flood Risk

A site-specific Flood Risk Assessment (FRA) was undertaken by JBA for the proposed development at Canal Bank and submitted under a separate cover with this application.

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) the proposed development must undergo a FRA to ensure sustainability and effective management of flood risk at the site; this requires a review of all available flood information and assessment of Flood Zones for the development site as part of the FRA.

The level of flood risk to the proposed site is assessed as part of the FRA. The assessment aims to identify, quantify and communicate to the Planning Authority and other stakeholders the risk of flooding to land, property and people at the site and the measures required to manage the risk. The objectives of the FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk in adjacent areas; and
- Develop appropriate flood risk mitigation and management measures which will allow for development of the site.

The JBA FRA report covers the following detail for the site and flood risk and includes:

- an overview of the site, its location, proposed development and relevant watercourses;
- information on flood history and identifies flood risk at the site;
- a discussion of flood risk mitigation and the impacts associated with development;
- the Justification Test is provided; and
- conclusions.

Aspects of the proposed development are considered as highly vulnerable to the impacts of flooding and are located within Flood Zone A/B. Therefore, under the planning guidelines the Justification Test (JT) must be applied and passed in order to satisfy the Guidelines.

The JT for the proposed development was undertaken by JBA. The JT was applied, and the proposed development passed the test.

7.4.3.4 Site Drainage

The Verde Due Diligence Report states that according to service maps received from the client a line of Limerick Main Drainage (LMD) Sewer is located along the northern site boundary. The line of the sewer was confirmed by Verde during the site walkover when three sets of manholes were observed over the sewer line along the northern boundary.

7.4.4 Protected Areas

Protected areas near the site have been identified in the Biodiversity chapter of this EIAR and are included below in Table 7.3 with details of the distance from the site and surface water pathways from the site.

Protected area	Location in relation to application site	Pathway from application site
Lower River Shannon SAC (site code 002165)	Adjacent	Site surface water discharge directly to canal and adjacent SAC
River Shannon and River Fergus Estuaries SPA (site code 004077)	c. 1.6 km southwest	Site surface water discharge via adjacent canal and SAC
Fergus Estuary and Inner Shannon, North Shore pNHA	c. 0.8 km to the west	Site surface water discharge via adjacent canal and SAC

Table 7.3 Protected Areas Assessment

7.4.5 Sensitive Receptors

Arising out of the baseline study therefore, the following sensitive surface water receptors have been identified:

- Park Canal;
- Lower River Shannon SAC;
- River Shannon and River Fergus Estuaries SPA; and
- Fergus Estuary and Inner Shannon, North Shore pNHA

For each identified receptor, the significance and sensitivity of the receptor is assessed in Table 7.4 below and a rating (High / Medium / Low / Negligible) applied, based on the methodology outlined in existing guidance and reproduced in Appendix 7.5.

No.	Existing Environment	Significance	Sensitivity	Existing Environment Significance / Sensitivity Rating (H/M/L/N)
1	Park Canal	International - Part of Lr. R. Shannon SAC	Sensitive to changes in water quality and flows	**Extremely High.** Attribute has an extremely high quality or value on an international scale
2	Lower River Shannon SAC	International	Sensitive to changes in water quality and flows	**Extremely High.** Attribute has an extremely high quality or value on an international scale
3	River Shannon and River Fergus Estuaries SPA	International	Sensitive to changes in water quality and flows	**Extremely High.** Attribute has an extremely high quality or value on an international scale
4	Fergus Estuary and Inner Shannon, North Shore pNHA	National	Sensitive to changes in water quality and flows	**Very High.** Attribute has a very high quality or value on a regional or national scale

Table 7.4 Existing Environment – Significance and Sensitivity / Importance

7.5 CHARACTERISTICS OF PROPOSED DEVELOPMENT

PHM Consulting provide engineering design solutions for the proposed strategic housing development. The engineering design included for:

- Roads;
- Foul Drainage and disposal to public mains sewer;
- Storm surface water management (collection, attenuation and discharge); and
- Water supply connection to public mains and internal network.

This section of the EIAR deals with the storm surface water aspects of the proposed development.

7.5.1 Storm Water Management

It is proposed that all generated storm waters from the development will be collected via a dedicated stormwater gravity network and discharged to the adjacent Park Canal along the northern side of the site, see Appendix 7.3.

Storm water at the site will be managed through the implementation of Sustainable Drainage System (SuDS) measures at the site. The site SuDS measures for the management of storm water include:

- Storm water detention / attenuation on site for the 1:100 Annual Exceedance Probability (AEP) storm rainfall event;

- Discharge to the Park Canal at a maximum greenfield runoff rate of 2 l/s/ha.;
- Provision of a hydrobrake to control the runoff rate;
- Hydrocarbon bypass separator to treat the storm water; and
- Provision of grit traps on all road gulley's at the site.

Storm surface water from the site will be discharged through a precast concrete headwall to the Park Canal. The outfall level will be set above the surveyed water level of the canal to reduce potential surcharging from the canal; it is proposed to provide a backflow prevention valve devise which is fitted within the outfall pipe to prevent surcharging of the site drainage network.

Details of the proposed site Storm Water Management System including the rational behind the design, details of SuDS measures and drainage calculations from the site Civil Engineering Report are included in Appendix 7.4.

7.5.2 Site Flood Risk and Finished Floor Levels

The Finished Floor Levels (FFL) of the buildings at the site have been set based on the recommendations from the site flood risk assessment.

The final FFL for all buildings with highly vulnerable use (i.e. residential land use) is recommended to be a minimum of 5.75mOD. This level is based on the 0.5% tidal level of 4.75mOD plus 0.5m for climate change and an additional 0.5m allowance for freeboard. Setting the buildings at this level (or above) will ensure they are appropriately mitigated for potential future flood events and will also ensure they are at low residual risk of flooding from canal breach/overtopping.

Less vulnerable land uses at the site, namely café & retail will be set at a minimum of 4.8mOD, which is 0.05m above the 0.2% AEP tidal level. These land uses are set closer to the levels on the adjacent Pa Healy Road to fit into the urban landscape.

The levels for the landscaping / open space and car parking areas at the site will be kept at grade as far as possible.

The proposed building Finished Floor Levels (FFL) as per the FRA report are shown in Table 7.5 below and also on the final site layout drawing provided in October 2021, as submitted under a separate cover.

Building	Proposed Building FFL
Block 1 (student accommodation)	5.75 mOD
Block 2	6.0 mOD

Block 3	6.0 mOD
Community Facilities	6.1 mOD
Block 4	6.2 mOD
Block 5	6.3 mOD
Block 6	6.4 mOD
Block 7	6.5 mOD
Housing	6.0 mOD
Commercial/Retail	5.02mOD & 4.8mOD

Table 7.5 Building Finished Floor Levels

7.6 POTENTIAL IMPACTS

7.6.1 Construction Stage Impacts (No Mitigation)

In the context of the proposed development, the construction stage in this case is taken to be the site preparation and the construction works at the site.

The principal potential impact on surface water is from an uncontrolled discharge to the Park Canal during the site preparation and construction.

7.6.1.1 Direct Impacts

There will be a potential direct impact on the surface water quality in the Park Canal during storm evens from the discharge of water from the site which may contain sediment and hydrocarbons.

During site earthworks and construction works at the site there is a risk of surface water pollution from the following potential sources in absence of mitigation:

- accidental spillage of fuels and lubricants by construction plant during with the potential for contaminated runoff going to the Park Canal.
- increase in sediment erosion and suspended solids being discharged to the Park Canal.

The significance of the identified potential impacts are assessed in Table 7.6 below**.**

7.6.1.2 Indirect Impacts

There is the potential for an indirect impact on surface water quality if there is an uncontrolled discharge from the site to the Pa Healy Road or Park Road and entering the surface water drainage system along the roads.

7.6.2 Significance of Potential Construction Stage Impacts (Unmitigated)

A summary of potential impacts without mitigation is presented in Table 7.6 below. As outlined in Table 7.4 above, the significance / sensitivity of the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA significance is rated as Extremely High, while the Fergus Estuary and Inner Shannon, North Shore pNHA is rated as Very High.

7.6.3 Post Construction Stage Impacts

Once the development has been constructed the mitigation measures to manage storm water runoff volumes and quality will be in place at the site, including storm water attenuation areas, hydrocarbon separator, a flow control device and headworks at the outfall to the Park Canal.

No.	Identified Potential Impact	Description of Impact (No Mitigation)	Significance of Impact (No Mitigation)
Construction Stage - Direct			
1	Impact on surface water quality from an accidental fuel leakage/ spillage	**High** - Potential to have a significant effect on the surface water quality in the Park Canal, which by its character, magnitude, duration or intensity alters a sensitive aspect of the designated environment at the canal. Any leakage / spillage would be accidental, of limited volume and would be temporary.	**Significant to Very Significant**
2	Impact on surface water quality from site earthworks and sediment erosion	**High** - Potential to have a significant effect on the surface water quality in the Park Canal, which by its character, magnitude, duration or intensity alters a sensitive aspect of the designated environment at the canal. Any sediment erosion would be short term only during the site earthworks and construction stage of the project.	**Significant to Very Significant**
Construction Stage - Indirect			
3	Impact on storm water runoff on adjoining road network drainage	**Medium** - Potential to have a moderate effect on the surface water quality, which alters the character of the receiving environment. Any impacts would be short term only during the site earthworks and construction stage of the project.	**Moderate to Significant**
Post Construction Stage - Direct			

No.	Identified Potential Impact	Description of Impact (No Mitigation)	Significance of Impact (No Mitigation)
4	Impact on surface water quality from an accidental fuel leakage/ spillage	**High** - Potential to have a significant effect on the surface water quality in the Park Canal, which by its character, magnitude, duration or intensity alters a sensitive aspect of the designated environment at the canal. Any leakage / spillage would be accidental, of very limited volume and would be temporary.	**Significant to Very Significant**

Table 7.6 Classification of Significance of Impacts (No Mitigation)

Table 7.6 indicates that if no mitigation measures are applied during the proposed development, particularly during earthworks and construction phase has the potential to have a Significant to very Significant impact on the surface water in the Park Canal which is a designated SAC.

7.6.4 Unplanned Events

It is considered highly unlikely that any unplanned events within the application site would result in a noticeable impact on surface water.

There is the potential for accidents at the site which could result in a fuel spillage, however, this has been considered in the assessment above.

7.6.5 Transboundary Impacts

The site does not cross any international boundaries, hence transboundary impacts are disregarded.

7.6.6 'Do-nothing Scenario'

If the proposed development of the site is not permitted, the area will remain as an undeveloped urban brownfield site.

7.6.7 Cumulative / Synergistic Impacts

There site is located within a built up area of Limerick City and the lands around the site are largely developed already.

In terms of surface water cumulative impacts the storm water runoff from the site will be regulated to the greenfield runoff rate, therefore the discharge of storm water to the Park Canal will not have a cumulative or adverse impact on the receiving environment.

7.7 MITIGATION

The impact assessment undertaken here indicates that without mitigation measures then the proposed development will have a Significant to Very Significant impact on the local surface water environment of the Park Canal.

Therefore, mitigation measures required to reduce the significance of potential impacts associated with the proposed development on the water environment receptors. A range of mitigation measures are identified and discussed here for the earth works and construction phase and for the post construction phase of the proposed development.

The majority of the potential impacts on surface water arising from the proposed development relate to the earthworks and construction stage. A specific Construction Environmental and Waste Management Plan (CEWMP) has been developed for the site to address potential construction stage impacts.

7.7.1 Site Outline Construction Environmental and Waste Management Plan

A site CEWMP has been prepared for the proposed development and submitted under a separate cover. Only those aspects of the outline CEWMP which relate to surface water are discussed here.

The outline CEWMP defines the project specific environmental measures that will be put in place and procedures to be followed during construction phase, both permanent and temporary, for the proposed project. The outline CEWMP has been produced as part of the planning application; It is intended that the plan will be updated to include more site specific information if, and when, planning approval has been granted.

All surface water shall be treated prior to discharge to receiving waters. Measure to protect surface waters from contamination are outlined in Section 4 of the CEWMP - Best Management Practices.

The proposed storm water detention ponds will provide for the storage of surface waters during storm events and will also provide a mechanism of treatment for the settlement of suspended solids prior to final discharge. The ponds will be installed as a priority item at the start of the construction stage.

The storm water detention ponds will be constructed early in the construction phase in order to provide best mitigation against adverse impact on the Canal receiving waters both during and after the construction phase.

Mitigation measures outlined in the CEWMP relating specifically to surface water include:

- precautions will be taken during site works to prevent surface water run-off from the site affecting the local surface waters and drainage network;
- provision of a wheel wash for vehicles exiting the site to prevent fugitive material on local roads which could end up in the local drainage network and surface water courses;
- A road sweeper will be used to remove dirt and debris from roads;
- any stock piles containing contaminated soils will be placed on an impermeable surface while awaiting the results of validation testing. The stockpiles will be sheeted to minimise

dust emissions and also to minimise the potential for leaching rainwater and run off contaminating clean areas;

- Emergency procedures will be developed to deal with any environmental emergencies on site such as uncontrolled discharges to surface water. A procedure for Environmental Emergency Preparedness and Response will be developed prior to commencement of construction activities at the site;
- Site clearance not to be undertaken during wet conditions when rainfall of more than 1 mm/hr is forecast within the next 24 hr. period;
- The proposed surface water head wall to be precast concrete to be placed during low water period and no work within/adjacent the Canal is to be done within the period October to June;
- All surface water to be treated for the removal of Hydrocarbon and grit prior to discharge;
- A penstock shut-off valve is to be provided on the outfall pipe from the detention pond in the event of an accidental spill of contaminates;
- Erosion and sediment traps will be provided prior to the storm water outfall to the Park Canal.
- Fuels, Lubricants, hydraulic fluid, solvents and oils to be carefully handled and spill kits provided.
- Accidental spillages to be immediately contained and contaminated soil removed from site;
- Waste fluids to be collected and removed from site;
- Dedicated wash down area to be provided for concrete trucks and temporary batch plant / Readymix silo washout. All washdown waters will go to a sealed basin area with no discharge to surface water or groundwater;
- A filter drain and silt pits will be located at the base of all embankments, settled solids will be removed from the silt pits regularly; and
- A bypass hydrocarbon interceptor will be installed in the car park drainage network prior to connection to the existing drainage network to prevent any hydrocarbon spills from entering the surrounding drainage network.

Section 4 of the outline CEWMP addresses Water Pollution Control Best Management Practices (BMP) at the site during construction. The BMP in relation to water pollution control include:

- Soil Erosion Control;

- Prevent Storm Water Flows from Contacting areas of disturbed soil;
- Sediment Control;
- Combine Soil Erosion and Sediment Control; and
- Inspection and Maintenance.

Section 5 of the outline CEWMP addresses BMP's for the project construction operations and includes details of the following operations in relation to storm water management during construction:

- earth dykes, drainage swales & ditches;
- drain outlet protection/velocity dissipation devices;
- slope drains;
- silt fences;
- desilting basins;
- sediment traps;
- check dams;
- use of fibre rolls in protection;
- gravel bag berm;
- street sweeping and vacuuming;
- sandbag barriers;
- straw bale barriers; and
- storm drain inlet protection.

7.7.2 Site Storm Water Discharge

Storm surface water runoff from the site will be attenuated and discharged to the Park Canal through a precast concrete headwall at the canal bank.

The storm water outfall will be set above the surveyed water level of the canal to reduce potential surcharging; a backflow prevention valve will fitted within the outfall pipe to prevent surcharging of the site drainage network.

7.7.3 Flood Risk

The building FFL of all buildings at a level which will provide adequate mitigation for future flood events including climate change and freeboard.

Open spaces and car parking levels will be kept at or close to existing ground levels to ensure that there is no loss of floodplain storage for these areas.

The areas of floodplain storage lost within the building footprints is minimal in terms of the overall floodplain area and will not have any significant impact on the flood risk to surrounding land. The site is also principally defended, although with a residual risk if defences were breached, and is unlikely to flood given recent mitigation improvements for the operation of the canal.

The ground floor of the commercial/retail buildings will be given flood resilient finishes in line with Technical Appendix B of the Planning System and Flood Risk Management Guidelines. This will help manage the potential impacts of internal flooding under an exceedance event.

7.7.4 Assessment of Impacts with Mitigation Measures in Place

With the above mitigation measures in place at the site during the earthworks and construction stage, and during the lifetime of the development, it is considered that that the following reduction in the assessed significance of impacts will result:

- Reduction of the potential impact on surface water quality from accidental fuel spillages or leaks (Impact No. 1) from **Significant / Very Significant** to **Slight**.
- Reduction of the potential impact on surface water quality from sediment erosion and suspended solids (Impact No. 2) from **Significant / Very Significant** to **Slight**.
- Reduction of the potential impact on surface water quality on adjoining streets (Impact No. 3) from **Moderate / Significant** to **Slight**.
- Reduction of the potential impact on surface water quality from accidental fuel spillages or leaks (Impact No. 4) from **Moderate / Significant** to **Slight**.

7.8 PREDICTED IMPACTS - RESIDUAL

7.8.1 Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to surface water quality during the earthworks and construction stage.

7.8.2 Post Construction Stage

Examination of the identified potential impacts on the receiving environment, provided appropriate mitigation measures are put in place, indicates there are no significant residual impacts with respect to surface water quality during the post construction stage.

7.9 MONITORING

7.9.1 Surface Water Monitoring

The treated surface water discharge from the site will be monitored on a regular basis during construction to ensure that there is no adverse impact on the water quality in the receiving waters of the Park Canal.

Details of surface water monitoring are included in the CEWMP for the site and include periodic inspections by the Construction Manager to address environmental issues including surface water. An EHS Inspection Audit of the construction site will be carried out by the appointed contractor and will be documented; the frequency of these audits will be weekly / monthly / other depending on the nature of contractor activity.

Figure 7.1 Surface Water Features

NOTES

1. EXTRACT FROM BING MAPS

LEGEND

🟥 SITE LOCATION

SLR

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR DUBLIN 1
T: +00353-1-2964667
www.slrconsulting.com

Revington Developments Ltd.

CANAL BANK

SITE LOCATION AND
LOCAL SURFACE WATER
FEATURES

FIGURE 7-1

1:10,000 @ A3	JULY 2021

Appendix 7.1 EU Directives / National Legislation and Regulations / Guidelines / Technical Standards

European Directives

Environmental Impact Assessment. Directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment;

Environmental Impact Assessment Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment;

Water Framework Directive (2000/60/EC);

Groundwater Directive (2006/118/EC);

Flooding Directive (2007/60/EC)

Integrated Pollution and Prevention Control Directive (2008/1/EC); and

The management of waste from extractive industries (2006/21/EC).

Irish Government Acts, National Legislation and Regulations

S.I. No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001);

The Planning and Development Acts, 2000 to 2009, The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments including, S.I. No. 364 of 2005 and S.I. 685 of 2006.

National legislation on the protection of the water environment. Since 2000 water management in EU member states has primarily been directed by the Water Framework Directive (2000/60/EC) and the associate ‘daughter’ Groundwater Directive (2006/118/EC). Irish legislation implementing these, and other relevant directives currently includes:

S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010 and amendments (S.I. No. 389 of 2011 and S.I. No. 149 of 2012);

European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014);

S.I. No. 278 of 2007 European Communities (Drinking Water) (No. 2) Regulations;

S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment (S.I. No. 327 of 2012);

S.I. No. 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended (S.I. No. 231 of 2010);

S.I. No. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010;

S.I. No. 457 of 2008 European Communities (Environmental Liability) Regulations which bring into force the European Liability Directive (2004/35/EC);

European Union (Planning and Development) (Environmental Impact Assessment) (No. 2) Regulations 2018 (S.I. No. 404 of 2018);

Local Government (Water Pollution) Acts 1977 to 1998;

European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);

European Communities (Quality of Shellfish Waters) Regulations, 2006 (S.I. No. 268 of 2006) and amendments (S.I No. 55 and 464 of 2009), and;

Bathing Water Quality Regulations, 2008 (S.I. No. 79 of 2008) and amendments (S.I No. 351 of 2011 and S.I. No. 163 of 2016);

Guidelines

EPA (Draft May 2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.

EPA (2010b). Methodology for Establishing Groundwater Threshold Values and the Assessment of Chemical and Quantitative Status of Groundwater, Including and Assessment of Pollution Trends and Trend Reversal.

Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P. and Moe, H. (2008). A Framework for the Assessment of Groundwater – Dependent Terrestrial Ecosystems under the Water Framework Directive. Environmental Research Centre Report Series No. 12.

Institute of Geologists of Ireland, 2007. Recommended collection, presentation and interpretation of geological and hydrogeological information for site developments.

OPW and DEHLG November 2009. The Planning System and Flood Risk Management: Guidelines for Planning Authorities.

Technical Standards

CIRIA (2007). The SuDS Manual. (C697). CIRIA publication, February 2007.

Appendix 7.2 Surface Water Quality Results and Screening for the Park Canal

Table 9: Pa Healy Road - Surface Water Analytical Results –

Metals, PAH, MTBE&BTEX, TPH, Phenols, Anions & Other Parameters

Sample Identity:		LOD	Upstream	Downstream	Groundwater		Drinking Water Regs	EQS (MAC)
Date:			21/1/19	21/1/19				
	Units							
Dissolved Arsenic	ug/l	<0.9	<0.9	<0.9	7.5	10	10	-
Dissolved Barium	ug/l	<1.8	84.9	85.2	-	100	-	-
Dissolved Beryllium	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Dissolved Boron	ug/l	<12	26	21	750	1000	1000	-
Dissolved Cadmium	ug/l	<0.03	<0.03	<0.03	3.75	5	5	<0.45
Total Dissolved Chromium	ug/l	<0.2	0.3	<0.2	37.5	30	50	-
Dissolved Copper	ug/l	<3	<3	<3	1500	30	2000	-
Dissolved Lead	ug/l	<0.4	<0.4	<0.4	7.5	-	10	14
Dissolved Mercury	ug/l	<0.5	<0.5	<0.5	0.75	1	1	0.07
Dissolved Nickel	ug/l	<0.2	1.7	1.2	15	20	20	34
Dissolved Selenium	ug/l	<1.2	<1.2	<1.2	-	-	10	-
Dissolved Vanadium	ug/l	<0.6	1.1	<0.6	-	-	-	-
Dissolved Zinc	ug/l	<1.5	6.4	6.0	75	100	-	-
PAH MS								
Naphthalene	ug/l	<0.005	<0.005	<0.005	-	1	-	130
Acenaphthylene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Acenaphthene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Fluorene	ug/l	<0.005	<0.005	<0.005	-	-	-	0.12
Phenanthrene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Anthracene	ug/l	<0.005	<0.005	<0.005	-	10000	-	0.4
Fluoranthene	ug/l	<0.005	<0.005	<0.005	-	1	-	1
Pyrene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Benzo(a)anthracene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Chrysene	ug/l	<0.005	<0.005	<0.005	-	-	-	-
Benzo(bk)fluoranthene	ug/l	<0.01	<0.01	<0.01	-	0.5	0.1	-
Benzo(a)pyrene	ug/l	<0.0002	<0.0002	<0.0002	0.0075	0.01	0.01	0.1
Indeno(123cd)pyrene	ug/l	<0.005	<0.005	<0.005	-	0.05	0.1	-
Dibenzo(ah)anthracene	ug/l	<0.005	<0.005	<0.005	-	0.05	-	-
Benzo(ghi)perylene	ug/l	<0.005	<0.005	<0.005	-	0.05	0.1	0.0082
PAH 16 Total	ug/l	<0.075	<0.075	<0.075	0.075	0.1	-	-
Benzo(b)fluoranthene	ug/l	<0.01	<0.01	<0.01	-	0.5	-	0.017
Benzo(k)fluoranthene	ug/l	<0.01	<0.01	<0.01	-	0.05	-	0.017
Methyl Tertiary Butyl Ether	ug/l	<0.1	<0.1	<0.1	10	30	-	-
Benzene	ug/l	<0.5	<0.5	<0.5	0.75	1	1	50
Toluene	ug/l	<5	<5	<5	525	10	-	-
Ethylbenzene	ug/l	<1	<1	<1	-	10	-	-
p/m-Xylene	ug/l	<2	<2	<2	-	10	-	-
o-Xylene	ug/l	<1	<1	<1	-	10	-	-
Aliphatics								
>C5-C6	ug/l	<10	<10	<10	-	10	-	-
>C6-C8	ug/l	<10	<10	<10	-	10	-	-
>C8-C10	ug/l	<10	<10	<10	-	10	-	-
>C10-C12	ug/l	<5	<5	<5	-	10	-	-
>C12-C16	ug/l	<10	<10	<10	-	10	-	-
>C16-C21	ug/l	<10	<10	<10	-	10	-	-
>C21-C35	ug/l	<10	<10	<10	-	10	-	-
Total aliphatics C5-35	ug/l	<10	<10	<10	-	10	-	-
Aromatics								
>C5-EC7	ug/l	<10	<10	<10	-	0.75**	-	-
>EC7-EC8	ug/l	<10	<10	<10	-	10	-	-
>EC8-EC10	ug/l	<10	<10	<10	-	10	-	-
>EC10-EC12	ug/l	<5	<5	<5	-	10	-	-
>EC12-EC16	ug/l	<10	<10	<10	-	10	-	-
>EC16-EC21	ug/l	<10	<10	<10	-	10	-	-
>EC21-EC35	ug/l	<10	<10	<10	-	10	-	-
Total aromatics C5-35	ug/l	<10	<10	<10	-	10	-	-
Total aliphatics and aromatics(C5-35)	ug/l	<10	<10	<10	7.5	10	-	-
Sulphate as SO4	mg/l	<0.5	24.3	24.6	187.5	200	250	-
Chloride	mg/l	<0.3	18.8	19.0	187.5	30	250	-
Nitrate as NO3	mg/l	<0.2	6.1	5.8	37.5	25	50	-
Nitrite as NO2	mg/l	<0.02	<0.02	<0.02	0.375	0.1	0.5	-
Ortho Phosphate as P	mg/l	<0.06	<0.03	<0.03	-	0.03	-	-
Free Cyanide	mg/l	<0.01	<0.01	<0.01	-	-	-	-
Total Cyanide	mg/l	<0.01	<0.01	<0.01	-	-	0.05	-
Ammoniacal Nitrogen as NH3	mg/l	<0.03	0.06	0.06	-	150	-	-
Hexavalent Chromium	ug/l	<2	<2	<2	7.5	30	50	-
Total Dissolved Chromium III	ug/l	<2	<2	<2	-	30	50	32

Sulphide	mg/l	<0.01	<0.01	<0.01	-	-	-	-
Total Alkalinity as CaCO3	mg/l	<1	164	166	-	-	-	-
Total Organic Carbon	mg/l	<2	9	10	-	No abnormal change	-	-
COD (settled)	mg/l	<7	22	24	-	-	-	-
pH	pH Units	<0.1	7.64	7.47	-	6.5-9.5	6.5-9.5	4.5<pH<9
EC	µS/cm	<1	395	425	1875	1000	2500	-

Notes

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Table 10: Pa Healy Road - Surface Water Analytical Results -VOC

Sample Identity:		LOD	Upstream	Downstream	Groundwater		Drinking Water Regs	EQS
Date:			21/1/19	21/1/19	EPA IGV	GW 2016		
	Units							
Dichlorodifluoromethane	ug/l	<2	<2	<2	-	-	-	-
Methyl Tertiary Butyl Ether	ug/l	<0.1	<0.1	<0.1	30	10	-	-
Chloromethane	ug/l	<3	<3	<3	-	-	-	-
Vinyl Chloride	ug/l	<0.1	<0.1	<0.1	-	0.375	0.5	-
Bromomethane	ug/l	<1	<1	<1	-	-	-	-
Chloroethane	ug/l	<3	<3	<3	-	-	-	-
Trichlorofluoromethane	ug/l	<3	<3	<3	-	-	-	-
1,1-Dichloroethene (1,1 DCE)	ug/l	<3	<3	<3	-	-	-	-
Dichloromethane (DCM)	ug/l	<5	<5	<5	10	15	-	-
trans-1-2-Dichloroethene	ug/l	<3	<3	<3	3	-	-	-
1,1-Dichloroethane	ug/l	<3	<3	<3	-	-	-	-
cis-1-2-Dichloroethene	ug/l	<3	<3	<3	3	-	-	-
2,2-Dichloropropane	ug/l	<1	<1	<1	-	-	-	-
Bromochloromethane	ug/l	<2	<2	<2	-	-	-	-
Chloroform	ug/l	<2	<2	<2	-	-	-	-
1,1,1-Trichloroethane	ug/l	<2	<2	<2	500	-	-	-
1,1-Dichloropropene	ug/l	<3	<3	<3	-	-	-	-
Carbon tetrachloride	ug/l	<2	<2	<2	-	-	-	-
1,2-Dichloroethane	ug/l	<2	<2	<2	3	2.25	3	-
Benzene	ug/l	<0.5	<0.5	<0.5	1	0.75	1	50
Trichloroethene (TCE)	ug/l	<3	<3	<3	70	7.5	10	-
1,2-Dichloropropane	ug/l	<2	<2	<2	-	-	-	-
Dibromomethane	ug/l	<3	<3	<3	-	-	-	-
Bromodichloromethane	ug/l	<2	<2	<2	-	-	-	-
cis-1-3-Dichloropropene	ug/l	<2	<2	<2	-	-	-	-
Toluene	ug/l	<5	<5	<5	10	525	-	-
trans-1-3-Dichloropropene	ug/l	<2	<2	<2	-	-	-	-
1,1,2-Trichloroethane	ug/l	<2	<2	<2	-	-	-	-
Tetrachloroethene (PCE)	ug/l	<3	<3	<3	40	7.5	10	-
1,3-Dichloropropane	ug/l	<2	<2	<2	-	-	-	-
Dibromochloromethane	ug/l	<2	<2	<2	-	-	-	-
1,2-Dibromoethane	ug/l	<2	<2	<2	-	-	-	-
Chlorobenzene	ug/l	<2	<2	<2	1	-	-	-
1,1,1,2-Tetrachloroethane	ug/l	<2	<2	<2	-	-	-	-
Ethylbenzene	ug/l	<1	<1	<1	10	-	-	-
p/m-Xylene	ug/l	<2	<2	<2	10	-	-	-
o-Xylene	ug/l	<1	<1	<1	10	-	-	-
Styrene	ug/l	<2	<2	<2	-	-	-	-
Bromoform	ug/l	<2	<2	<2	-	-	-	-
Isopropylbenzene	ug/l	<3	<3	<3	-	-	-	-
1,1,2,2-Tetrachloroethane	ug/l	<4	<4	<4	-	-	-	-
Bromobenzene	ug/l	<2	<2	<2	-	-	-	-
1,2,3-Trichloropropane	ug/l	<3	<3	<3	-	-	-	-
Propylbenzene	ug/l	<3	<3	<3	-	-	-	-
2-Chlorotoluene	ug/l	<3	<3	<3	-	-	-	-
1,3,5-Trimethylbenzene	ug/l	<3	<3	<3	-	-	-	-
4-Chlorotoluene	ug/l	<3	<3	<3	-	-	-	-
tert-Butylbenzene	ug/l	<3	<3	<3	-	-	-	-
1,2,4-Trimethylbenzene	ug/l	<3	<3	<3	-	-	-	-
sec-Butylbenzene	ug/l	<3	<3	<3	-	-	-	-
4-Isopropyltoluene	ug/l	<3	<3	<3	-	-	-	-
1,3-Dichlorobenzene	ug/l	<3	<3	<3	-	-	-	-
1,4-Dichlorobenzene	ug/l	<3	<3	<3	-	-	-	-
n-Butylbenzene	ug/l	<3	<3	<3	-	-	-	-
1,2-Dichlorobenzene	ug/l	<3	<3	<3	10	-	-	-
1,2-Dibromo-3-chloropropane	ug/l	<2	<2	<2	-	-	-	-
1,2,4-Trichlorobenzene	ug/l	<3	<3	<3	0.4	-	-	-
Hexachlorobutadiene	ug/l	<3	<3	<3	0.1	-	-	0.6
1,2,3-Trichlorobenzene	ug/l	<3	<3	<3	-	-	-	-
Surrogate Recovery Toluene D8	%	<0	104	95	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	107	103	-	-	-	-

Notes

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Table 11: Pa Healy Road - Surface Water Analytical Results -SVOC

Sample Identity:		LOD	Upstream	Downstream	Groundwater		Drinking Water Regs	EQS
Date:			21/1/19	21/1/19		EPA IGV		
	Units							
Phenols								
2-Chlorophenol	ug/l	<1	<1	<1	-	200	200	-
2-Methylphenol	ug/l	<0.5	<0.5	<0.5	-	500	-	-
2-Nitrophenol	ug/l	<0.5	<0.5	<0.5	-	-	-	-
2,4-Dichlorophenol	ug/l	<0.5	<0.5	<0.5	-	-	-	-
2,4-Dimethylphenol	ug/l	<1	<1	<1	-	-	-	-
2,4,5-Trichlorophenol	ug/l	<0.5	<0.5	<0.5	-	-	-	-
2,4,6-Trichlorophenol	ug/l	<1	<1	<1	-	200	200	-
4-Chloro-3-methylphenol	ug/l	<0.5	<0.5	<0.5	-	500	-	-
4-Methylphenol	ug/l	<1	<1	<1	-	500	-	-
4-Nitrophenol	ug/l	<10	<10	<10	-	-	-	-
Pentachlorophenol	ug/l	<1	<1	<1	-	2	9	1
Phenol	ug/l	<1	<1	<1	-	500	500	-
PAHs								
2-Chloronaphthalene	ug/l	<1	<1	<1	-	-	-	-
2-Methylnaphthalene	ug/l	<1	<1	<1	-	-	-	-
Phthalates								
Bis(2-ethylhexyl) phthalate	ug/l	<5	<5	<5	6	-	-	-
Butylbenzyl phthalate	ug/l	<1	<1	<1	-	-	-	-
Di-n-butyl phthalate	ug/l	<1.5	<1.5	<1.5	-	2	6	-
Di-n-Octyl phthalate	ug/l	<1	<1	<1	-	-	-	-
Diethyl phthalate	ug/l	<1	<1	<1	-	-	-	-
Dimethyl phthalate	ug/l	<1	<1	<1	-	-	-	-
Other SVOCs								
1,2-Dichlorobenzene	ug/l	<1	<1	<1	-	10	1000	-
1,2,4-Trichlorobenzene	ug/l	<1	<1	<1	-	0.4	20	-
1,3-Dichlorobenzene	ug/l	<1	<1	<1	-	-	-	-
1,4-Dichlorobenzene	ug/l	<1	<1	<1	-	-	-	-
2-Nitroaniline	ug/l	<1	<1	<1	-	-	-	-
2,4-Dinitrotoluene	ug/l	<0.5	<0.5	<0.5	-	-	-	-
2,6-Dinitrotoluene	ug/l	<1	<1	<1	-	-	-	-
3-Nitroaniline	ug/l	<1	<1	<1	-	-	-	-
4-Bromophenylphenylether	ug/l	<1	<1	<1	-	-	-	-
4-Chloroaniline	ug/l	<1	<1	<1	-	-	-	-
4-Chlorophenylphenylether	ug/l	<1	<1	<1	-	-	-	-
4-Nitroaniline	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Azobenzene	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Bis(2-chloroethoxy)methane	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Bis(2-chloroethyl)ether	ug/l	<1	<1	<1	-	-	-	-
Carbazole	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Dibenzofuran	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Hexachlorobenzene	ug/l	<1	<1	<1	-	-	-	0.05
Hexachlorobutadiene	ug/l	<1	<1	<1	-	-	-	0.6
Hexachlorocyclopentadiene	ug/l	<1	<1	<1	-	-	-	-
Hexachloroethane	ug/l	<1	<1	<1	-	-	-	-
Isophorone	ug/l	<0.5	<0.5	<0.5	-	-	-	-
N-nitrosodi-n-propylamine	ug/l	<0.5	<0.5	<0.5	-	-	-	-
Nitrobenzene	ug/l	<1	<1	<1	-	-	-	-

Notes

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Appendix 7.3 Site Storm Water Management and Outfall to the Park Canal

NOTES:

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2. DO NOT SCALE FROM DRAWING USE FIGURED DIMENSIONS ONLY.

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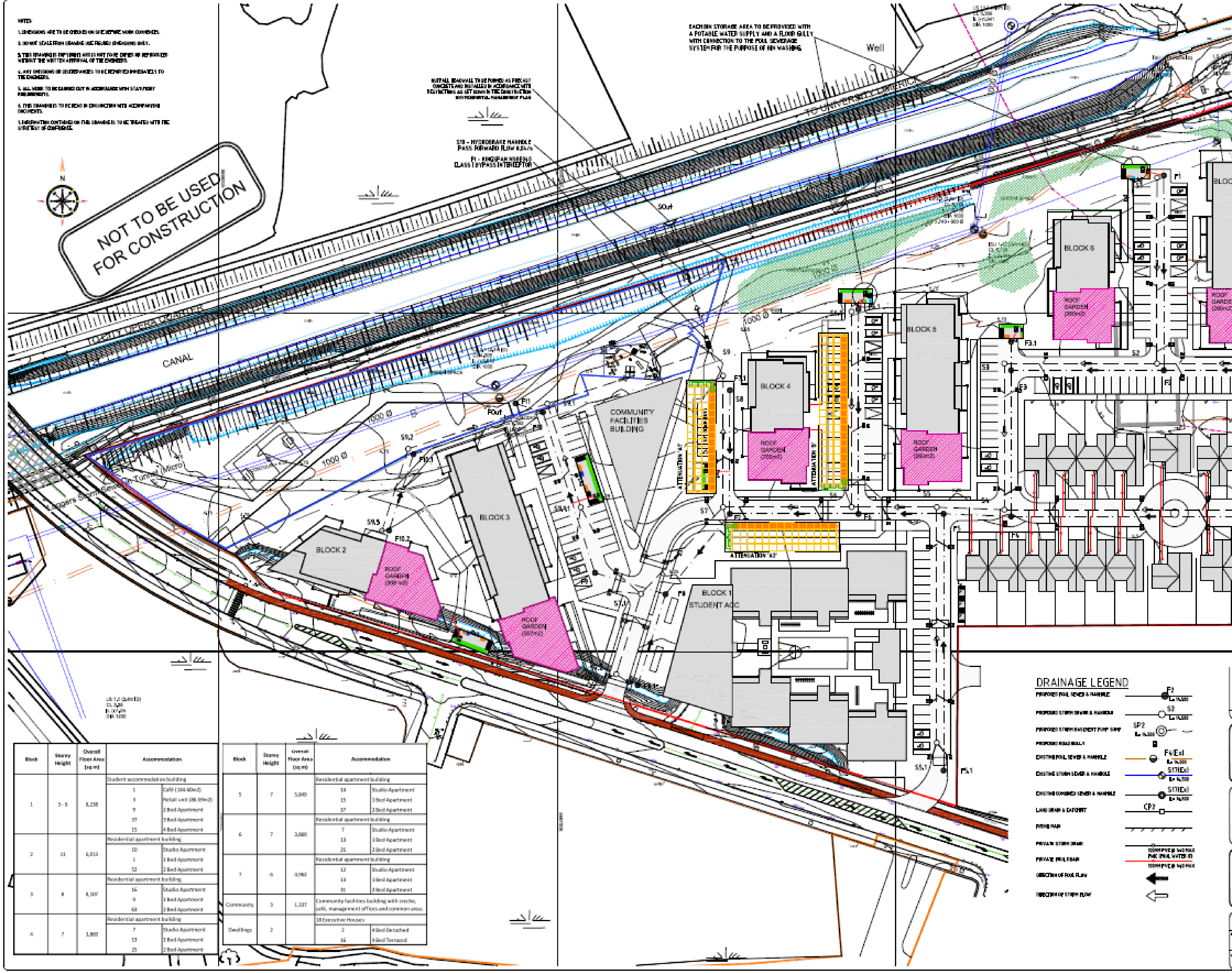

Block	Storey Height	Overall Floor Area (sq m)	Accommodation	
1	3 - 6	8,238	Student accommodation building	
			1	Café (144.60m2)
			3	Retail unit (86.59m2)
			9	2 Bed Apartment
			37	3 Bed Apartment
			15	4 Bed Apartment
2	11	6,013	Residential apartment building	
			10	Studio Apartment
			1	1 Bed Apartment
			52	2 Bed Apartment
3	8	8,107	Residential apartment building	
			16	Studio Apartment
			9	1 Bed Apartment
			63	2 Bed Apartment
4	7	3,803	Residential apartment building	
			7	Studio Apartment
			13	1 Bed Apartment
			25	2 Bed Apartment

Block	Storey Height	Overall Floor Area (sq m)	Accommodation	
5	7	5,849	Residential apartment building	
			14	Studio Apartment
			15	1 Bed Apartment
			37	2 Bed Apartment
6	7	3,889	Residential apartment building	
			7	Studio Apartment
			13	1 Bed Apartment
			25	2 Bed Apartment
7	6	4,962	Residential apartment building	
			12	Studio Apartment
			13	1 Bed Apartment
			31	2 Bed Apartment
Community	3	1,337	Community facilities building with creche, café, management offices and common areas	
Dwellings	2		18 Executive Houses	
			2	4 Bed Detached
			16	4 Bed Terraced

DRAINAGE LEGEND

PROPOSED FOUL SEWER & MANHOLE	F2
PROPOSED STORM SEWER & MANHOLE	S2
PROPOSED STORM BASEMENT PUMP SUMP	SP2
PROPOSED ROAD GULLY	
EXISTING FOUL SEWER & MANHOLE	F4(Ex)
EXISTING STORM SEWER & MANHOLE	S17(Ex)
EXISTING COMBINED SEWER & MANHOLE	S17(Ex)
LAND DRAIN & CATCHPIT	CP2
RISING MAIN	
PRIVATE STORM DRAIN	100MM PVC @ 1:40 MAX
PRIVATE FOUL DRAIN	PWC (FOUL WATER IC) 100MM PVC @ 1:40 MAX
DIRECTION OF FOUL FLOW	←
DIRECTION OF STORM FLOW	⇦

REV	DATE	DESCRIPTION	BY/CHKD/APPD

Client

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PROPOSED MIXED-USE DEVELOPMENT AT
PA HEALY ROAD, LIMERICK
DRAINAGE - GENERAL ARRANGEMENT

Drawn: POB	Scale: 1:500	Project Number: 108-96	Rev. -
Chkd.: POB	Date: 10/2021	Drawing Number: 201	A1
Appd: EOD	Status: PLANNING ISSUE		

Appendix 7.4 Site Storm Water Management Measures (Civil Engineering Report)

5.0 STORM WATER MANAGEMENT STRATEGY

5.1 Storm Water Drainage

This chapter of the Services Report outlines the way in which the storm water runoff from the proposed development is to be managed and discharged.

The storm water sewer layout for the proposed development is shown on Drawings 108-96-201.

5.2 Drainage Strategy and SuDS

It is proposed that all generated storm waters from the development will be collected via a separate stormwater gravity network and discharged to the Canal which is located along the western boundary of the development site. Currently there is an open channel within the site which runs parallel with the canal and discharges to the canal at the southern corner of the site.

Refer to Appendix B for Storm Network design spreadsheets.

Sustainable drainage systems (SuDS) are a feature of all modern developments and their aim is to maintain or restore a more natural hydrological regime, such that the impact of urbanisation on downstream and upstream flooding and water quality is negated. Originally, SuDS were introduced primarily as single purpose facilities, however, this has now evolved into more integrated systems which serve a variety of purposes, including habitat and amenity enhancement.

SuDS involve a change in our way of managing urban run-off from solely looking at volume control to an integrated multi-disciplinary approach which addresses water quality, water quantity, amenity and habitat. SuDS minimise the impacts of urban runoff by capturing runoff as close to source as possible and then releasing it slowly. The use of SuDS to control runoff also provides the additional benefit of reducing pollutants in the surface water by settling out suspended solids, and in some cases providing biological treatment.

The successful achievement of sustainable urban drainage does not solely rely on the use of engineered techniques to control and treat runoff. 'Good housekeeping' measures, such as safe storage and handling of oils and chemicals, street sweeping and control of sediment run-off from construction sites are an essential component of SuDS. Public awareness is also an important factor in ensuring the successful implementation of sustainable drainage practices.

The drainage strategy employed for dealing with storm water from the proposed development follows the principles of Sustainable Urban Drainage Systems (SUDS) as set out in CIRIA document C521 *'Design Manual for Scotland and Northern Ireland'*. Specifically, the Best Management Practices (BMP's) for the control of surface waters, as prepared by Dublin Corporation and as set out in their document *'Storm Water Management Policy for Developers 1999'*, have been used in the design of the surface water system. The adopted principals are in line with the 'Greater Dublin Strategic Drainage Strategy', April 2005.

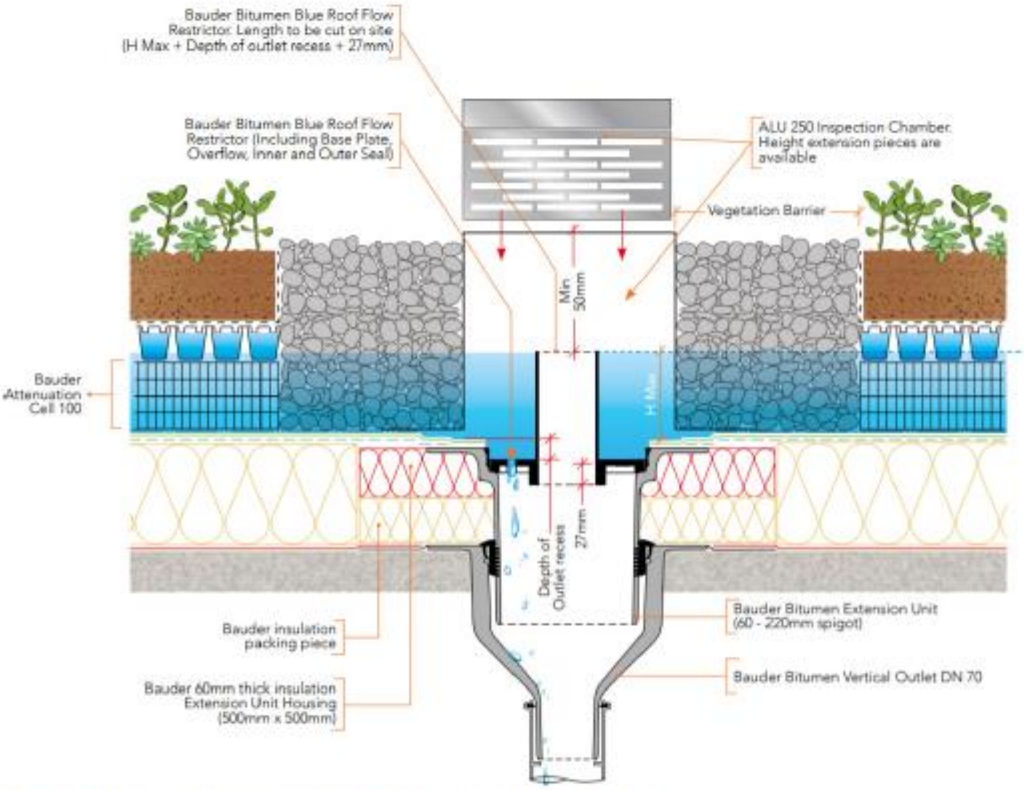
A key part of the design strategy is limiting the amount of post-development run-off below the Mean Annual Peak Flow (Rural) ($QBAR_R$) associated with the lands in their pre-development state. Given the vulnerability of the receiving Canal which flows into the Abbey River it is proposed to limit run-off below the Annual Peal Flow and adopt a limiting pass forward flow of 2 litres per second per hectare.

Given the physical aspects of the current site condition and essentially the imported material in the past that was used to raise the site levels and in consultation with the Environmental Due diligence report prepared by VERDE Environmental it is not proposed to provide for discharge or permeation to ground.

The inclusion of systems which promote the discharge of surface water to ground have not been considered in this particular instance given the pre-existing condition of the site. It is however proposed to include a Blue Roof to a number of the proposed buildings. Blue roofs provide a system of retention of water on the roofs with a slow release mechanism that is designed for each individual area. The proposed Bauder Blue Roof can retain a depth of 100mm of rainfall on the roof surface with the capacity to support either a growing medium or a paved pedestrian system over.

See details below.

Blue roofs for SuDS



The areas proposed to be provided with the above system include:

Building	Blue Roof Area (m2)	Attenuated Volume (m3)
Block 2	308	30.8

Block 3	307	30.7
Block 4	260	26
Block 5	260	26
Block 6	260	26
Block 7	260	26
Total	**1655**	**165.5**

All surface run-off from roofs, roads, paved areas, and open space areas which graduate towards paved areas is to be captured, detained, treated, and eventually discharged to the Canal channel.

Within the calculations an allowance for predicted increased Rainfall intensities due to Climate Change has been incorporated in the form of an increase in recorded rainfall data by 20%. Met Eireann Rainfall Data for this site location is presented in Appendix C, while the data used in the calculation is presented in Appendix D.

5.3 Attenuation

In order to provide for adequate storage of storm waters it is necessary to establish the current discharge rate for the site as a Greenfield. The existing storm water discharge from the site ($QBAR_R$) is calculated using the estimation method contained in the Institute of Hydrology Report No. 124:

$$QBAR_R = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

$$= 0.00108 \times (0.5)^{0.89} \times (995)^{1.17} \times (0.3)^{2.17}$$

$$= 0.0137 m^3/s \ (137.5 \ l/s)$$

The calculation is based on a minimum site area of 50 hectares and then adopted for the specific site area. Therefore, for the total site area of 4.0ha the pre-development run-off is calculated as 11.0 litres per second. As stated in the previous section a limiting run-off of 2.0 l/s has been adopted which allows for a run-off of 8.12 litres per second. For the full calculation refer to Appendix D.

Limiting the post development flow to that of the pre-development run-off is to be achieved by means of a throttle in the form of a "Hydrobrake" flow control device on the outfall pipe. Details of the Hydrobrake product are included in Appendix E.

The impact of limiting the run-off is the creation of a requirement to store excess flow. The required storage volume is a function of the return period of the rainfall event along with the duration of the event. An analysis has been carried out of various storm durations from 30 minutes to 48 hours within the 30 and 100 Year Return Periods based on the most up to date site specific rainfall return data available from Met Eireann.

The resulting critical storm events occur as follows:

30 Year Event – 12 Hour Storm – Storage Required = 840.5m^3

100 Year Event – 12 Hour Storm - Storage Required = 1178.5m^3

It is proposed that the storage of the attenuated storm water will be provided within carpark and landscaped areas in the form of 3 No. subsurface 'StormTech' MC-3500 arched attenuation units with capacity for the 1 in 30 and 1 in 100 year critical storm events without flooding.

Attenuation A1 = 314.8m^3

Attenuation A2 = 314.8m^3

Attenuation B = 440.8m^3

Storm Network capacity = 82.5m^3

Bauder Blue Roof Storage = 165.5m^3

Total Volume of Storage Provided = 1318.4m^3

1318.4 - 1178.5 / 1178.5 = 12% Extra Over

This extra over storage is available for the required allowance to cater for 'Urban Creep' which is recommended at 10%.

When the run-off from the development exceeds the allowable peak, the flow will back up in the sewers and will be detained within the basins. When the storm passes and the run-off reduces below the allowable peak, water from the detention basins will flow through the discharge outfall and off the site.

Analysis has also been carried out for various scenarios whereby in a tidal event the discharge from the site is limited. Latest available data from the OPW indicates the following high water level in the vicinity of the development:

1 in 10 Year Tidal Event (10% AEP) – 4.08m AOD

1 in 200 Year Tidal Event (0.5% AEP) – 4.75m AOD

1 in 1000 Year Tidal Event (0.1% AEP) – 5.15m AOD

When the normal water level of the Canal is raised as a consequence of these events the result will be reduced discharge availability through the outfall. The proposed Check Valve will prevent surcharging of the system from the Canal thereby preserving 100% of the provided capacity within the development. Worst case scenario would be a Zero Litres per Second discharge for a period of high water levels.

In the low probability scenario that a storm event occurs corresponding with a high tidal event the necessary volumetric capacities that will be required within the development system for a period of 4 hours (including rainfall Climate Change allowance of 20%) are as follows:

1 in 10 year storm with a 4 hour duration – 693.2m^3 Storage

1 in 30 year storm with a 4 hour duration - 904.3m^3 Storage

1 in 100 year storm with a 4 hour duration – 1195.3m^3 Storage.

Adequate storage is therefore provided within the development system to cater for the above low probability senarios.

5.4 Water Quality

The removal of suspended solids and other contaminates is integral to the success of any sustainable urban drainage system; therefore it is proposed that all road gulleys and drainage channels are trapped to retain grit and debris prior to entering the collection system.

It is proposed to provide for hydrocarbon removal prior to surface waters reaching the Hydrobrake manhole through the provision of a Class I Bypass Interceptor located as per drawing 108-96-201. This 'Klargester' NSBE040 Bypass Interceptor has been sized based on the cumulative contributing paved areas and the peak discharge rates of the full gravity system. Refer to Appendix F for Details.

The interceptor will require monitoring to ensure that materials that are separated and stored are removed for disposal.

5.5 Storm Network Detailed Design

The storm water sewers are designed in accordance with the DoELG's 'Recommendations for Site Development Works for Housing Areas' 1998. The sewer network has been designed using the 1 in 5 year intensities to generate the hydrograph applied to the network design.

The minimum storm sewer size specified is 225mm diameter. Road gullies are to be provided at maximum 30m centres and are to be trapped. Gully connections are to be 150mm diameter. Double gullies with separate connections provided at all low points.

The minimum private storm drain shall be 100mm diameter. Each dwelling unit will have its own separate storm water connection.

Access for maintenance purposes has been allowed through standard D400 manhole covers. For the details of the proposed system and layout see drawing 108-96-201. The system will require minimal maintenance. Velocities within the network range from 1.0m/s to 3.0m/s.

5.6 Surface Water Outfall

Surface water from the collection system shall discharge through a precast concrete headwall. The proposed outfall level is set above the surveyed water level of the canal. In the event of surcharge of the collection system it is proposed to provide a backflow prevention valve devise which is fitted within the outfall pipe. Refer to Appendix G for details.

In relation to the Outfall it is proposed to precast the head wall off-site in order to eliminate any potential contamination of the canal waters from the use of wet pour concrete. Refer to drawing 108-97-161 for full details

Appendix 7.5 Rating of Existing Environment Significance / Sensitivity

Criteria for Rating Site Attributes - Estimation Importance of Hydrology Attributes (Box 4.2, NRA 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has an extremely high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a very high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2,500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1,000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities

Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q23) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Appendix 7.6 Descriptions of Effects (EPA, 2017)

Descriptions of Effects (EPA, May 2017 - Draft)

Impact Characteristic	Term	Description
Quality of Effects	Positive Effects	A change which improves the quality of the environment
	Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative / Adverse Effects	A change which reduces the quality of the environment
Describing the Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable2 changes in the character of the environment but without significant consequences.
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.

Impact Characteristic	Term	Description
	Profound Effects	An effect which obliterates sensitive characteristics
Describing the Extent and Context of Effects	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of Effects	Likely Effects	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Unlikely Effects	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Duration and Frequency of Effects	Momentary Effects	Effects lasting from seconds to minutes
	Brief Effects	Effects lasting less than a day
	Temporary Effects	Effects lasting less than a year
	Short-term Effects	Effects lasting one to seven years
	Medium-term Effects	Effects lasting seven to fifteen years

Impact Characteristic	Term	Description
	Long-term Effects	Effects lasting fifteen to sixty years
	Permanent Effects	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually.
Describing the Types of Effects	Indirect / Secondary Effects	Likely, significant effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	Do-Nothing Effects	The environment as it would be in the future should the subject project not be carried out.
	Worst Case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
	Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.

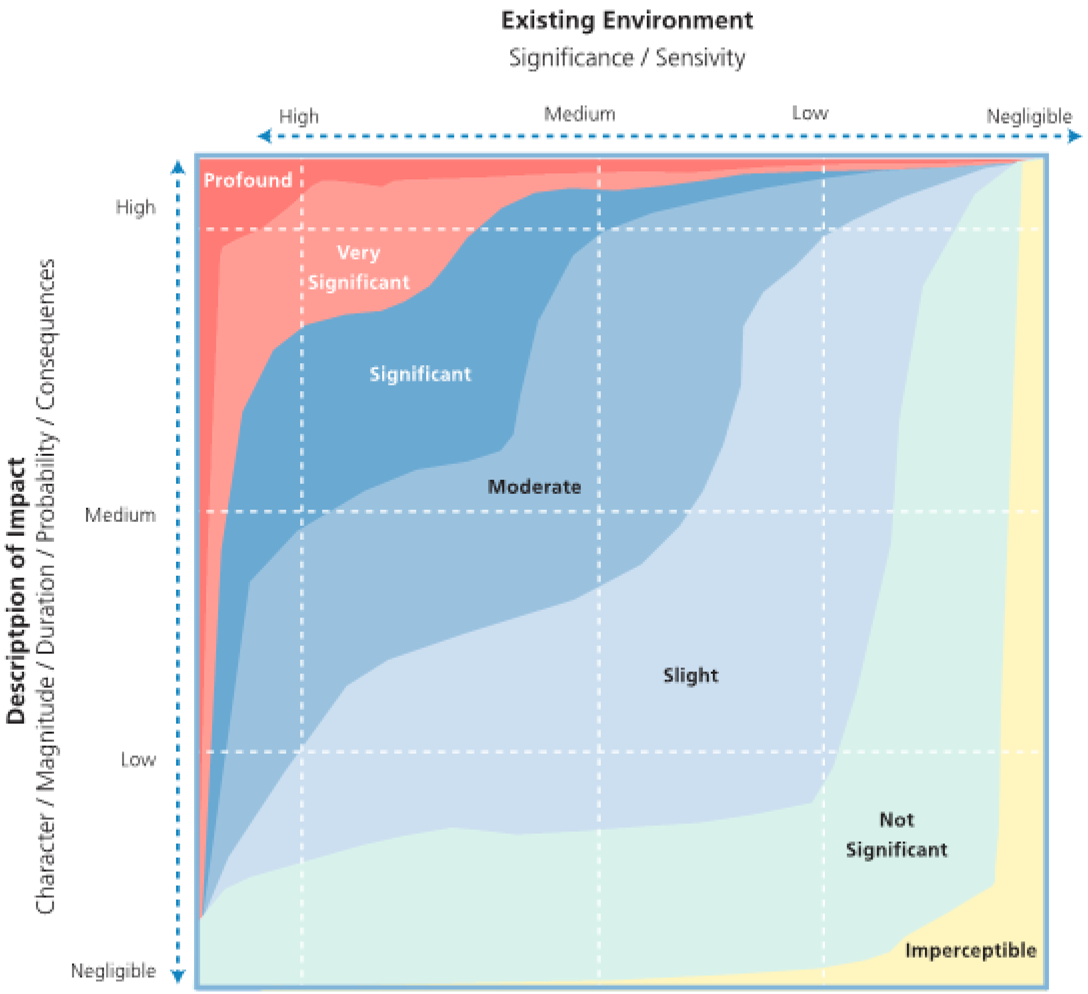
Impact Characteristic	Term	Description
	Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of SOx and NOx to produce smog).

Appendix 7.7 Classification of the Significance of Impacts

Classification of the Significance of Impacts (EPA, May 2017 - Draft)

Determining Significance

The diagram below shows how comparison of the character of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact.



8.0 AIR QUALITY AND CLIMATE

8.1 Introduction and Methodologies

This chapter assesses the likely air quality and climate impacts associated with the proposed strategic housing development (SHD) at Canal Bank, Pa Healy Road, Limerick. The SHD consists of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3 no. retail units, creche and management facilities building, and dwelling houses.

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8.1.1 Methodology

This chapter has been prepared having regard to the following guidelines;

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning & Local Government, 2018)
- Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017)
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft (EPA, 2017)

8.1.2 Relevant Legislation & Guidance

8.1.2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Appendix 8.1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011 (S.I. No. 180/2011), which incorporate EU Directive 2008/50/EC, which has set limit values for a number of pollutants. The limit values for NO2, PM10 and PM2.5 are of relevance to this assessment (see Table 8.1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directive are used which are triggers for particular actions (see Appendix 8.1).

Pollutant	**Regulation** Note 1	**Limit Type**	**Value**
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as PM$_{10}$)	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as PM$_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

Table 8.1 Ambient Air Quality Standards

8.1.2.2 Dust Deposition Guidelines

The concern from a health perspective is focussed on particles of dust which are less than 10 microns (PM10) and less than 2.5 microns (PM2.5) and the EU ambient air quality standards outlined in Table 8.1 have set ambient air quality limit values for PM10 and PM2.5.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust deposition of 350 mg/(m2*day) averaged over a one-year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Heritage & Local Government (DEHLG, 2004) apply the Bergerhoff limit value of 350 mg/(m2*day) to the site boundary of quarries. This limit value can also be implemented with regard to potential dust impacts from construction of the proposed development.

8.1.2.3 Climate Agreements

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013 (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (Government of Ireland, 2015) was enacted (the Act). The purpose of the Act was to enable Ireland 'to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050' (3.(1) of No. 46 of 2015). This is referred to in the Act as the 'national transition objective'. The Act made provision for a national mitigation plan, and a national adaptation framework. In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The Climate Action Plan (CAP) (Government of Ireland, 2019), published in June 2019, and updated in 2021 (Government of Ireland, 2021a), outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP has set a built environment sector reduction target of 40 - 45% relative to 2030 pre-NDP (National Development Plan) projections.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019, and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme in December 2019, followed by the publication of the Climate Action and Low Carbon Development (Amendment) Bill 2021 (hereafter referred to as the 2021 Climate Bill) in March 2021. The Climate Act was signed into Law on the 23rd July 2021, giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act (Government of Ireland, 2021b), is to provide for the approval of plans "for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050". The 2021 Climate Act will also "provide for carbon budgets and a decarbonisation target range for certain sectors of the economy". The 2021 Climate Act defines the carbon budget as "the total amount of greenhouse gas emissions that are permitted during the budget period".

The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request that each Local Authority produce a climate action plan lasting five years, specifying the mitigation measures and the adaptation measures to be adopted by the Local Authority.

Limerick City and County Council Climate Change Adaptation Strategy 2019-2024 (Limerick City and County Council 2021) outlines a number of goals and plans to prepare for and adapt to climate change in the key sectors of infrastructure and built environment, land use and development, drainage and flood management, natural resources and cultural infrastructure and community, health and wellbeing. Some of the measures promoted within the Adaptation Strategy relevant to infrastructure and built environment include integrating climate considerations into the design, planning, tendering process and construction of new developments and ensuring climate change is considered in locating future developments, the promotion of climate resilient and sustainable design and construction, the promotion of green infrastructure, adequate assessment of the potential flooding related risks and appropriate mitigation measures required for new developments.

Under amendments to Part L of the Building Regulations from November 2019 all new buildings were required to comply with the Near Zero Energy Building (NZEB) regulations. This aims to make new residential buildings 70% more energy efficient than the 2005 levels. The amendments to Part L give effect to the European Union (Energy Performance of Buildings) Regulations 2019, published on 3 May 2019 (S.I. 183 of 2019). The regulations transpose Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings (recast), as amended by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018. The Directive sets requirements for Member States to improve the energy performance of buildings and make an important contribution to the reduction of greenhouse gas emissions. The improved efficiency of buildings will help in reducing Ireland's GHG emissions and thus help to mitigate climate change. The regulations require that at least 20% of the total energy use of buildings is sourced from renewables. There is also a requirement to reduce the heat loss from buildings and avail of heat gain through the fabric of the building in addition to providing energy efficient space and water heating systems. The NZEB requirements will result in a typical Building Energy Rating (BER) of A2 which represents a 70% improvement in carbon emissions levels on the emissions levels of buildings from 2005.

8.1.3 Construction Phase Methodology

8.1.3.1 Air Quality

During the construction phase the main focus in relation to air quality impacts will be from potential fugitive dust emissions from site activities. The Institute of Air Quality Management in the UK (IAQM) guidance document 'Guidance on the Assessment of Dust from Demolition and Construction' (2014) outlines an assessment method for predicting the impact of dust emissions from demolition, earthworks, construction and haulage activities based on the scale and nature of the works and the sensitivity of the area to dust impacts. The IAQM methodology has been applied to the construction phase of this development in order to predict the likely risk of dust impacts in the absence of mitigation measures and to determine the level of site-specific mitigation required. The use of UK guidance is considered best practice in the absence of applicable Irish guidance.

As per the IAQM guidance (2014) high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time or areas where users would expect a high level of amenity. Commercial properties, parks and places of work are regarded as medium sensitivity while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity. Ecological sites can also be dust sensitive, according to the IAQM guidance high sensitivity ecological areas are defined as "locations with an international or national designation and the designated features may be affected by dust soiling".

Traffic emissions associated with construction vehicles accessing the site also have the potential to impact air quality during the construction phase. The air quality assessment has been carried out following procedures described in the publications by the EPA (2015; 2017) and using the methodology outlined in the guidance documents published by the UK Highways Agency (2019a) and UK Department of Environment Food and Rural Affairs (DEFRA) (2016; 2018). TII reference the use of the UK Highways Agency and DEFRA guidance and methodology in their document Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011). This approach is considered best practice in the absence of Irish guidance and can be applied to any development that causes a change in traffic.

The UK Highways Agency Design Manual for Roads and Bridges (DMRB) guidance (UK Highways Agency, 2019a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment.

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- A change in speed band;
- A change in carriageway alignment by 5m or greater.

Traffic data for the proposed development was provided by PHM Consulting to inform this assessment. None of the impacted road links meet the above scoping criteria for the construction phase and therefore, a detailed assessment is not required as there is no potential for significant impacts to air quality.

8.1.3.2 Climate

The impact of the construction phase of the development on climate was determined by a qualitative assessment of the nature and scale of greenhouse gas generating construction activities associated with the proposed development.

The UK Highways Agency has published an updated DMRB guidance document in relation to climate impact assessments LA 114 Climate (UK Highways Agency 2019b). This guidance is specific to road projects but can be used for any project that causes a change in traffic. The following scoping criteria are used to determine whether a detailed climate assessment is required for a proposed project. If any of the road links impacted by the proposed development meet or exceed the below criteria, then further assessment is required.

- A change of more than 10% in AADT;
- A change of more than 10% to the number of heavy-duty vehicles; and
- A change in daily average speed of more than 20 km/hr.

Traffic data for the proposed development was provided by PHM Consulting to inform this assessment. None of the impacted road links meet the above scoping criteria for the construction phase climate impacts and therefore, a detailed assessment is not required as there is no potential for significant impacts to climate.

8.1.4 Operational Phase Methodology

8.1.4.1 Air Quality

Operational phase traffic has the potential to impact local air quality as a result of increased vehicle movements associated with the proposed development. The UK Highways Agency scoping criteria detailed in Section 8.1.3.1 was used to determine if any road links are affected by the proposed development and require inclusion in an air dispersion modelling assessment. As there are road links present that exceed the scoping threshold, the assessment will proceed to a qualitative model.

The guidance states a proportionate number of representative receptors which are located in areas which will experience the highest concentrations or greatest improvements as a result of the proposed development are to be included in the modelling (UK Highways Agency, 2019a). The TII guidance (2011) defines sensitive receptor locations as: residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present. Therefore, according to the scoping criteria in Section 8.1.3.1 the local road links with sensitive receptors within 200 m which can be classed as ‘affected’ should proceed to an air dispersion modelling of operational phase traffic emissions due to the potential for impacts to air quality.

In 2019 the UK Highways Agency DMRB air quality guidance was revised with LA 105 Air Quality replacing a number of key pieces of guidance (HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15). This revised document outlines a number of changes for air quality assessments in relation to road schemes but can be applied to any development that causes a change in traffic. Previously the DMRB air quality spreadsheet was used for the majority of assessments in Ireland with detailed modelling only required if this screening tool indicated compliance issues with the EU air quality standards. Guidance from TII (TII, 2011) recommends the use of the UK Highways Agency DMRB spreadsheet tool for assessing the air quality impacts from road schemes. However, the DMRB spreadsheet tool was last revised in 2007 and accounts for modelled years up to 2025. Vehicle emission standards up to Euro V are included but since 2017, Euro 6d standards are applicable for the new fleet. In addition, the model does not account for electric or hybrid vehicle use. Therefore, this is a somewhat outdated assessment tool. The LA 105 guidance document states that the DMRB spreadsheet tool may still be used for simple air quality assessments where there is unlikely to be a breach of the air quality standards. Due to its use of a “dirtier” fleet, vehicle emissions would be considered to be higher than more modern models and therefore any results will be conservative in nature and will provide a worst-case assessment.

The 2019 UK Highways Agency DMRB air quality revised guidance LA 105 Air Quality states that modelling should be conducted for NO2 for the base, opening and design years for both the do minimum (do nothing) and do something scenarios. Modelling of PM10 is only required for the base year to demonstrate that the air quality limit values in relation to PM10 are not breached. Where the air quality modelling indicates exceedances of the PM10 air quality limits in the base year then PM10 should be included in the air quality model in the do minimum and do something scenarios. Modelling of PM2.5 is not required as there are currently no issues with compliance with regard to this pollutant. The modelling of PM10 can be used to show that the project does not impact on the PM2.5 limit value as if compliance with the PM10 limit is achieved then compliance with the PM2.5 limit will also be achieved. Historically modelling of carbon monoxide (CO) and benzene was required however, this is no longer needed as concentrations of these pollutants have been monitored to be significantly below their air quality limit values in recent years, even in urban centres (EPA, 2021a). The key pollutant reviewed in this assessment is NO2. Concentrations of PM10 have been modelled for the base year to indicate that there are no potential compliance issues.

Conversion of NOx to NO2

NOX (NO + NO2) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGV's the proportion of NOX emitted as NO2, rather than NO is increasing. With the correct conditions (presence of sunlight and O3) emissions in the form of NO, have the potential to be converted to NO2.

Transport Infrastructure Ireland states the recommended method for the conversion of NOx to NO2 in Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011). The TII guidelines recommend the use of DEFRAs NOx to NO2 calculator (2020) which was originally published in 2009 and is currently on version 8.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O3 and proportion of NOx emitted as NO for each local authority across the UK. O3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO2 or PM10.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO2 and NOx for Ireland. The "All Non-Urban UK Traffic" traffic mix option was used.

Update to NO2 Projections using DMRB

In 2011 the UK DEFRA published research (Highways England, 2013) on the long term trends in NO2 and NOX for roadside monitoring sites in the UK. This study marked a decrease in NO2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this is that there now exists a gap between projected NO2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO2 concentrations for predicted future years. Subsequently, the UK Highways Agency published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years. This methodology has been used in the current assessment to predict future concentrations of NO2 as a result of the proposed development.

Data for the Do Nothing (DN) and Do Something (DS) scenarios for the base year 2019, opening year 2023 and design year 2039 were provided. The traffic data is detailed in Table 8.2. Background concentrations have been included as per Section 8.2.2 of this chapter based on available EPA background monitoring data (EPA, 2021a). The locations of the sensitive receptors modelled are shown in Table 8.3 and Figure 8.1.

Link Number	Road Name	Speed (kph)	Base Year	Do-Nothing		Do-Something	
			2019	2023	2038	2023	2038
1	R463 O'Dwyers Bridge (Athlunkard Street)	50	12782 (3.2%)	13715 (3.4%)	15415 (4.1%)	14209 (3.3%)	15909 (4%)
2	R463 Corbally Road	50	16267 (3.7%)	17455 (4%)	19618 (4.8%)	18187 (3.8%)	20351 (4.6%)
3	Pa Healy Road (at Corbally Roundabout)	50	11591 (8.8%)	12437 (9.3%)	13979 (11.1%)	13663 (8.4%)	15205 (10.3%)
4	Western Devt Access	50	0 (0%)	0 (0%)	0 (0%)	1847 (0%)	1847 (0%)
5	Eastern Devt Access	50	0 (0%)	0 (0%)	0 (0%)	197 (0%)	197 (0%)
6	Pa Healy Rd (at Park Road Junction)	50	10068 (6.7%)	10803 (7.1%)	12142 (8.6%)	11621 (6.6%)	12960 (8.1%)
7	Park Road (adj. To site)	50	3401 (2.1%)	3650 (2.3%)	4102 (2.8%)	3737 (2.2%)	4189 (2.7%)
8	Park Road (South of Pa Healy Road)	50	11250 (5.4%)	12072 (5.7%)	13568 (6.9%)	12802 (5.4%)	14298 (6.6%)
9	Rhebogue Road	50	2158 (5%)	2316 (5.3%)	2603 (6.4%)	2446 (5%)	2733 (6.1%)
10	R455 Clare Street	50	15000 (0.7%)	16095 (0.7%)	18090 (0.9%)	16223 (0.7%)	18218 (0.9%)
11	R455 Dublin Road	50	25464 (1.1%)	27322 (1.2%)	30709 (1.4%)	27659 (1.2%)	31046 (1.4%)
12	R858 Pennywell Road	50	8555 (1.3%)	9180 (1.4%)	10318 (1.7%)	9316 (1.4%)	10453 (1.7%)

Table 8.2 Traffic Data Used in Local Air Quality Modelling Assessment

Name	Receptor Type	X (ITM)	Y (ITM)
1	Residential	558443	657440
2	Ardscoil Mhuire	558427	657794
3	Residential	558875	657298
4	Residential	558945	657636

Table 8.3 Sensitive Air Quality Receptors

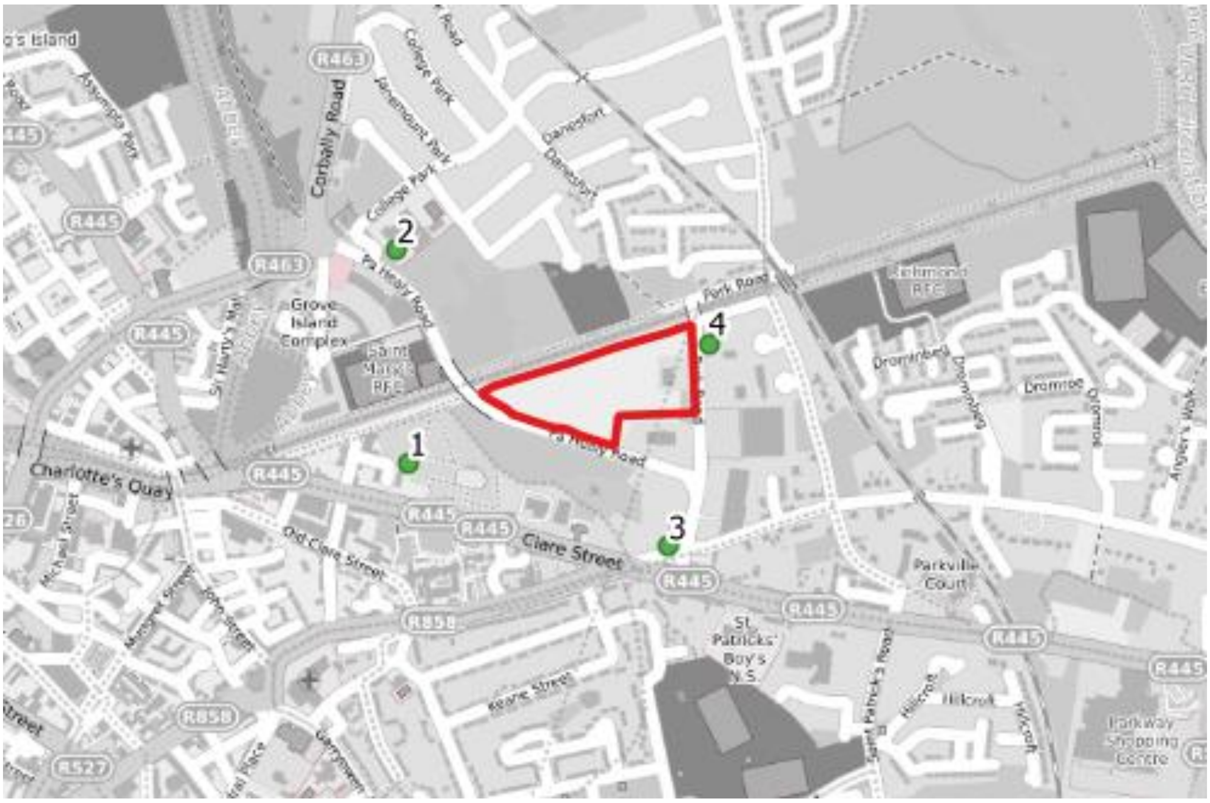

Figure 8.1 Sensitive Receptors for Operational Traffic Assessment

8.1.4.2 Climate

Ireland has annual GHG targets which are set at an EU level and need to be complied with in order to reduce the impact of climate change. Impacts to climate as a result of GHG emissions are assessed against the targets set out by the EU under Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013. Which has set a target of a 30% reduction in non-ETS sector emissions by 2030 relative to 2005 levels.

As per the EU guidance document Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Commission, 2013) the climate baseline is first established by reference to EPA data on annual GHG emissions (see Section 8.2.3). Thereafter the impact of the proposed development on climate is determined. Emissions from road traffic associated with the proposed development have the potential to emit carbon dioxide (CO2) which will impact climate.

The UK Highways Agency scoping criteria detailed in Section 8.1.3.2 was used to determine if any road links are affected by the proposed development and require inclusion in a climate modelling assessment.

The proposed development will not increase traffic by more than 10% AADT on any road links, therefore, the scoping criteria are not met and a detailed climate assessment is not required as there is no potential for significant impacts to climate as a result of traffic emissions.

The EU guidance (2013) also states indirect GHG emissions as a result of a development must be considered, this includes emissions associated with energy usage. The External Lighting and Lifecycle report prepared in relation to the proposed development outlines a number of measures in relation to energy usage from the proposed development primarily in relation to heat and electricity. A number of measures have been incorporated into the overall design of the development to reduce the impact to climate where possible.

8.1.4.3 Ecology

For routes that pass within 2 km of a designated area of conservation (either Irish or European designation) the TII requires consultation with an ecologist (2011). However, in practice the potential for impact to an ecological site is highest within 200m of the proposed scheme or development and when significant changes in AADT (>5%) occur. Only sites that are sensitive to nitrogen deposition should be included in the assessment. In addition, the UK Highways Agency (2019a) states that a detailed assessment does not need to be conducted for areas that have been designated for geological features or watercourses.

Transport Infrastructure Ireland's Guidelines for Assessment of Ecological Impacts of National Road Schemes (2009) and Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DEHLG, 2010) provide details regarding the legal protection of designated conservation areas.

If both of the following assessment criteria are met, an assessment of the potential for impact due to nitrogen deposition should be conducted:

- A designated area of conservation is located within 200 m of the proposed development; and
- A significant change in AADT flows (>5%) will occur.

The Lower River Shannon SAC (Site Code: 002165) is within 200m of road links directly impacted by the proposed development. As such an assessment of the impact with regards to nitrogen deposition was conducted. Dispersion modelling and prediction was carried out at typical traffic speeds at these locations. Ambient NOx concentrations were predicted for the opening year (2023) and design year (2038) along a transect of up to 200m within the SAC in line with the UK Highways Agency (2019a) and TII (2011) guidance. The road contribution to dry deposition along the transect was also calculated using the methodology outlined in Appendix 9 of the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011).

8.2 Description of Existing Environment

8.2.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM10, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than PM2.5) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles (PM2.5 - PM10) will actually increase at higher wind speeds. Thus, measured levels of PM10 will be a non-linear function of wind speed.

Shannon Airport meteorological station, which is located approximately 27 km west of the proposed development at the closest point, collects meteorological data in the correct format for the purposes of this assessment and has a data collection of greater than 90%. Long-term hourly observations at Shannon Airport meteorological station provide an indication of the prevailing wind conditions for the region. For data collated during five representative years (2016 – 2020), the predominant wind direction is south-westerly, with generally moderate wind speeds (see Figure 8.2) (Met Eireann, 2021).

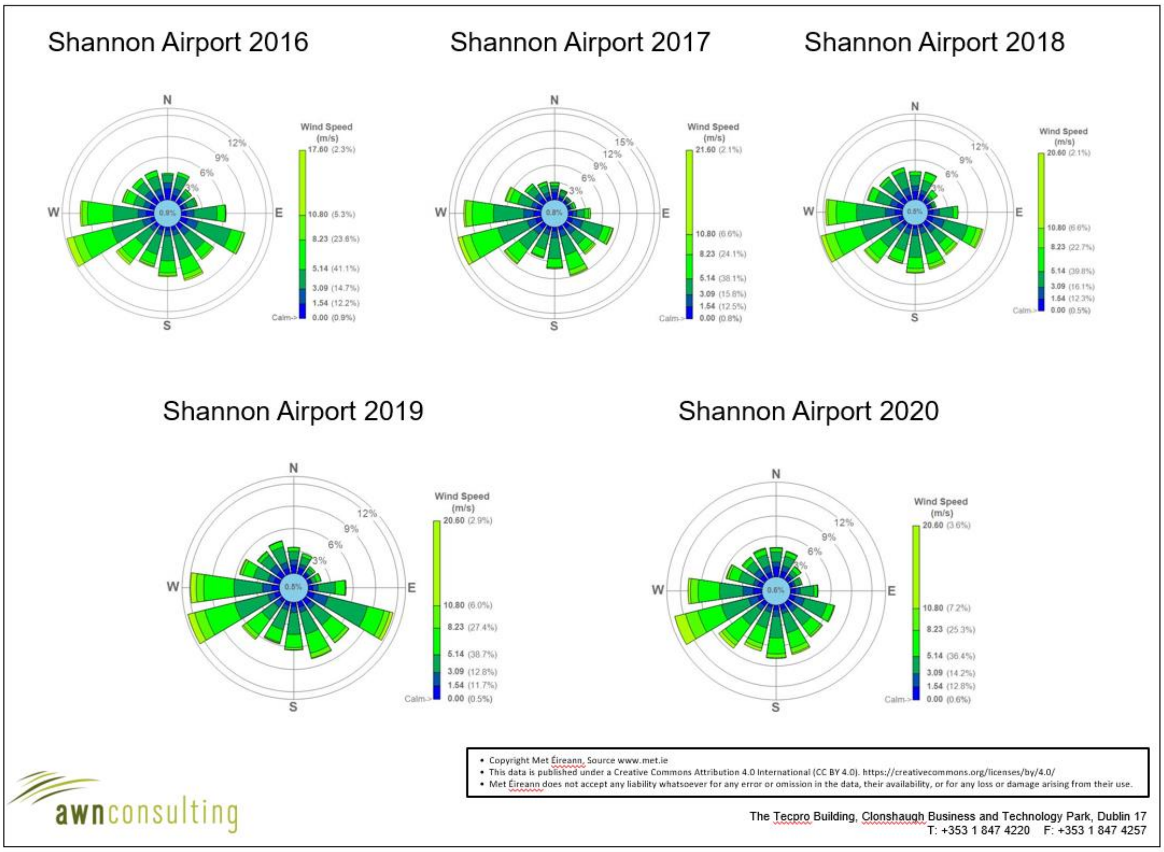

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Figure 8.2 Shannon Airport Windrose 2016 – 2020 (Met Eireann, 2021)

8.2.2 Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "Air Quality In Ireland 2020" (EPA, 2021a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2021b). The EPA data provides a long-term data set for background air quality at a variety of locations throughout Ireland. The use of existing long-term data is considered best practice in air quality assessments (TII, 2011).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2021b). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In 2020 the EPA reported (EPA 2021a) that Ireland was compliant with EU legal air quality limits at all locations, however this was largely due to the reduction in traffic due to Covid-19 restrictions. The EPA report details the effect that the Covid-19 restrictions had on stations, which included reductions of up to 50% at some monitoring stations which have traffic as a dominant source. The report also notes that CSO figures show that while traffic volumes are still slightly below 2019 levels, they have significantly increased since 2020 levels. 2020 concentrations are therefore predicted to be an exceptional year and not consistent with long-term trends. For this reason they have not been included in the baseline section.

In terms of air monitoring and assessment, the proposed development is in Zone C (EPA 2021b). The long-term EPA monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

Long-term NO2 monitoring was carried out at two urban Zone C locations – Kilkenny and Portlaoise (EPA 2021a). The NO2 annual average from 2015 to 2019 at the two locations was 8 µg/m3. Monitoring was also recorded for two years at a suburban traffic location in Dundalk with 2018-2019 annual average NO2 concentrations of 13 µg/m3. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value of 40 µg/m3. Based on the above information, a conservative estimate of the background NO2 concentration for the proposed development is 13 µg/m3.

Long-term PM10 monitoring is carried out at three suburban Zone C locations, Galway, Ennis and Portlaoise. The average PM10 concentration measured at the sites in 2015-2019 was 14 µg/m3. Monitoring for PM10 was commenced in Dundalk in 2018, with 2018-2019 annual average PM10 concentrations of 15 µg/m3. Ennis is the closest site to the proposed development and had a 5-year average concentration of 16.7 µg/m3. Hence, long-term average PM10 concentrations in the vicinity of the proposed development are predicted to be lower than the annual average limit value of 40 µg/m3.Based on the above information a conservative estimate of the background PM10 concentration for the Zone C region of the proposed development is 17 µg/m3.

Continuous PM2.5 monitoring carried out at two Zone C suburban locations of Bray and Ennis which showed annual average concentrations of 9 µg/m3 over 2015 to 2019. The concentrations at Ennis over the five years were higher than at Bray, with the 5-year average concentration of 11 µg/m3. Based on the above information a conservative estimate of the background PM2.5 concentration for the Zone C region of the proposed development is 11 µg/m3. Hence, long-term average PM2.5

concentrations for the proposed development are predicted to be lower than the annual average limit value of 25 µg/m3.

Background concentrations for the Opening Year 2023 and Design Year of 2038 have been calculated for the local air quality assessment. These have used current estimated background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16) (2018).

8.2.3 Climate Baseline

Anthropogenic emissions of greenhouse gases in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details provisional emissions up to 2020 (EPA 2021c). The data published in 2021 states that Ireland has exceeded its 2020 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC1 by an estimated 6.73 Mt. For 2020, total national greenhouse gas emissions are 57.7million tonnes carbon dioxide equivalent (Mt CO2eq) with 44.38 MtCO2eq of emissions associated with the ESD sectors for which compliance with the EU targets must be met. Agriculture is the largest contributor in 2020 at 37.1% of the total, with the transport sector accounting for 17.8% of emissions of CO2.

GHG emissions for 2020 are estimated to be 3.6% lower than those recorded in 2019. Emission reductions have been recorded in 6 of the last 10 years. However, compliance with the annual EU targets has not been met for five years in a row. Emissions from 2016 – 2020 exceeded the annual EU targets by 0.29 MtCO2eq, 2.94 MtCO2eq, 5.57 MtCO2eq, 6.85 MtCO2eq and 6.73 MtCO2eq respectively. Agriculture is consistently the largest contributor to emissions with emissions from the transport and energy sectors being the second and third largest contributors respectively in recent years.

The EPA 2020 GHG Emissions Projections Report for 2020 – 2040 (EPA, 2021d) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018 and the Climate Action Plan published in 2019. Implementation of these are classed as a "With Additional Measures scenario" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the period 2013 to 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 12.2 MtCO2eq under the "With Existing Measures" scenario and under the "With Additional Measures" scenario (EPA, 2021d). The projections indicate that Ireland can meet its non-ETS EU targets over the period 2021 – 2030 assuming full implementation of the 2019 Climate Action Plan and the use of the flexibilities available.

After the publication of the 2021 Climate Act in July 2021 and the 2021 CAP, carbon budgets and sectoral ceilings for the built environment sector will be adopted in the coming months and will be outlined in the 2022 CAP which will allow a comparison with the net CO2 project GHG emissions.

8.2.4 Construction Dust Sensitivity

In line with the IAQM guidance document (2014) prior to assessing the impact of dust from a proposed development, the sensitivity of the area must first be assessed as outlined below. Both receptor sensitivity and proximity to proposed works areas are taken into consideration. For the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time. Commercial properties and places of work are regarded as medium sensitivity while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity.

In terms of receptor sensitivity to dust soiling, there are less than 10 no. high sensitivity residential receptors within 20 m of the site boundary. Based on the IAQM criteria outlined in Table 8.4, the worst-case sensitivity of the area to dust soiling is considered to be medium.

Receptor Sensitivity	**Number Of Receptors**	**Distance from source (m)**			
		<20	**<50**	**<100**	**<350**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	**Medium**	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 8.4 Sensitivity of the Area to Dust Soiling Effects on People and Property

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health impacts. The criteria take into consideration the current annual mean PM10 concentration, receptor sensitivity based on type and the number of receptors affected within various distance bands from the construction works. A conservative estimate of the current annual mean PM10 concentration in the vicinity of the proposed development is 17 µg/m3 and there are less than 10 no. high sensitivity receptor within 20 m of the site boundary. Based on the IAQM criteria outlined in Table 8.5, the worst-case sensitivity of the area to human health impacts is considered low.

Receptor Sensitivity	**Annual Mean PM_{10} Concentration**	**Number Of Receptors**	**Distance from source (m)**				
			<20	**<50**	**<100**	**<200**	**<350**
High	< 24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	**Low**	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low	Low

Table 8.5 Sensitivity of the Area to Human Health Impacts

The IAQM guidance (2014) also outlines the criteria for determining the sensitivity of an ecological receptor to dust impacts. The sensitivity is determined based on the distance to the source, the designation of the site, (European, National or local designation) and the potential dust sensitivity of the ecologically important species present.

Only ecological sites within 50 m of the proposed development site need to be considered in relation to dust impacts (IAQM, 2014). Lower River Shannon SAC is within 20m of the northern boundary of the site. This can be considered a high sensitivity receptor according to the IAQM guidance due to the presence of nationally important species (IAQM, 2014). According to the IAQM criteria in Table 8.6 the sensitivity of the area to dust related ecological impacts is high.

Receptor Sensitivity	**Distance from the Source (m)**	
	<20	**<50**
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table 8.6 Sensitivity of the Area to Dust Related Ecological Impacts

8.3 Do Nothing Scenario

The Do-Nothing scenario includes retention of the current site without the proposed development in place. In this scenario, ambient air quality at the site will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc).

As the site is zoned for development, in the absence of the proposed development it is likely that a development of a similar nature would be constructed in the future in line with national policy and the development plan objectives. Therefore, the construction and operational phase impacts outlined in this assessment are likely to occur in the future even in the absence of the proposed development.

8.4 Likely Significant Effects

8.4.1 Construction Phase

8.4.1.1 Air Quality

The greatest potential impact on air quality during construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust. While construction dust tends to be deposited within 350m of a construction site, the majority of the deposition occurs within the first 50m. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. A review of Shannon Airport meteorological data (see Section 8.2.1) indicates that the prevailing wind direction is south-westerly and wind speeds are generally moderate in nature. In addition, dust generation is considered negligible on days where rainfall is greater than 0.2 mm. A review of historical 30-year average data for Shannon Airport meteorological station indicates that on average 211 days per year have rainfall over 0.2 mm (Met Eireann, 2021) and therefore it can be determined that over 57% of the time dust generation will be reduced. It is important to note that the potential impacts associated with the construction phase of the proposed development are short-term in nature.

In order to determine the level of dust mitigation required during the proposed works, the potential dust emission magnitude for each dust generating activity needs to be taken into account, in conjunction with the previously established sensitivity of the area (see Section 8.2.4). The major dust generating activities are divided into four types within the IAQM guidance to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and

- Trackout (movement of heavy vehicles).

Demolition

Demolition will primarily involve the removal of buildings or structures currently on the site in a potentially dusty manner. This may also involve dust generation at heights. Dust emission magnitude from demolition can be classified as small, medium and large and are described below.

Large: Total building volume >50,000 m3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
Medium: Total building volume 20,000 m3 – 50,000 m3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
Small: Total building volume less than 20,000 m3.

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 8.7 Risk of Dust Impacts - Demolition

As part of the proposed SHD there is the requirement for demolition of 1 no. existing derelict building. This is an industrial storage type building set in its own grounds, formally occupied by Limerick Transport. Under the IAQM guidance (2014) the proposed demolition can be classified as small. This results in an overall low risk of dust soiling impacts, a negligible risk of human health impacts and a medium risk of ecological impacts as a result of demolition activities prior to mitigation (see Table 8.7).

Earthworks

Earthworks typically involve excavating material, loading and unloading of materials, tipping and stockpiling activities. Activities such as levelling the site and landscaping works are also considered under this category. Following the IAQM guidance (2014), dust emission magnitude from earthworks can be classified as small, medium and large and are described below.

- **Large**: Total site area > 10,000 m2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved >100,000 tonnes;
- **Medium**: Total site area 2,500 m2 – 10,000 m2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8 m in height, total material moved 20,000 – 100,000 tonnes; and
- **Small:** Total site area < 2,500 m2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

Under the IAQM guidance (2014) the proposed earthworks can be classified as large. This results in an overall medium risk of dust soiling impacts, a low risk of human health impacts and a high risk of ecological impacts as a result of earthworks activities prior to mitigation (see Table 8.8).

Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.8 Risk of Dust Impacts - Earthworks

Construction

Dust emission magnitude from construction can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large**: Total building volume > 100,000 m3, on-site concrete batching, sandblasting;
- **Medium**: Total building volume 25,000 m3 – 100,000 m3, potentially dusty construction material (e.g. concrete), on-site concrete batching;
- **Small**: Total building volume < 25,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber).

The dust emission magnitude from construction associated with the proposed development works can be classified as large due to the total building volume involved exceeding 100,000 m3. The gross floor area of the overall development is circa 45,478 m2. Assuming an average floor to floor height of 3m this would equate to a gross buildings volume of >136,000 m3. Therefore, there is an overall medium risk of dust soiling impacts, a low risk of human health impacts and a high risk of ecological impacts as a result of the proposed construction activities prior to mitigation (Table 8.9).

Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.9 Risk of Dust Impacts – Construction

Trackout

Factors which determine the dust emission magnitude associated with trackout are vehicle size, vehicle speed, number of vehicles, road surface material and duration of movement. Dust emission magnitude from trackout can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large**: > 50 HGV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m;
- **Medium**: 10 - 50 HGV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 - 100 m;
- **Small**: < 10 HGV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.

Dust emission magnitude from trackout can be classified as large under IAQM guidance as there is likely to be more than 100m of unpaved site road and the HGVs may be up to 50 per day during the peak construction period. This results in an overall medium risk of dust soiling impacts, a low risk of human health impacts and a high risk of ecological impacts as a result of the proposed trackout activities prior to mitigation (see Table 8.10).

Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Table 8.10 Risk of Dust Impacts – Trackout

Summary of Dust Emission Risk

The risk of dust impacts as a result of the proposed development are summarised in Table 8.11 for each activity. The magnitude of risk determined is used to prescribe the level of site specific mitigation required for each activity in order to prevent significant impacts occurring.

Overall, in order to ensure that no dust nuisance occurs during the demolition, earthworks, construction and trackout activities, a range of dust mitigation measures associated with a high risk of dust impacts must be implemented. In the absence of mitigation dust impacts from construction works are predicted to be short-term, localised, negative and slight.

Potential Impact	**Dust Emission Magnitude**			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Dust Soiling	Low Risk	Medium Risk	Medium Risk	Medium Risk
Human Health	Negligible Risk	Low Risk	Low Risk	Low Risk
Ecology	Medium Risk	High Risk	High Risk	High Risk

Table 8.11 Summary of Dust Impact Risk used to Define Site-Specific Mitigation

There is also the potential for traffic emissions to impact air quality in the short-term over the construction phase. Particularly due to the increase in HGVs accessing the site. The construction stage traffic provided has been reviewed and a detailed air quality assessment has been scoped out as none of the road links impacted by the proposed development satisfy the UK HA LA 105 assessment criteria in Section 8.1.3.1. It can therefore be determined that the construction stage traffic will have a neutral, imperceptible, localised and short-term impact on air quality due to the minor increase in site related traffic as a result of the proposed development.

8.4.1.2 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., will give rise to CO2 and N2O emissions. The Institute of Air Quality Management document Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on emissions. Therefore, the impact on climate is assessed to be neutral, localised, imperceptible and short term.

8.4.1.3 Human Health

Dust emissions from construction activities have the potential to impact human health through PM10 and PM2.5 emissions. The overall sensitivity of the area to human health impacts from dust emissions is considered low as per Section 8.4.4. It has been established that there is a low risk of human health impacts from construction dust emissions. Therefore, in the absence of mitigation human health impacts are considered short-term, localised, negative and imperceptible.

8.4.2 Operational Phase

8.4.2.1 Air Quality

The impact of the proposed development has been assessed by modelling emissions from the traffic generated as a result of the development. The impact of NO2 emissions for the opening and design years was predicted at the nearest sensitive receptors to the development. This assessment allows the significance of the development, with respect to both relative and absolute impacts, to be determined.

Transport Infrastructure Ireland's document 'Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes' (2011) detail a methodology for determining air quality impact significance criteria for road schemes and this can be applied to any development that causes a change in traffic. The degree of impact is determined based on both the absolute and relative impact of the proposed development. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed development is not in place in future years, in order to determine the degree of impact. Impacts were assessed at 4 no. worst-case sensitive receptors, residential properties (R1 to R4) within 200m of the road links impacted by the proposed development (see Table 8.3 and Figure 8.1). These three residential properties and a school are a representative sample of sensitive receptors on the impacted roads.

The results of the assessment of the impact of the proposed development on NO2 in the opening year 2023 are shown in Table 8.12 and for design year 2038 are shown in Table 8.13. The annual average concentration is in compliance with the limit value at all worst-case receptors in 2023 and 2038. Concentrations of NO2 are at most 41% of the annual limit value in 2023 and 40% of the annual limit in 2038. There are some increases in traffic levels between the opening and design years, therefore any reduction in concentrations is due to reduced background concentrations. In addition, the hourly limit value for NO2 is 200 µg/m3 and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO2 concentration is not predicted to be exceeded in any modelled year (Table 8.14).

The impact of the proposed development on annual mean NO2 concentrations can be assessed relative to "Do Nothing (DN)" levels. Relative to baseline levels, there are predicted to be some imperceptible increases in NO2 concentrations at the worst-case receptors assessed. Concentrations will increase by at most 0.3% of the annual NO2 limit value at receptor R2 in 2023. Changes in concentrations are similarly low for the design year 2038, concentrations at receptor R3 will increase by 0.26%. Using the assessment criteria outlined in Appendix 8.2 Table A1.3.1 and Table A1.3.2 the impact of the proposed development in terms of NO2 is considered negligible. Therefore, the overall impact of NO2 concentrations as a result of the proposed development is long-term, negative and imperceptible.

Concentrations of PM10 were modelled for the baseline year of 2019. The modelling showed that concentrations were in compliance with the annual limit value of 40 µg/m3 at all receptors assessed, therefore, further modelling for the opening and design years was not required. Concentrations due to modelled traffic reached at most 0.08 µg/m3. When a background concentration of 17 µg/m3 is included the overall impact is 45% of the annual limit value at the worst case receptor.

The impact of the proposed development on ambient air quality in the operational stage is considered long-term, localised, negative and imperceptible.

Receptor	Impact Opening Year 2023				
	DN	DS	DS - DN	Magnitude	Description
1	14.0	14.0	0.01	Imperceptible	Negligible
2	15.6	15.7	0.12	Imperceptible	Negligible
3	17.0	17.1	0.11	Imperceptible	Negligible
4	13.7	13.7	0.02	Imperceptible	Negligible

Table 8.12 Predicted Annual Mean NO2 Concentrations – Opening Year 2023 (µg/m3).

Receptor	Impact Design Year 2038				
	DN	DS	DS - DN	Magnitude	Description
1	14.1	14.1	0.01	Imperceptible	Negligible
2	16.0	16.1	0.10	Imperceptible	Negligible
3	17.5	17.6	0.11	Imperceptible	Negligible
4	13.8	13.8	0.01	Imperceptible	Negligible

Table 8.13 Predicted Annual Mean NO2 Concentrations – Design Year 2038 (µg/m3).

Receptor	Opening Year 2023		Design Year 2038	
	DN	DS	DN	DS
R1	47.6	47.6	45.3	45.4
R2	53.2	53.6	52.1	52.5

R3	58	58.4	56.9	57.2
R4	46.6	46.6	44.5	44.5

Table 8.14 Predicted 99.8th percentile of Daily Maximum 1-hour NO2 Concentrations (µg/m3).

8.4.2.2 Human Health

Traffic related air emissions have the potential to impact human health if they do not comply with the ambient Air Quality Standards detailed in Table 8.1. There are no exceedances of these limit values predicted. Therefore, in the absence of mitigation human health impacts are considered long-term, localised, negative and imperceptible.

8.4.2.3 Air Quality Impact on Designated Sites

The impact of NOX (i.e. NO and NO2) emissions resulting from the traffic associated with the proposed SHD at the Lower River Shannon SAC (Site Code 002165) was assessed. Ambient NOX concentrations were predicted for the assessment years of 2023 and 2038 along a transect of up to 200m, starting from 7 m which is the distance from the Pa Healy Road to the designated areas boundaries and are given in Table 8.16 for 2023 and Table 8.17 for 2038 for the SAC. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of TII (2011).

The predicted annual average NOX levels in the Lower River Shannon SAC are below the limit value of 30 µg/m3 for the “Do Nothing” and the “Do Something” (i.e. the proposed development) scenarios, with NOX concentrations reaching 89% of the limit value in the DN and 91% of the limit value in the DS, including background levels.

The impact of the proposed development can be assessed relative to “Do Nothing” levels, the impact of the proposed SHD leads to an increase in NOX concentrations of at most 0.56 µg/m3 within the SAC. Appendix 9 of the TII guidelines (2011) states that where the scheme or development is expected to cause an increase of more than 2 µg/m3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NOX should be assessed by the project ecologist. Concentrations within the SAC is not predicted to increase by 2 µg/m3 or more and the predicted concentrations are also below the standard, as such it was not necessary for the sensitivity of the habitat to NOX to be assessed by an ecologist as there is no potential for significant impacts to ecology from NOX emissions.

The contribution to the NO2 dry deposition rate along the 200m transect within the SAC is also detailed in Table 8.16 for 2023 and Table 8.17 for 2038. The maximum increase in the NO2 dry deposition rate is 0.03 Kg(N)/ha/yr. This is well below the critical load for inland and surface water habitats of 5 - 10Kg(N)/ha/yr (TII, 2011).

It can be determined that the impact from air quality on the designated sites is negative, long-term and imperceptible.

Distance to Road (m)	**NO_X Concentration (µg/m^3)**			**NO_2 Dry Deposition Rate Impact (Kg N ha^{-1} yr^{-1})**
	Do Nothing	**Do Something**	**Change in NOx Concentration**	
7	26.63	27.18	0.56	0.0300
17	24.20	24.63	0.43	0.0230
27	22.33	22.65	0.32	0.0180
37	20.98	21.23	0.25	0.0140
47	19.97	20.16	0.20	0.0110
57	19.19	19.34	0.16	0.0090
67	18.58	18.70	0.12	0.0060
77	18.09	18.19	0.10	0.0050
87	17.71	17.78	0.08	0.0030
97	17.40	17.46	0.06	0.0020
107	17.16	17.20	0.05	0.0020
117	16.97	17.00	0.04	0.0010
127	16.82	16.85	0.03	0.0020
137	16.72	16.74	0.02	0.0010
147	16.65	16.67	0.02	0.0000
157	16.61	16.63	0.02	0.0010
167	16.60	16.61	0.02	0.0000
177	16.55	16.57	0.01	0.0000
187	16.51	16.52	0.01	0.0000
197	16.46	16.47	0.01	0.0010

Table 8.16 Predicted Air Quality Impact on Designated Sites 2023

Distance to Road (m)	NO_X Concentration (µg/m^3)			NO_2 Dry Deposition Rate Impact (Kg N ha^{-1} yr^{-1})
	Do Nothing	Do Something	Change in NOx Concentration	
7	28.90	29.36	0.46	0.024
17	25.94	26.29	0.35	0.019
27	23.66	23.92	0.27	0.015
37	22.01	22.22	0.21	0.011
47	20.77	20.94	0.16	0.009
57	19.82	19.95	0.13	0.007
67	19.08	19.18	0.10	0.005
77	18.49	18.57	0.08	0.004
87	18.02	18.08	0.06	0.002
97	17.64	17.69	0.05	0.002
107	17.34	17.38	0.04	0.001
117	17.11	17.14	0.03	0.001
127	16.94	16.96	0.02	0.001
137	16.81	16.83	0.02	0.000
147	16.73	16.74	0.02	0.000
157	16.68	16.69	0.01	0.000
167	16.66	16.67	0.01	0.001
177	16.61	16.62	0.01	0.000
187	16.55	16.56	0.01	0.000
197	16.50	16.50	0.01	0.000

Table 8.17 Predicted Air Quality Impact on Designated Sites 2038

8.4.3 Climate

The proposed development will not increase traffic by more than 10% AADT on any road links, therefore, the scoping criteria set out in Section 8.1.3.2 are not met and a detailed climate assessment is not required as there is no potential for significant impacts to climate as a result of traffic emissions.

Climate change has the potential to alter weather patterns and increase the frequency of rainfall in future years. A Flood Risk Assessment (FRA) has been conducted by JBA Consulting as part of the application. This assessment concluded that the sources of flooding the site has been shown to reside predominantly within Flood Zone C with some of the proposed accommodation blocks located within Flood Zone A (defended - tidal) and Flood Zone B (fluvial/tidal).

To manage the risk of flooding, it is proposed to raise the finished flour level of all buildings to a minimum of 5.75mOD, most residential blocks are to be set at 6mOD or above. This is based on the 0.5% tidal level (4.75mOD) plus 0.5m climate change and 0.5m freeboard. This will provide adequate mitigation for future flood events including climate change and freeboard. All surface run-off from roofs, paved areas, and open spaces are to be captured, detained, treated, and eventually discharged to the Canal channel. Storage is provided in 2 no. ponds for the 1% AEP rainfall event plus climate change (20%). Stormwater is managed appropriately and the open space within the site is configured to avoid conflict with existing Flood Zones. The Justification Test the FRA applies has been applied and passed and the proposed development will also be protected against the potential impacts from climate change.

8.4.4 Cumulative

Should the construction phase of the proposed development coincide with the construction of any other permitted developments within 350m of the site then there is the potential for cumulative dust impacts to the nearby sensitive receptors according to the IAQM guidance (IAQM, 2014).

However appropriate dust mitigation measures, as outlined in Appendix 8.3, will be applied throughout the construction phase of the proposed development which will avoid significant cumulative impacts on air quality from coinciding construction phases. With appropriate mitigation measures in place, the predicted cumulative impacts on air quality associated with the construction phase of the proposed development are deemed short-term and not significant.

Cumulative impacts have been incorporated into the traffic data supplied for the operational stage air and climate modelling assessments where such information was available. The results of the modelling assessment (Section 8.4.2) show that there is a long-term, negative and imperceptible impact to air quality and climate during the operational stage.

8.4.5 Worst-case Scenario

In terms of construction phase impacts, worst-case assumptions regarding volumes of excavation materials and number of vehicle movements have been used in order to determine the highest level of mitigation required in relation to potential dust impacts (see Section 8.4.1.1).

Worst-case traffic data was used in the assessment of construction and operational phase impacts. In addition, conservative background concentrations were used in order to ensure a robust assessment. Thus, the predicted results of the construction and operational stage assessment are worst-case, and the significance of effects is most likely overestimated.

There are no likely risks of major accidents and disasters in relation to air quality associated with the proposed development due to the nature and scale of the development.

8.5 Mitigation Measures and Monitoring

8.5.1 Incorporated Design Mitigation

The proposed development has been designed so as to reduce the impact on climate as much as possible during operation. The External Lighting and Building Lifecycle Report prepared as part of the proposed project and submitted under separate cover with this planning application details a number of design measures that have been considered in order to reduce the impact on climate wherever possible. Such measures include:

- The development will be in compliance with the requirements of the Near Zero Energy Building (NZEB) Standards;
- A renewable energy rating (RER) of 20% will be achieved to comply with Part L (2019) of the NZEB regulations;
- Minimising heat loss where possible;
- Provision of electric car charging points;
- Rainwater harvesting system;
- Design of glazing to maximise solar heat gain.

The following heating and renewable strategies are also being considered for use:

- Gas Absorption Heat Pumps;
- Condensing Boilers;
- Photovoltaic (PV) systems.

These measures will aid in reducing the impact to climate during the operational phase of the proposed development in line with the goals of the Limerick City and County Council - Climate Change Adaptation Strategy 2019-2024.

In addition, adequate attenuation and drainage have been incorporated into the design of the development to avoid potential flooding impacts as a result of increased rainfall events in future years. This includes for drainage system and attenuation storage design allow for a climate related increase in rainfall intensities.

8.5.2 Construction Phase Mitigation

8.5.2.1 Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. A dust management plan will be implemented onsite. The main contractor will be responsible for the coordination and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. Full details of the dust management plan can be found in Appendix 8.3. These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) for the site.

In summary the measures which will be implemented will include:

- Drop heights from conveyors, loading shovels, hoppers and other loading equipment will be minimised, if necessary fine water sprays will be employed.
- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads will be restricted to essential site traffic.
- Any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- When conditions are such that there is a risk of trackout of dust (i.e. very dry or muddy), vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads.
- Vehicles using site roads will have their speed restricted through speed limit implementation, and this speed restriction will be enforced rigidly. On any site roads, this will be 20 kmph.
- Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust and other dust generating activities will be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

8.5.2.2 Climate

Impacts to climate during the construction stage are predicted to be imperceptible however, good practice measures can be incorporated to ensure potential impacts are lessened. These include:

- Prevention of on-site or delivery vehicles from leaving engines idling, even over short periods.
- Ensure all plant and machinery are well maintained and inspected regularly.
- Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.

8.5.3 Operational Phase Mitigation

The impact of the proposed development on air quality and climate is predicted to be imperceptible with respect to the operational phase in the long term. Therefore, no additional site specific mitigation measures are required beyond the site specific incorporated design mitigation as described in Section 8.5.1.

8.5.4 Monitoring

Monitoring of construction dust deposition at locations along the site boundary close to the nearby sensitive receptors during the construction phase of the proposed development is recommended to ensure mitigation measures are working satisfactorily. This can be carried out using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The TA Luft limit value is 350 mg/(m2*day) during the monitoring period between 28 - 32 days.

There is no monitoring recommended for the operational phase of the development as impacts to air quality and climate are predicted to be imperceptible.

8.6 Residual Impact Assessment

8.6.1 Construction Phase

With the implementation of the dust mitigation measures, associated with a high risk of dust impacts, outlined in Section 8.5.2 and Appendix 8.3 dust impacts from construction will be localised, imperceptible, negative and short-term but will not pose a nuisance at nearby receptors.

Best practice mitigation measures are proposed for the construction phase of the proposed development which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values (see Table 8.1) which are based on the protection of human health. Therefore, the impact of construction of the proposed development is likely to be negative, short-term and imperceptible with respect to human health.

8.6.2 Operational Phase

The proposed development has been designed to reduce the impact on climate where possible. The proposed development will comply with the NZEB standards. Electric vehicle car charging points have been incorporated into the development and increased bicycle parking has been provided to promote a modal shift and thus reduce GHG emissions.

8.6.3 Cumulative

Cumulative construction phase impacts will result from dust emissions impacting people and property within 350m of the proposed development site and neighbouring sites. Impacts are predicted to be negative, short-term and imperceptible at nearby receptors once the dust mitigation measures outlined in Appendix 8.3 are implemented.

According to the IAQM guidance (2014) site traffic, plant and machinery are unlikely to have a significant impact on climate. Therefore, cumulative impacts are not predicted.

Operational phase impacts involve an increase in traffic related pollutants in the local area. The traffic data for the proposed development in conjunction with other nearby permitted and proposed developments was found to have an imperceptible, negative and long-term impact on local air quality and climate.

8.7 Interactions

Air quality does not have a significant number of interactions with other topics. The most significant interactions are between population and human health and air quality. An adverse impact due to air quality in either the construction or operational phase has the potential to cause health and dust nuisance issues. The mitigation measures that will be put in place at the proposed development will ensure that the impact of the proposed development complies with all ambient air quality legislative limits and therefore the predicted impact is short term and imperceptible with respect to population and human health in the construction phase and long term and imperceptible with respect to the operational phase.

Interactions between air quality and traffic can be significant. With increased traffic movements and reduced engine efficiency, i.e. due to congestion, the emissions of vehicles increase. The impacts of the proposed development on air quality are assessed by reviewing the change in annual average daily traffic on roads close to the site. In this assessment, the impact of the interactions between traffic and air quality are considered to be imperceptible due to the low level changes in traffic associated with the proposed development.

The construction and operation of the proposed development will lead to emissions to atmosphere which have the potential to impact on sensitive fora, fauna and water. However, the effect of these emissions is predicted not to be significant for both the construction and operational phase. Construction phase mitigation measures will minimise dust emissions which have the potential to impacts on flora, fauna and water. In the operational phase, impacts meet the criteria set down for ecological sensitive site as discussed in Section 8.4.2 and therefore the interactions between air quality and flora, fauna and water are neutral for both the construction and operational phase.

With the appropriate mitigation measures to prevent fugitive dust emissions (see Section 8.5.2.1 and Appendix 8.3), it is predicted that there will be no significant interactions between air quality and land and soils. No other significant interactions with air quality have been identified.

8.8 Difficulties Encountered

There were no difficulties encountered when completing this assessment.

8.9 Consultation

Having regard to the nature of the proposed development together with the available guidelines for completing air quality and climate assessments, sufficient information existed to scope the content of this chapter and consultation was not deemed necessary.

8.10 References and Sources

Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021).

Department of the Environment Heritage and Local Government (DEHLG) (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities

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Institute of Air Quality Management (IAQM) (2016) Guidance on the Assessment of Dust from Demolition and Construction Version 1.1

Limerick City and County Council' (2021) Climate Change Adaptation Strategy 2019-2024

Met Éireann (2021) Met Eireann website: https://www.met.ie/

The Scottish Office (1996) Planning Advice Note PAN50 Annex B: Controlling The Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings

Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes

UK Highways Agency (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document & Calculation Spreadsheet)

UK Highways Agency (2019a) UK Design Manual for Roads and Bridges (DMRB), Volume 11, Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 LA 105 Air quality

UK Highways Agency (2019b) UK Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 14 LA 114 Climate

UK Office of Deputy Prime Minister (2002) Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance

USEPA (1997) Fugitive Dust Technical Information Document for the Best Available Control Measures

World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000)

APPENDIX 8.1 Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC) (see Table 12-1). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. Council Directive 1999/30/EC, as relating to limit values for sulphur dioxide, nitrogen dioxide, lead and particulate matter, is detailed in Table 13.1. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM10, 40% for the hourly and annual limit value for NO2 and 26% for hourly SO2 limit values. The margin of tolerance commenced from June 2002, and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to PM2.5. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for PM2.5 are included in Directive 2008/50/EC. The approach for PM2.5 was to establish a target value of 25 µg/m3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m3, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to PM2.5 between 2010 and 2020. This exposure reduction target will range from 0% (for PM2.5 concentrations of less than 8.5 µg/m3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m3). Where the AEI is currently greater than 22 µg/m3 all appropriate measures should be employed to reduce this level to 18 µg/m3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three year period from 2008 - 2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as “a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC”. These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NOX (NO and NO2) is applicable for the protection of vegetation in highly rural areas away from major sources of NOX such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NOX limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway
- 5 km from the nearest major industrial installation
- 20 km from a major urban conurbation

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

APPENDIX 8.2 Transport Infrastructure Ireland Significance Criteria

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Table A12.2.1 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Table A12.2.2 Air Quality Impact Significance Criteria For Annual Mean Nitrogen Dioxide and PM10 and PM2.5 Concentrations at a Receptor

APPENDIX 8.3 Dust Management Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (IAQM (2014), The Scottish Office (1996), UK Office of Deputy Prime Minister (2002) and BRE (2003)) and the USA (USEPA (1997)).

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance. As the prevailing wind is predominantly south-westerly, locating construction compounds and storage piles downwind (to the east) of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;

- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;
- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Demolition

Prior to demolition blocks should be soft striped inside buildings (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).

During the demolition process, water suppression should be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used.

Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed.

Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK Office of Deputy Prime Minister, 2002).

A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;

- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing / Earth Moving

Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK Office of Deputy Prime Minister, 2002);
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and
- The specification of effective measures to deal with any complaints received.

9.0 NOISE AND VIBRATION

9.1 Introduction

This document prepared by AWN Consulting Ltd. (AWN) to assess the potential noise and vibration impacts of the proposed development in the context of current relevant standards and guidance.

This assessment has been prepared by Mike Simms BE MEngSc MIOA MIET, Senior Acoustic Consultant at AWN, who has worked in the field of acoustics for 20 years and has been a consultant since 1998. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential.

This report includes a description of the receiving ambient noise climate in the vicinity of the subject site and an assessment of the potential noise and vibration impact associated with the proposed development, during both the short-term construction phase and the permanent operational phase, on its surrounding environment. The assessment of direct, indirect and cumulative noise and vibration impacts on the surrounding environment have been considered as part of the assessment.

Mitigation measures are included, where relevant, to ensure the proposed development is constructed and operated in an environmentally sustainable manner in order to ensure minimal impact on the receiving environment.

9.2 Assessment Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out within the relevant sections of this report. In addition to specific guidance documents for the assessment of noise and vibration impacts which are discussed further in the relevant sections, the following guidelines were considered and consulted for the purposes of this report:

- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft August 2017 and
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

The study has been undertaken using the following methodology:

- An environmental noise survey has been undertaken in the vicinity of the subject site in order to characterise the existing baseline noise environment;
- A review of the most applicable standards and guidelines has been conducted in order to set a range of acceptable noise and vibration criteria for the construction and operational phases of the proposed development;
- Predictive calculations have been performed during the construction phase of the project at the nearest sensitive locations to the development site;
- Predictive calculations have been performed to assess the potential impacts associated with the operational of the development at the most sensitive locations surrounding the development site; and
- A schedule of mitigation measures has been proposed to reduce, where necessary, the identified potential outward impacts relating to noise and vibration from the proposed development.

9.2.1 Construction Phase Criteria

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local Authorities typically control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

The approach adopted here calls for the designation of an NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. A threshold noise value is applied to each category. Exceedances (construction noise only) of the threshold value, at the facade of a sensitive receptor during construction, indicates a potential significant noise impact associated with the construction activities. The threshold values recommended by BS5228-1 are set out in Table 9.1.

Assessment category and threshold value period (L_{Aeq})	**Threshold value, in decibels (dB)**		
	Category A Note A	**Category B** Note B	**Category C** Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

Table 9.1 Example Threshold of Significant Effect at Dwellings

Note A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Note B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

Note C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

Note D) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only valid for residential properties.

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. Based on review of existing noise levels obtained from the noise survey, relevant BS5228-1 threshold values at the various assessment locations are presented in Table 9.2.

Period	**Construction Noise Threshold Value $L_{Aeq,1hr}$ (dB)**	**Baseline Noise Category**
Daytime (07:00 – 19:00) and Saturdays(07:00 – 13:00)	65	A
Evening(19:00 to 23:00hrs)	55	A
Night time (23:00 to 07:00hrs)	45	A

Table 9.2 Rounded Baseline Noise Levels and Associated Categories

See Section 9.5.1.1 for the assessment in relation to this development. If the construction noise level exceeds the appropriate category value, then a potential significant effect is deemed to occur.

Guidance on the degree of significance is presented the UK document *Design Manual for Roads and Bridges (2020) LA 111 Sustainability & Environmental Appraisal. Noise and Vibration Rev 2*. The approach is as follows:

- to determine the threshold value for construction noise according to the method from BS5228 described above and
- to compare the predicted construction noise level with the existing noise levels and the threshold value according to the criteria in the table below.

Potentially this procedure is to be followed separately for each noise-sensitive location, however in this instance as the existing noise levels at all survey locations correspond to Category A according to table above, all noise-sensitive locations are considered together.

Similarly, for this proposed development the vast majority of construction works will take place within the 'Daytime' period, i.e. 07:00 – 19:00 on Mondays to Fridays and 07:00 – 13:00 on Saturdays.

The magnitude of the construction noise impact according the DMRB is mapped to the EPA significance terms as detailed in Table 9.3:

Construction Noise Level	**Magnitude of Impact (DMRB)**	**EPA Significance of Effect**
Below or equal Baseline Noise Level	Negligible	Not Significant
Above Baseline and below or equal to threshold	Minor	Slight – Moderate
Above threshold and below or equal to threshold + 5dB	Moderate	Moderate – Significant
Above threshold + 5dB	Major	Significant – Very Significant

Table 9.3 Description of Construction Noise Impacts based on DMRB

9.2.1.1 Construction Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV).

9.2.1.1.1 Building Damage

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5 mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration. For example, rock breaking and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12 mm/s and 5 mm/s respectively. This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant of such activities during the night.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- British Standard BS 7385: 1993: *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration*, and;

- British Standard BS 5228-2: 2009+A1:2014: *Code of practice for noise and vibration control on construction and open sites – Vibration*.

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. Below these values minor damage is unlikely. Where continuous vibration is such as to give rise to dynamic magnification due to resonance, the guide values may need to be reduced by up to 50%. BS 5288-2 also comments that important buildings which are difficult to repair might require special consideration on a case by case basis.

BS 5228-2 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

Suggested levels of allowable vibration (in terms of peak particle velocity) at the closest part of a sensitive property to the source of vibration are summarized in Table 9.4.

Line (see Figure 3)	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4Hz to 15Hz	15Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings.	50 mm/s at 4Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial building types.	15 mm/s at 4Hz increasing to 20 mm/s at 15Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Table 9.4 Transient Vibration Guide Values for Cosmetic Building Damage

Note 1 Values referred to are at the base of the building.

Note 2 For Line 2, at frequencies below 4Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

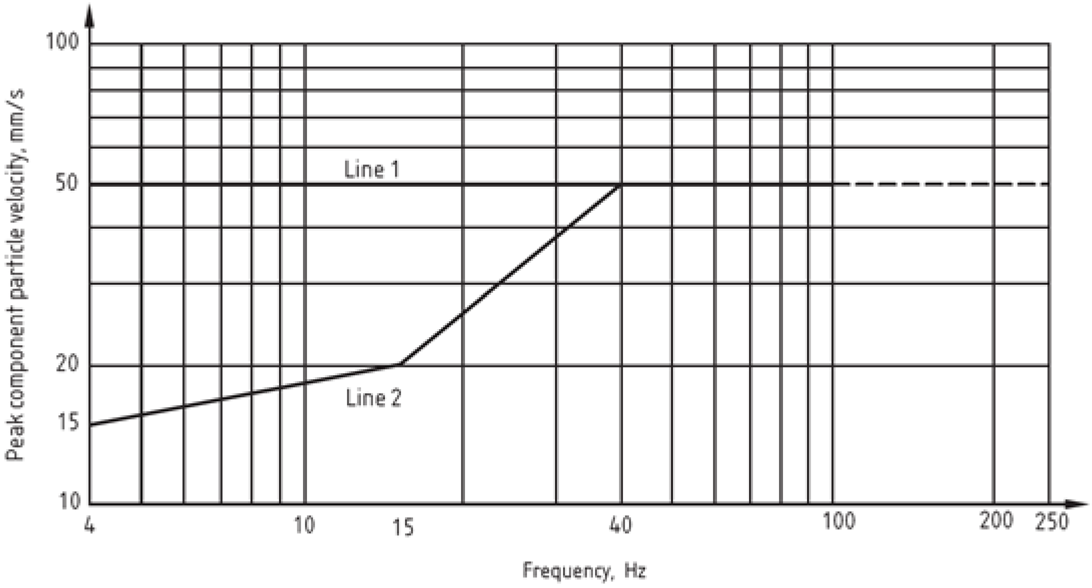

Figure 9.1: Transient Vibration Guide Values for Cosmetic Damage

The guide values contained in Table 9.4 relate to predominantly transient vibration which does not give rise to resonant responses in structures, and to low rise buildings.

9.2.1.1.2 Human Perception

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. Higher levels of vibration, however, are typically tolerated for single events or events of short duration. For example, during piling, one of the primary sources of vibration during construction, vibration levels may typically be tolerated at up to 2.5mm/s. This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant to such activities during the night-time (or if they are trying to sleep during the daytime).

BS 5228-2 also provides a useful guide relating to the assessment of human response to vibration in terms of the peak particle velocity (PPV). Table 9.5 below summarises the range of vibration values and the associated potential effects on humans.

Vibration Level, PPV	**Effect**
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies. At lower frequencies people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1 mm/s	It is likely that a vibration level of this magnitude in residential environments will cause complaint.
10 mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level

Table 9.5 Guidance on effects of human response to PPV magnitudes

Expected vibration levels from the construction works will be discussed further in Section 9.5.1.1.

9.2.2 Operational Phase Criteria

9.2.2.1 Building Services Plant Noise

The most appropriate standard used to assess the impact of a new continuous source (i.e. plant items) to a residential environment and that often applied but Dublin City Council is BS 4142 *Methods for* *rating and assessing industrial and commercial sound* (2014). This standard describes a method for assessing the impact of a specific noise source at a specific location with respect to the increase in "background" noise level that the specific noise source generates. The standard provides the following definitions that are pertinent to this application:

Specific sound level, $L_{Aeq, Tr}$	is equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T. This level has been determined with reference to manufacturers information for specific plant items.
Rating level $L_{Ar,T}$	is the specific noise level plus adjustments for the character features of the sound (if any), and;
Background noise level	is the sound A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. This level is expressed using the LA90 parameter. These levels were measured as part of the baseline survey.

The assessment procedure in BS4142: 2014 is outlined as follows:

1. determine the specific noise level;
2. determine the rating level as appropriate;
3. determine the background noise level, and;
4. subtract the background noise level from the specific noise level in order to calculate the assessment level.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific source will have an adverse impact or a significant adverse impact. A difference of +10dB or more is a likely to be an indication of a significant adverse impact. A difference of around +5dB is likely to be an indication of an adverse impact, dependent on the context. Where the rated plant noise level is equivalent to the background noise level, noise impacts are typically considered to be neutral.

9.2.2.2 Additional traffic on surrounding roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development. In order to assist with the interpretation of the noise associated with additional vehicular traffic on public roads, Table 9.6, taken from DMRB, offers guidance as to the likely degree of impact associated with any long-term change in traffic noise level.

Change in Sound Level (dB)	**Subjective Reaction**	**DMRB Magnitiude of Impact**	**EPA Significance of Effect**
0	Inaudible	No impact	Imperceptible
0.1 – 2.9	Barely Perceptible	Negligible	Not significant
3 – 4.9	Perceptible	Minor	Slight, Moderate
5 – 9.9	Up to a doubling of loudness	Moderate	Significant
10+	Doubling of loudness and above	Major	Very significant

Table 9.6 Significance in Change of Noise Level

The guidance outlined in Table 9.6 will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely long-term impacts during the operational phase.

9.2.2.3 Inward Noise Impact

9.2.2.3.1 Limerick Noise Action Plan (NAP)

The Limerick Noise Action Plan (NAP) was finalised in October 2018. The NAP states that in order to give effect to National Policy Objective 65 of the National Planning Framework 2040, that the following strategic approach will be adopted by the Council:

> *“Ensuring that appropriate noise assessments are carried out in respect of planning applications for residential and other noise sensitive developments and the principles of good acoustic design are applied, in line with "Professional Practice Guidance on Planning & Noise: New Residential Developments" (2017) (ProPG) and that predicted internal and external noise levels are in keeping with World Health Organisation recommendations and guidance.”*

In addition, the following is provided

> *“All new applications for residential developments will be assessed in accordance with this policy and where there is the likelihood of an adverse noise impact that planning applications should be supplemented by an Acoustic Design Statement carried out by appropriately qualified acousticians and competent persons. The Acoustic Design Statement should demonstrate that all facets of the "Professional Practice Guidance on Planning & Noise" have been followed”.*

In accordance with this NAP policy, a complete assessment of inward noise impact has been incorporated into this EIAR chapter to comply with the requirements of this policy.

9.2.2.3.2 ProPG: Planning & Noise

The Professional Guidance on Planning & Noise (ProPG) document was published in May 2017. The document was prepared by a working group comprising members of the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH). Although not a UK or Irish government document, since its publication it has been generally considered as a best practice guidance and has been widely adopted in the absence of equivalent Irish guidance.

The ProPG outlines a systematic risk-based 2-stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

- Stage 1 - Comprises a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels; and,

- Stage 2 – Involves a full detailed appraisal of the proposed development covering four “key elements” that include:
    - Element 1 - Good Acoustic Design Process;
    - Element 2 - Noise Level Guidelines;
    - Element 3 - External Amenity Area Noise Assessment, and;
    - Element 4 - Other Relevant Issues.

A key component of the evaluation process is the preparation and delivery of an Acoustic Design Statement (ADS) which is intended for submission to the planning authority. This document is intended to clearly outline the methodology and findings of the Stage 1 and Stage 2 assessments, so as the planning authority can make an informed decision on the permission. ProPG outlines the following possible recommendations in relation to the findings of the ADS:

A. Planning consent may be granted without any need for noise conditions;

B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects (“avoid”); or,

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects (“prevent”).

Section 3.0 of the ProPG provides a more detailed guide on decision making to aid local authority planners on how to interpret the findings of an accompanying Acoustic Design Statement (ADS).

A summary of the ProPG approach is illustrated in Figure 9.2.

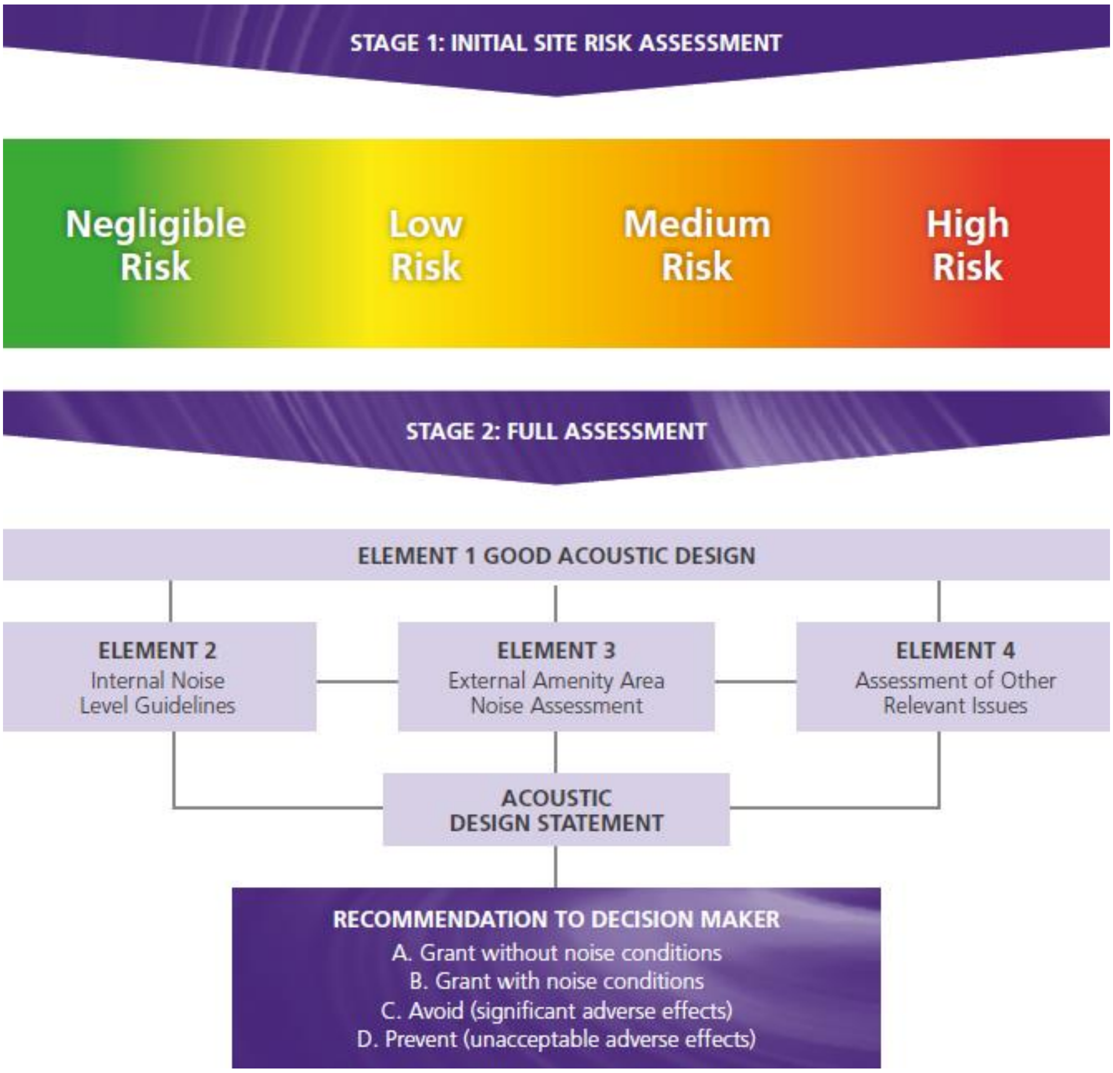

Figure 9.2: ProPG Approach (Source: ProPG)

9.2.2.3.3 WHO Environmental Noise Guidelines for Europe

The World Health Organisation (WHO) have published in October 2018 Environmental Noise Guidelines for the European Region. The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

However, It should be noted that the WHO guideline values referred to here are recommended to serve as the basis for a policy-making process to allow evidence based public health orientated recommendations. They are not intended to be noise limits and the WHO document states the following regarding the implementation of the guidelines,

> *"The WHO guideline values are evidence-based public health-oriented recommendations. As such, they are recommended to serve as the basis for a policy-making process in which policy options are considered. In the policy decisions on reference values, such as noise limits for a possible standard or legislation, additional considerations – such as feasibility, costs, preferences and so on – feature in and can influence the ultimate value chosen as a noise limit. WHO acknowledges that implementing the guideline recommendations will require coordinated effort from ministries, public and private sectors and nongovernmental organizations, as well as possible input from international development and finance organizations. WHO will work with Member States and support the implementation process through its regional and country offices."*

It is therefore not intended to refer to the WHO guidelines in an absolute sense as part of this assessment and it will be a decision for national and local policy makers to adopt the WHO guidelines and propose noise limits for use.

9.2.2.3.4 ProPG: Stage 1 - Noise Risk Assessment

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorisation of the site as a negligible, low, medium or high risk based on the pre-existing noise environment. Figure 9.3 presents the basis of the initial noise risk assessment, it provides appropriate risk categories for a range of continuous noise levels either measured and/or predicted on site.

It should be noted that a site should not be considered a negligible risk if more than 10 L_{AFmax} events exceed 60 dB during the night period and the site should be considered a high risk if the L_{AFmax} events exceed 80 dB more than 20 times a night.

Paragraph 2.9 of ProPG states that,

> *"The noise risk assessment may be based on measurements or prediction (or a combination of both) as appropriate and should aim to describe noise levels over a "typical worst case" 24 hour day either now or in the foreseeable future."*

In this instance it is proposed to develop a 3D computer noise model of the development site and predict the noise levels across the entire site in order to investigate the initial noise risk. The noise model will use the measured noise levels during the survey, discussed in Section 9.3.2, to validate the model. Furthermore, the model allows the site to be assessed taking into account the changes in topography that are required to allow development. This is to comply with the requirements of paragraph 2.8 of ProPG which states,

> *"The risk assessment should not include the impact of any new or additional mitigation measures that may subsequently be included in development proposals for the site and proposed as part of a subsequent planning application. In other words, the risk assessment should include the acoustic effect of any existing site features that will remain (e.g. retained buildings, changes in ground level) and exclude the acoustic effect of any site features that will not remain (e.g. buildings to be demolished, fences and barriers to be removed) if development proceeds."*

In this instance there are buildings to be demolished at the eastern edge of the site, however this it not expected to affect the noise levels at the most exposed southern edge of the site. The site topography is not expected to change significantly during construction.

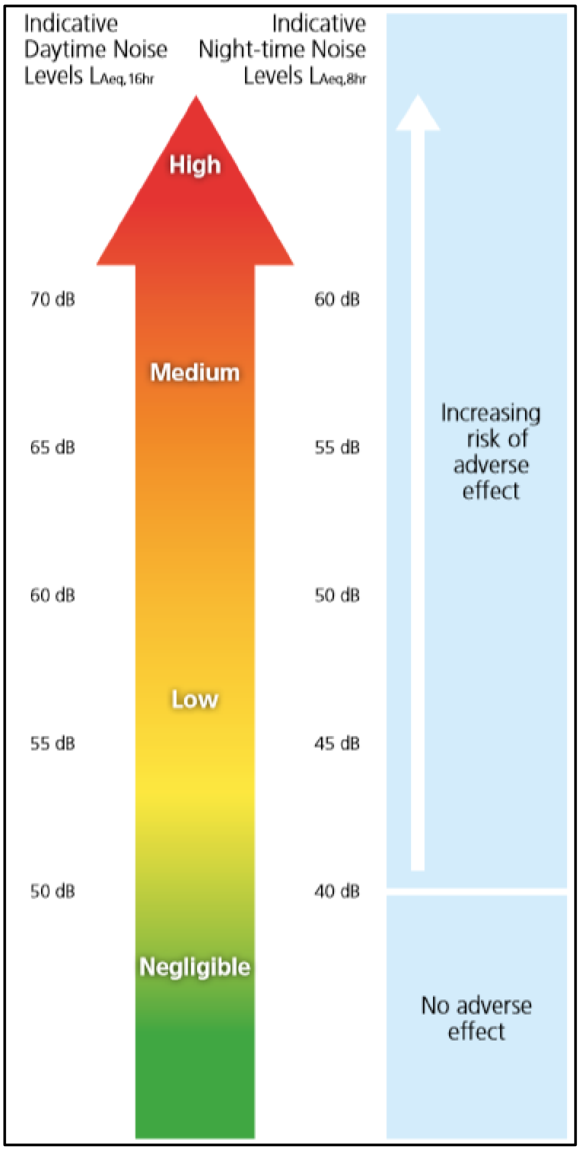

Figure 9.3: ProPG Stage 1 - Initial Noise Risk Assessment

9.3 Receiving Environment

9.3.1 Environmental Noise Surveys

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*.

9.3.1.1 Noise Survey Locations

One unattended and one attended location were chosen to inform the assessment impact of the proposed development:

- UN1: At the southern edge of the site, some 5 meters from the edge of Pa Healy Road
- AT1: At entrance of the existing warehouse within the site along Park Road.

These locations are shown in Figure 9.4 to Figure 9.6.

Figure 9.4: Noise Survey Locations

Figure 9.5: Microphone position at UN1 (see yellow ellipse)

Figure 9.6: Microphone position at AT1

9.3.1.2 Noise Measurement Parameters

The noise survey results are presented in terms of the following parameters:

L_{Aeq}	is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.
L_{AFmax}	is the instantaneous maximum sound level measured during the sample period using the 'F' time weighting.
L_{A10}	is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.
L_{A90}	is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

9.3.1.3 Survey Periods

Unattended noise measurements were conducted on a continuous basis between 10:45hrs in 22 July and 10:45hrs on 24 July 2020.

The attended noise survey was carried out on Friday 18 June 2021. Noise levels were measured over 15-minute periods on a cyclic basis at each measurement location.

The weather during the survey period was dry with varying cloud cover. Wind speeds were moderate; however they were not considered to have had a detrimental effect on the noise measurements.

9.3.1.4 Personnel and Instrumentation

AWN installed and collected the noise monitoring equipment. The following instrumentation was used in conducting the noise and surveys:

Equipment	Type	Serial Number	Calibration Date
Sound Level Meter	Rion NL-52	1076330	October 2020
Sound Level Meter	Bruel & Kjaer 2250 Lite	2818080	July 2021

Table 9.7: Instrumentation Details

9.3.1.5 Unattended Noise Measurements

The results of the unattended monitoring survey at Location UN1 are summarised for daytime periods in Table 9.8 and for night-time periods in Table 9.9.

Monitoring Period/ Range		Measured Noise Levels (dB re. 2x10-5 Pa)	
		L_{Aeq}	L_{A90}
21 September	Highest	73	64
	Lowest	64	40
	Average	71	56
22 September	Highest	73	65
	Lowest	65	40
	Average	71	56
23 September	Highest	73	61
	Lowest	69	49
	Average	71	57
24 September	Highest	71	61
	Lowest	69	41
	Average	73	57

Table 9.8: Summary of Daytime Unattended noise measurements at UN1

Daytime noise levels were in the range 64 to 73 dB $L_{Aeq,15min}$ and 40 to 61 dB $L_{A90,15min}$. Traffic on Pa Healy road was the dominant noise source.

Monitoring Period/ Range		**Measured Noise Levels (dB re. 2x10-5 Pa)**	
		LAeq	**LA90**
21 Sept – 22 Sept	Highest	69	46
	Lowest	40	34
	Average	62	39
22 Sept – 23 Sept	Highest	69	45
	Lowest	54	38
	Average	63	41
22 Sept – 23 Sept	Highest	67	47
	Lowest	55	35
	Average	63	40

Table 9.9: Summary of Night-time Unattended noise measurements at UN1

Daytime noise levels were in the range 63 to 73 dB $L_{Aeq,15min}$ and 40 to 65 dB $L_{A90,15min}$. Night-time noise levels were in the range 40 to 69 dB L_{Aeq} and 34 to 47 dB L_{A90}. Traffic on Pa Healy Road was the dominant noise source.

L_{Aeq} and L_{AFMax} values were measured at 15-minute intervals over the duration of the survey. Figure 9.7 and Figure 9.8 present the number of measured L_{Aeq} and L_{AFMax} events for each decibel level during the day and night periods. It is noted from Figure 9.8 the noise level of 82 dB L_{Amax} is not normally exceeded.

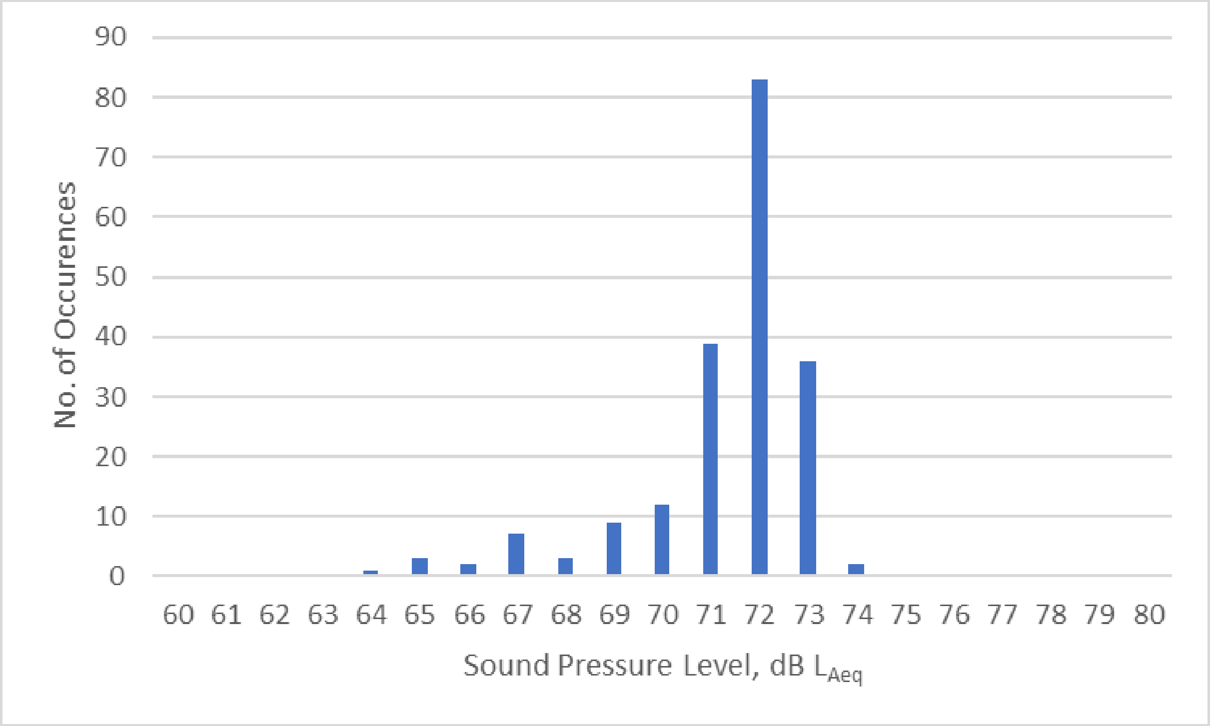

Figure 9.7 Number of Events at Each Decibel Level – Day

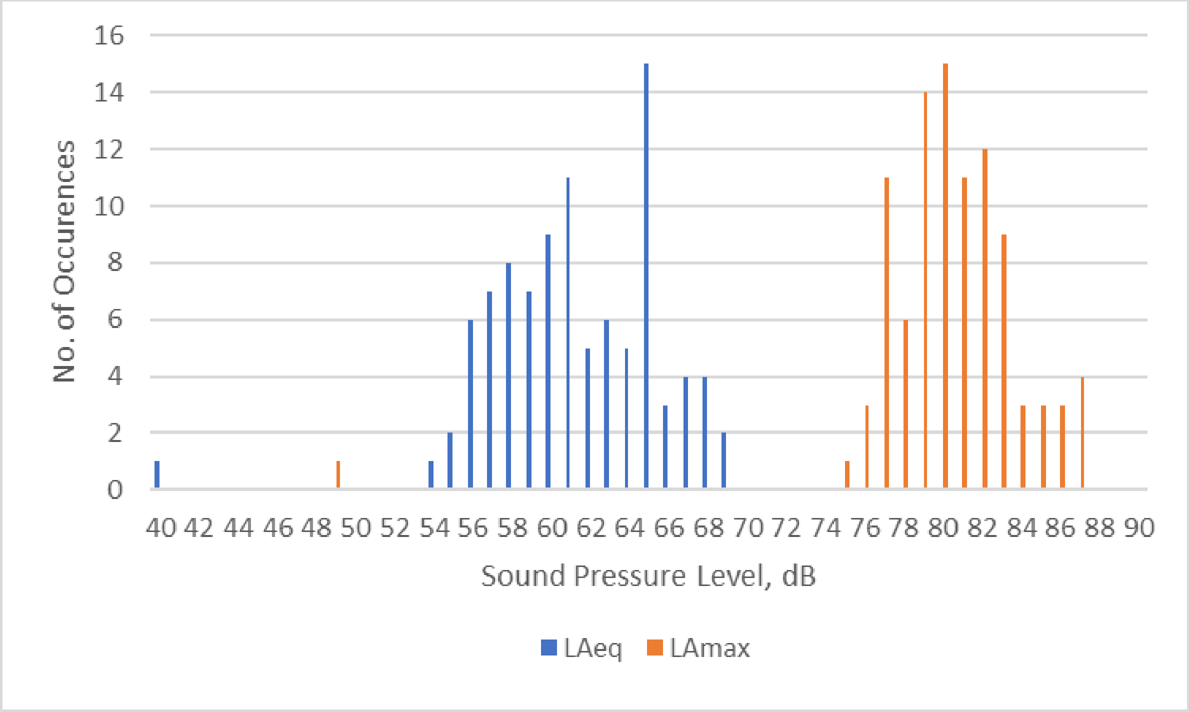

Figure 9.8 Number of Events at Each Decibel Level – Night

9.3.1.6 Attended Noise Measurements

The survey results for the attended monitoring are given in Table 9.10.

Location	Start Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)			
		L_{Aeq}	L_{AFmax}	L_{A10}	L_{A90}
21 Sept	10:30	62	82	66	46
	10:45	62	78	65	46
24 Sept	10:20	61	79	64	48
	10:36	63	82	66	48

Table 9.10: Attended Noise Survey Results

At AT1, the noise environment was dominated by traffic movements along Park Road to the east of the site. Birdsong was also audible.

9.3.2 Road Noise Model

In addition to the noise survey discussed in the previous section, proprietary noise calculation software has been used for the purposes of this impact assessment to calculate road traffic noise levels at various facades across the development site. The selected software, Brüel & Kjær Type 7810 Predictor, calculates noise levels in accordance with the UK's Calculation of Road Traffic Noise (CRTN 1988) which is the recommended procedure for Irish National routes as per Transport Infrastructure Ireland's (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004).

The resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- The magnitude of the noise source in traffic flow and average velocity;
- The distance between the source and receiver;
- The presence of obstacles such as screens or barriers in the propagation path;
- The presence of reflecting surfaces; and,
- The hardness of the ground between the source and receiver.

In order to determine the noise levels at the various façades of the proposed development, the following information was included in the model:

- Site layout drawings of proposed development, and;
- OS mapping of surrounding environment.

The results of the noise survey were used to calibrate the noise model. In this instance the noise model results are within 1dB of the measured values indicating good agreement between the model and the measurements. Figure 9.9 shows a 3D view of the noise developed model.

Predicted noise levels for day and night periods over the site, in the absence of the proposed development are presented in Figure 9.10 and Figure 9.11. These are used to evaluate the Noise Risk at the site.

Figure 9.9 3D Noise model of site

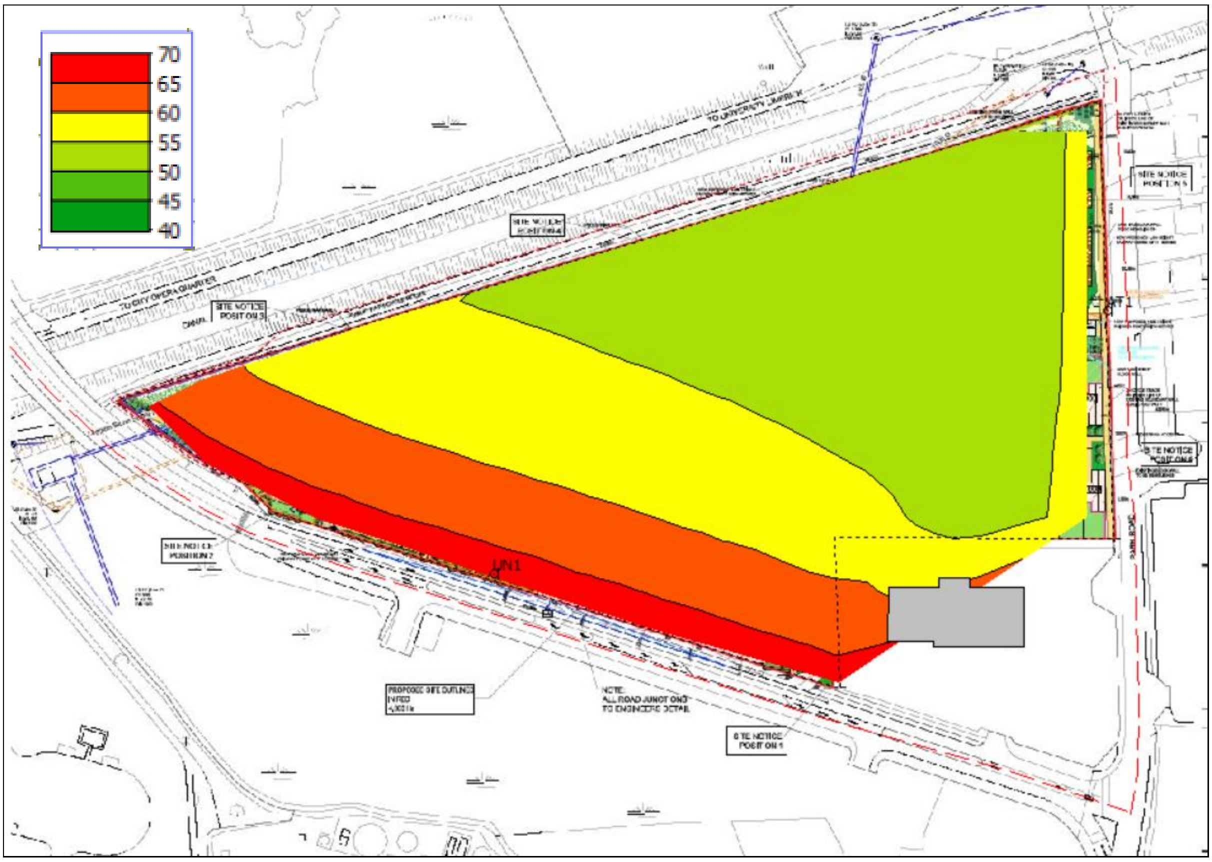

Figure 9.10 3D Daytime noise contours over existing site – in the absence of the development

Figure 9.11 3D Daytime noise contours over existing site – in the absence of the development

Figure 9.12 and Figure 9.13 show the predicted noise level contours over the site with the proposed development in place. Daytime noise levels range from 65 to 70 dB L_{day} at the southern edge of the site, to 55 to 60 dB L_{day} at the eastern edge of the site. Noise levels due to road traffic along the northern edge of the site are significantly lower.

Similarly, night noise levels range from 60 to 65 dB L_{night} at the southern edge of the site, to 50 to 55 dB L_{night} at the eastern edge of the site. Noise levels due to road traffic along the northern edge of the site are significantly lower.

For the purposes of developing noise mitigation measures, the façades in the site are assigned in 'zones' based on the predicted noise level. Figure 9.14 place the façades along Pa Healy Road into Zone A and selected façades along Park Road into Zone B. At other façades, mitigation measures in respect of noise are not deemed required.

Figure 9.12 Daytime predicted noise contours

Figure 9.13 3D Night-time predicted noise contours

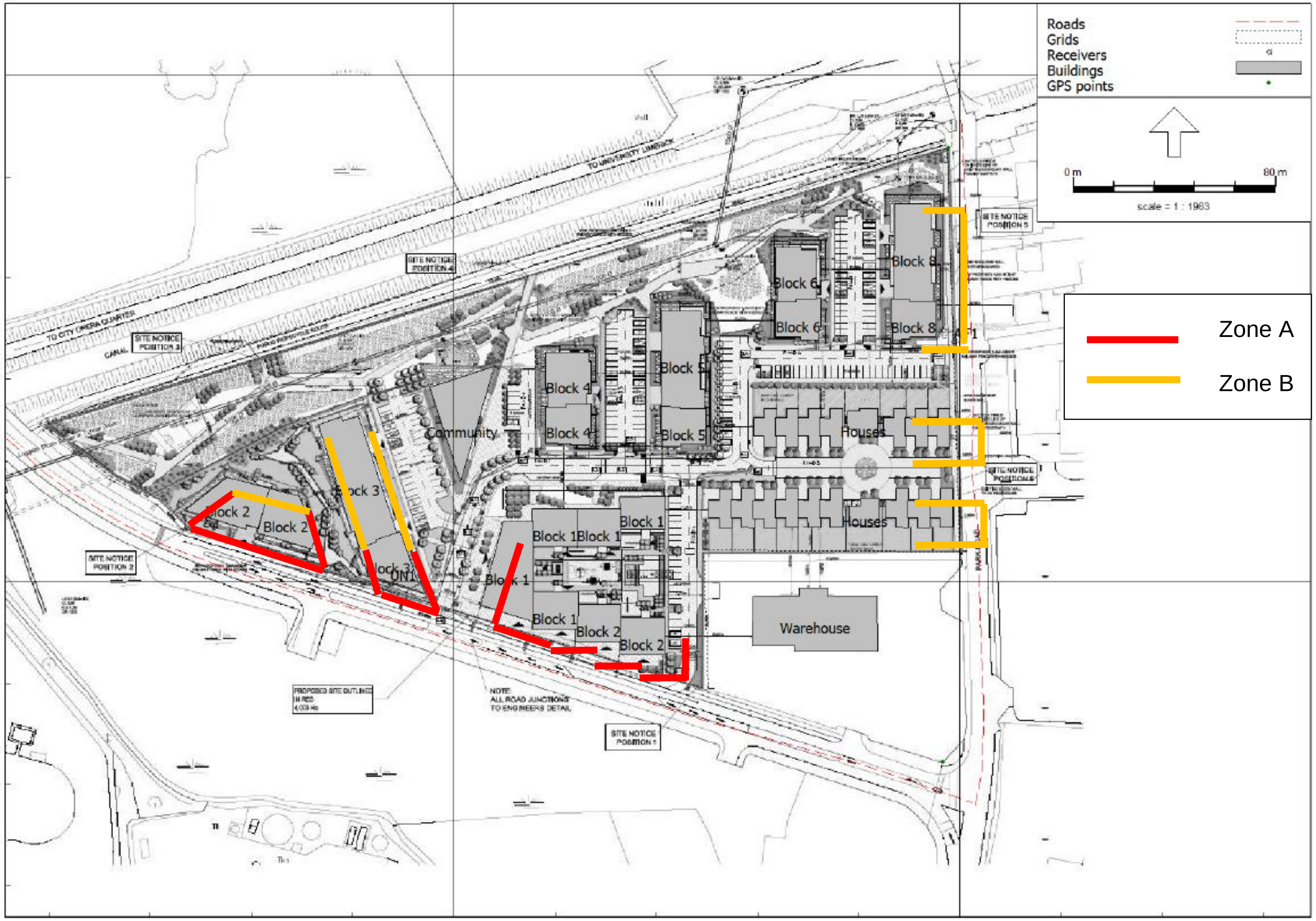

Figure 9.14 Façade zoning for noise mitigation measures

9.3.3 Future Noise Environment

It is important to note that the noise model is based on the measured noise levels and is representative of current traffic volumes. It is acknowledged that an increase in road traffic volumes would give rise to a corresponding increase in noise levels. With road traffic noise, typically a 25% increase in volumes would be expected to give rise to a 1 dB increase in noise levels.

In order to present a worst-case scenario, all predicted façade noise levels and mitigation measures will include a 2 dB increase to account for future traffic growth

9.3.4 Summary of Assumed Façade Noise Levels on Developed Site

Based on a review of the survey data, the following noise levels are assumed to be incident on the east façades of the development, which face on to Pa Healy Road:

Façades	**Octave Band Centre Frequency (Hz)**						**Overall dB(A)**
	125	**250**	**500**	**1k**	**2k**	**4k**	
Zone A Daytime L_{Aeq}	65	66	65	69	61	50	71
Zone A Night-time L_{Aeq}	63	61	61	63	57	51	66
Zone A Night-time L_{Amax}	70	70	79	74	73	72	81
Zone B Daytime L_{Aeq}	55	60	60	64	57	45	66
Zone B Night-time L_{Aeq}	47	50	51	56	49	40	58
Zone B Night-time L_{Amax}	67	69	70	75	68	60	77

Table 9.11 Assumed Noise Levels at Pa Healy Road Facades

9.3.5 Noise Risk Assessment Conclusion

Giving consideration to the noise levels presented in the previous sections, the initial site noise risk assessment has concluded that the level of risk across the site is Low Risk at the northern corner of the site to High Noise Risk along Pa Healy Road. ProPG states the following with respect to various levels of risk:

Negligible Risk	*These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.*
Low Risk	*At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*
Medium Risk	*As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.*

Given the above it can be concluded that the development site may be categorised as 'low to medium' risk and as such an Acoustic Design Strategy will be required to demonstrate that suitable care and attention has been applied in mitigating and minimising noise impact to such an extent that an adverse noise impact will be avoided in the final development.

It should be noted that ProPG states the following with regard to how the initial site noise risk is to be used,

> *"2.12 It is important that the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker. The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the acoustic issues that would be faced. Thus, a site considered to be high risk will be recognised as presenting more acoustic challenges than a site considered as risk. A site considered as negligible risk is likely to be acceptable from a noise perspective and*

> *need not normally be delayed on noise grounds. A potentially problematical site will be flagged at the earliest possible stage, with an increasing risk indicating the increasing importance of good acoustic design."*

Therefore, following the guidance contained in ProPG does not preclude residential development on sites that are identified as having medium or indeed high-risk noise levels. It merely identifies the fact that a more considered approach will be required to ensure the developments on the higher risk sites are suitable designed to mitigate the noise levels. The primary goal of the approach outlined in ProPG is to ensure that the best possible acoustic outcome is achieved for a particular site.

9.4 Characteristics of the Proposed Development

A brief description of the proposal is as follows: *A mixed-use development of build-to-rent apartments, student apartments incorporating common areas, dwelling houses, café and 3 no. retail units, creche and management facilities building at Canal Bank, Pa Healy Road, Limerick.*

For a full description of the development, refer to Chapter 3.

9.5 Potential Impact of the Proposed Development

The potential impacts of the proposed development are considered for the short-term construction phase and long-term operational phase. These are set out in the following sections.

9.5.1 Proposed Development

9.5.1.1 Construction Stage

The largest noise and vibration impact of the proposed development will occur during the construction phase due to the operation of various plant machinery and HGV movement to, from and around the site. However, the construction phase can be classed as a short-term phase (approximately seven years in duration for all phases).

The nearest noise-sensitive locations to the site are the residential properties to the east of the site at The Park, which are and east, each of which is approximately 25 m from the closest point of the site boundary. Based on the results of the baseline noise surveys undertaken, the ambient daytime noise level at these properties was found to be between 61 and 63 dB $L_{Aeq,T}$.

Thresholds for significant noise from construction can be determined by referring to Table 8.1 (BS 5228-1) and the baseline ambient noise levels, as outlined in the assessment criteria section.

The daytime significance threshold for construction noise at the site is set at 65 dB $L_{Aeq,T}$. A night-time threshold is not included as construction work will not be taking place at night.

BS 5228-1 contains noise level data for various construction machinery. The noise levels relating to site clearance, ground excavation and loading lorries (dozers, tracked excavators and wheeled loaders) reach a maximum of 81 dB $L_{Aeq,T}$ at a distance of 10 m. For this assessment, a worst-case scenario is assumed of 3 no. such items with a sound pressure level (SPL) of 81 dB at 10 m operating simultaneously along the closest works boundary. This would result in a total noise level of 86 dB at 10 m and an equivalent combined sound power level of 114 dB L_{WA}. This worst-case scenario is the typical assumption made for developments of this size, on the basis that it is unlikely that more than 3 no. items of such plant/equipment would be operating simultaneously in such close proximity to each other.

Guidance on the approximate attenuation achieved by barriers surrounding the site is also provided in BS 5228-1. It states that when the top of the plant is just visible to the receiver over the noise barrier, an approximate attenuation of 5 dB can be assumed, while a 10 dB attenuation can be assumed when the noise screen completely hides the sources from the receiver.

The latter scenario can be assumed in this case due to the proximity of the noise-sensitive locations, i.e. a barrier height will be chosen so as to completely hide the source. Table 9.12 shows the potential noise levels calculated at various distances based on the assumed sound power level and attenuation provided by the barrier of 10 dB.

Description of Noise Source	**Sound Power Level (dB Lw(A))**	**Calculated noise levels at varying distances (dB LAeq,T)**				
		10	**20**	**30**	**50**	**100**
3 no. items each with SPL of 81 dB at 10 m operating simultaneously.	114	76	70	66	62	56

Table 9.12 Potential construction noise levels at varying distances assuming attenuation of 10 dB from site barrier

The calculated noise levels in Table 9.12 show that there is potential for the maximum permissible daytime noise level to be exceeded at distances up to 30 m from the works. This indicates that additional mitigation measures will be required to prevent likely significant impacts at residential properties. These measures are detailed in Section 9.6.1.

9.5.1.1.1 Construction Vibration

Potential for vibration impacts during the construction phase programme are likely to be limited given the ground breaking, piling and excavations required. There is potential for piling to be used for building and basement foundations for office and apartment buildings. For the purposes of this assessment the expected vibration levels during piling assuming augured or bored piles have been determined through reference to published empirical data. The British Standard BS 5228 – Part 2: Vibration, publishes the measured magnitude of vibration of rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock, (Table D.6, Ref. No. 106):

- 0.54 mm/s at a distance of 5 m, for auguring;
- 0.22 mm/s at a distance of 5 m, for twisting in casing;
- 0.42 mm/s at a distance of 5m, for spinning off, and;
- 0.43 mm/s at a distance of 5 m, for boring with rock auger.

Considering the low vibration levels at very close distances to the piling rigs, vibration levels at the nearest buildings are not expected to pose any significance in terms of cosmetic or structural damage. In addition, the range of vibration levels is typically below a level which would cause any disturbance to occupants of nearby buildings.

In this instance, taking account of the distance to the nearest sensitive off-site buildings, vibration levels at the closest neighbouring buildings are expected to be orders of magnitude below the limits set out in Table 9.4 to avoid any cosmetic damage to buildings. Vibration levels are also expected to be below a level that would cause disturbance to building occupants, as set out in Table 9.5. The potential vibration impact during the construction phase if of short-term, neutral and imperceptible impact.

9.5.1.2 Operational Stage

The main potential noise outward noise impact to the surrounding will be from additional vehicles on the surrounding road network and building services and mechanical plant serving the development.

Potential impacts from each of these sources are discussed below.

9.5.1.2.1 Building Services Plant

It is expected that the principal items of building and mechanical services plant will be for heating and ventilation of the buildings. These items and their location will be selected at the detailed design stage to ensure that noise emissions to sensitive receivers both external and within the development itself will be within the relevant criteria set out above. The effects are considered neutral, not significant and permanent.

9.5.1.2.2 Additional Vehicular Traffic on Surrounding Roads

During the operational phase of the proposed development, there will be an increase in vehicular traffic associated with the site and other planned developments on surrounding roads.

The predicted change in noise levels due to an increase in road traffic has been calculated for each of these roads. Projected traffic data used for the purpose of this assessment includes committed and planned developments in the vicinity of the project site as listed in Chapter 11 of this EIAR.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative increase in noise level associated with traffic movements on existing roads surrounding the subject site with and without development using the Annual Average Daily Traffic (AADT) data.

The impact from the increase in traffic from the proposed development has been assessed for the year of 2023 and the year of 2038 relative to the Do Nothing scenario along the sections of road detailed in Table 9.13 .

In terms of the overall traffic data as described by the AADT parameter, in order to increase traffic noise levels by 1dB, traffic volumes would need to increase by the order of 25% approximately. A review of the potential traffic level increases attributable to the proposed development indicates that the development will not give rise to increases of this magnitude on the surrounding road network.

Road Link	Noise level (dB LA10) Increase between Do Nothing and Do Something based on AADT Traffic Data	
	2023	**2038**
R463 O'Dwyers Bridge (Athlunkard St)	0.2	0.1
R463 Corbally Rd	0.2	0.2
Pa Healy Rd (at Corbally Rbt)	0.4	0.4
Pa Healy Rd (at Park Road Jn)	0.3	0.3
Park Road (adj. To site)	0.1	0.1
Park Road (South of Pa Healy Road)	0.3	0.2
Rhebogue Rd	0.2	0.2
R455 Clare St	0.0	0.0
R455 Dublin Rd	0.1	0.0
R858 Pennywell Rd	0.1	0.1

Table 9.13: Predicted Change In Noise Level associated with Vehicular Traffic

The predicted increase in traffic flows associated with the development in the years of 2023 and 2038 will result in an increase less than 1dB along all roads receiving traffic from the proposed development will have a negligible effect. The effect is therefore neutral, imperceptible and permanent.

At these newly constructed roads, the noise level increase is slightly higher. The effect is negative, not significant and permanent.

9.5.2 Do-Nothing Impact

In the absence of the proposed development being constructed, the noise environment at the nearest noise sensitive locations and within the development site will remain largely unchanged resulting in a neutral impact in the long-term.

9.5.3 Cumulative

On review of the Limerick City Council planning register there is no other proposed development of scale in the local area which would require the cumulative assessment for noise and vibration impacts.

9.5.4 Inward Impact: ProPG Stage 2 – Full Acoustic Assessment

9.5.4.1 Element 1 – Good Acoustic Design Process

9.5.4.1.1 ProPG Guidance

In practice, good acoustic design should deliver the optimum acoustic design for a particular site without adversely affecting residential amenity or the quality of life of occupants or compromising other sustainable design objectives. It is important to note that ProPG specifically states that good acoustic design is not equivalent to overdesign or "gold plating" of all new development but that it seeks to deliver the optimum acoustic environment for a given site.

Section 2.23 of the ProPG outlines the following checklist for Good Acoustic Design:

- Check the feasibility of relocating, or reducing noise levels from relevant sources;
- Consider options for planning the site or building layout;
- Consider the orientation of proposed building(s);
- Select construction types and methods for meeting building performance requirements;
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc;
- Assess the viability of alternative solutions; and,
- Assess external amenity area noise.

In the context of the proposed development, each of the considerations listed above have been addressed in the following subsections.

9.5.4.1.2 Application of GAD Process to Proposed Application

<u>Relocation or Reduction of Noise from Source</u>

The main noise sources are located outside the redline boundary of the site and therefore it is beyond the scope of this development to introduce any noise mitigation at source.

Planning, Layout and Orientation

In the first instance, the outdoor amenity spaces are located along the northern of the site where noise levels are lowest; indeed the proposed development buildings serve to screen these areas from traffic noise from Pa Healy road.

Select Construction Types for meeting Building Regulations

Masonry constructions will be used in constructing the external walls of the development. This construction type offers high levels of sound insulation performance. However, as is typically the case the glazed elements and any required ventilation paths to achieve compliance with Part F of the Building Regulations will be the weakest elements in the façade in terms of sound insulation performance.

Consideration will therefore be given to the provision of upgraded glazing and acoustic ventilators where required. For units where it will not be possible to achieve the desirable internal acoustic environments with windows open, the proposal here will be to provide dwelling units with glazed elements and ventilators that have good acoustic insulation properties so that when the windows are closed the noise levels internally are good. Inhabitants will be able to open the windows if they wish, however, doing so will increase the internal noise level. This approach to mitigation is supported in ProPG where it states the following (note emphasis has been added in bold),

> *"2.22 Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided;* ***occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open****. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents "*
>
> *Note 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however*

> *any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded*
>
> *2.34 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole dwelling ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see Supplementary Document 2). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded."*

It is very important to note that it is impractical to achieve the good internal noise levels with windows open across the vast majority of development sites in close proximity to major infrastructure such as roads or airports. Such sites would need to be classified as having a negligible risk in accordance with the ProPG noise risk assessment approach. For this reason, there are no guidance documents either at a local level or an international level that AWN is aware of which would support the approach of achieving the ideal internal noise levels only in the open window scenario. It is therefore considered entirely correct and justifiable to provide building facades with a moderate degree of sound insulation such that with windows closed but vents opened a good internal acoustic environment is achieved.

Impact of noise control measures on fire, health and safety etc

The good acoustic design measures that have been implemented on site, e.g. upgrading the glazing along certain façades are not considered to have effects on fire risk issues or health and safety.

Assess Viability of Alternative Solutions

The option of introducing additional noise screening along the boundary of the site was considered. In this instance, it was concluded that the effectiveness of measured of this type would be limited given the lines-of-sight from apartments at upper floors to the surrounding road network and the importance of retaining open amenity spaces on the quieter side of the site.

Assess External Amenity Area Noise

ProPG provides the following advice with regards to external noise levels for amenity areas in the development:

> *"The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB LAeq,16hr."*

The values are largely based on WHO guideline values. In Figure 9.12, the it is shown that the areas between buildings and much of the open amenity space are predicted to have noise levels generally within this range.

For this development the good acoustic design principles employed have ensured that the private external spaces are positioned to benefit from the screening effect of the development buildings. Current measured levels at 4m height are of the order of 55dB, thus it is reasonable to expect noise level to reduce once the acoustic screening of the buildings themselves is taken into account.

Summary

Considering the constraints of the site, in so far as possible and without limiting the extent of the development area, the principles of Good Acoustic Design have been applied to the development.

In terms of viable alternatives to acoustic treatment of façade elements, currently it is not considered likely that there will be further options for mitigation outside of proprietary acoustic glazing and ventilation.

9.5.4.2 Element 2 – Internal Noise Guidelines

9.5.4.2.1 Internal Noise Criteria

Element 2 of the ProPG document sets out recommended internal noise targets derived from BS 8233 (2014). The recommended indoor ambient noise levels are set out in Table 9.14 and are based on annual average data, that is to say they omit occasional events where higher intermittent noisy events may occur, such as New Year's Eve.

Activity	Location	(07:00 to 23:00hrs)	(23:00 to 07:00hrs)
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,T}$*

Table 9.14: ProPG Internal Noise Levels

*Note The document comments that the internal L_{AFmax},T noise level may be exceeded no more than 10 times per night without a significant impact occurring.

In addition to these absolute internal noise levels ProPG provides guidance on flexibility of these internal noise level targets. For instance, in cases where the development is considered necessary or desirable, and noise levels exceed the external noise guidelines, then a relaxation of the internal L_{Aeq} values by up to 5 dB can still provide reasonable internal conditions.

9.5.4.2.2 Proposed Façade Treatment

The British Standard BS EN 12354-3: 2000: *Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound* provides a calculation methodology for determining the sound insulation performance of the external envelope of a building. The method is based on an elemental analysis of the building envelope and can take into account both the direct and flanking transmission paths.

The Standard allows the acoustic performance of the building to be assessed taking into account the following:

- Construction type of each element (i.e. windows, walls, etc.);
- Area of each element;
- Shape of the façade, and;
- Characteristics of the receiving room.

The principals outlined in BS EN 12354-3 are also referred to in BS8233 and Annex G of BS8233 provides a calculation method to determine the internal noise level within a building using the composite sound insulation performance calculated using the methods outlined in BS EN 12354-3. The methodology outlined in Annex G of BS8233 has been adopted here to determine the required performance of the building facades.

9.5.4.2.3 Glazing

As is the case in most buildings, the glazed elements of the building envelope are typically the weakest element from a sound insulation perspective. In this instance the facades in Zones A and B will be provided with glazing that, when closed, achieve the minimum sound insulation performance as set out in Table 9.15.

Zone	Octave Band Centre Frequency (Hz)						Rw
	125	250	500	1k	2k	4k	
A	26	28	38	46	44	56	40
B	23	25	32	34	36	38	34

Table 9.15: Sound Insulation Performance Requirements for Glazing, SRI (dB)

The acoustic specifications listed in Table 9.15 can be achieved using double-glazed units with slightly thicker than standard glass. This performance could also be achieved using a suitably specified triple glazing window.

It is important to note that the acoustic performance specifications detailed herein are minimum requirements which apply to the overall glazing system. In the context of the acoustic performance specification the ‘glazing system’ is understood to include any and all of the component parts that form part of the glazing element of the façade, i.e. glass, frames, seals, openable elements etc.

9.5.4.2.4 Wall Construction

In general, all wall constructions (i.e. block work or concrete) offer a high degree of sound insulation, much greater than that offered by the glazing systems. Therefore, noise intrusion via the wall construction will be minimal. The calculated internal noise levels across the building façade have assumed a minimum sound reduction index of 50 dB R_w for this construction.

9.5.4.2.5 Ventilation

The ventilation strategy for the development will be in accordance with Part F of the Building Regulations and will be finalised at the detail design stage. Options which will be considered to achieve compliance with background ventilation requirements will be adjustable hit and miss acoustic ventilators or trickle vents built into the façade or window frames respectively. It is recommended that the wall vents in Zones A and B are specified to achieve a sound insulation performance of 39 dB $D_{n,e,w}$. This specification can be achieved by a range of proprietary vents in either through frame trickle vent or through wall vents.

9.5.4.2.6 Roof

There is the potential for the roof structure to allow the passage of sound into the rooms. In order to control potential sound transmission via this route the ceiling / roof construction will need to provide a sound reduction in excess of that required for the windows.

For the proposed houses with pitched tiled roofs, a suitable sound reduction performance would be provided by a standard tiled or slated roof with a single 12.5mm layer plasterboard ceiling and heat insulation layer above the ceiling.

For the proposed apartments, the reinforced concrete roof with thermal insulation and plasterboard ceiling below will also provide suitable sound insulation.

Any penetrations through the ceiling constructions must be as small as possible and made good by fully filling with plaster or with an acoustic sealant.

9.5.4.2.7 Internal Noise Levels

Taking into account the external façade levels and the specified building envelope the internal noise levels have been calculated. In all instances the good internal noise criteria are achieved for daytime and night-time periods.

9.5.4.3 Element 3 – External Amenity Area Noise Assessment

As previously discussed, Figure 9.12 illustrates that the inhabitants will have access to private outdoor amenity area at the especially at the northern half of the site, which achieves a noise level ≤55dB $L_{Aeq,16hr}$ which is recommended in ProPG.

9.5.4.4 Element 4 – Assessment of Other Relevant Issues

Element 4 gives consideration to other factors that may prove pertinent to the assessment, these are defined in the document as:

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences
- 4(v) acoustic design v wider planning objectives

Each is discussed in turn below.

9.5.4.4.1 Compliance with Relevant National and Local Policy

There are no National policy documents relating to the acoustic design of residential dwellings. Locally the Limerick Noise Action Plan specifies that the guidance contained within ProPG should be used in assessing the noise impact on new residential developments within the Limerick City and County areas.

This Acoustic Design Statement has been prepared in compliance with the requirements of ProPG and therefore complies with the requirements of local policy.

9.5.4.4.2 Magnitude and Extent of Compliance with ProPG

As discussed within this report the following conclusions have been drawn with regards to the extent of compliance with ProPG:

- All dwellings as part of the development have been designed to achieve the good level of internal noise levels specified within ProPG with windows closed but with the mechanical ventilation systems providing suitable levels of ventilation, and;
- All external amenity areas have been shown to have an external noise level that complies with the recommended criterion set out in ProPG. In addition, the majority of external areas also comply with the more onerous noise criterion for external spaces aspired to in the Limerick Noise Action Plan.

Based on the preceding it is concluded that the proposed development is in full compliance with the requirements of ProPG.

9.5.4.4.3 Likely Occupants of the Development

The criteria adopted as part of this assessment are based on those recommended for permanent dwellings and are therefore considered robust and appropriate for the likely occupants.

9.5.4.4.4 Acoustic Design v Unintended Adverse Consequences

Unintended adverse consequences did not occur on this project.

9.5.4.4.5 Acoustic Design v Wider Planning Objectives

With reference to the Limerick Noise Action Plan (NAP) 2018, this assessment has demonstrated the noise insulation measures required to ensure that the proposed dwelling units achieve a good internal noise environment.

9.6 Mitigation Measures (Ameliorative, Remedial or Reductive Measures)

In order to ameliorate the likely noise impacts, a schedule of noise control measures has been formulated for both construction and operational phases.

9.6.1 Construction Stage

With regard to construction activities, best practice operational and control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2.

BS5228 includes guidance on several aspects of construction site practices, including, but not limited to:

- selection of quiet plant;
- control of noise sources;
- screening (boundary, and or localised plant screening);
- hours of work;

- liaison with the public, and;
- monitoring.

Detailed comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise monitoring.

9.6.1.1 Selection of Quiet Plant

This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible.

9.6.1.2 Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS5228 states that "as far as reasonably practicable sources of significant noise should be enclosed". In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators.

BS5228 makes a number of recommendations in relation to "*use and siting of equipment*". These are all directly relevant and hence are reproduced below. These recommendations will be adopted on site.

> *"Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas.*

> *Machines such as cranes that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy.*
>
> *Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels.*
>
> *Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended.**
>
> *Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material."*

Other forms of noise control at source relevant to the development works are set out below:

- For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant should be switched off when not in use and not left idling.

- For percussive tools such as pneumatic concrete breakers and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Erect localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries.

- For concrete mixers, control measures should be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.

- For all materials handling ensure that materials are not dropped from excessive heights, lining drops chutes and dump trucks with resilient materials.

- Demountable enclosures can also be used to screen operatives using hand tools/ breakers and will be moved around site as necessary.

- All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

9.6.1.3 Screening

Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver.

Screening may be a useful form of noise control when works are taking place at basement and ground level to screen noise levels at ground floor adjacent buildings.

In addition, careful planning of the site layout should also be considered. The placement of site buildings such as offices and stores and in some instances materials such as aggregate can provide a degree of noise screening if placed between the source and the receiver. The use of localised mobile (mobile hoarding screens and / or acoustic quilts) to items of plant with the potential to generate high levels of noise are an effective noise control measure. These options should be considered when percussive works are taking place in close proximity to the nearest sensitive perimeter buildings.

9.6.1.4 Liaison with the Public

A designated noise liaison should be appointed to site during construction works. All noise complaints should be logged and followed up in a prompt fashion by the liaison officer. In addition, prior to particularly noisy construction activity, e.g. demolition, breaking, piling, etc., the liaison officer should inform the nearest noise sensitive locations of the time and expected duration of the noisy works.

9.6.1.5 Hours of Work

Construction works will be undertaken within the times below, taken from the Section 6 of the Construction Environmental Management Plan:

- Monday to Friday 08:00 to 20:00hrs

- Saturday 08:00 to 16:00hrs
- Sunday and Public Holidays No noisy work on site.

9.6.2 Operational Stage

9.6.2.1 Building Services Plant

During the detailed design of the development, the selection and location of mechanical and electrical plant will be undertaken in order to ensure the noise emission limits set out in Section 9.2.2.1 above are not exceeded. Plant items in the proposed development are limited to domestic heating and ventilation equipment and therefore no specific mitigation measures are required.

9.6.2.2 Additional Traffic on Surrounding Roads

During the operational phase of the development, noise mitigation measures with respect to the (outward) impact of traffic from the development are not deemed necessary.

9.6.2.3 Inward Impact

At detailed design stage, a glazing and vent specifications fulfilling the requirements in 9.5.4.29.6.2.3 will ensure suitable internal noise levels.

9.7 Residual Impact of the Proposed Development

This section summarises the likely noise impact associated with the proposed development, taking into account the mitigation measures.

9.7.1 Construction Phase

During the construction phase of the project there will be a short-term noise impact on nearby noise sensitive properties from site activities and the close proximity of adjacent buildings. The application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration are kept to minimised. For the nearest noise sensitive locations within 50m of the proposed development, negative, significant and temporary effects are likely.

For the majority of noise sensitive locations at greater distances from the proposed development, negative, moderate and short-term effects are likely.

9.7.2 Operational Phase

9.7.2.1 Building Services Plant

With the application of mitigation measures for building services noise as described in Section 6.2.1, the range of potential noise levels is not expected to add significantly to the existing noise environment. The resultant noise effect from this source will be of neutral, not significant, permanent impact.

9.7.2.2 Additional Traffic on Surrounding Roads

The predicted change noise levels associated with additional traffic is predicted to be of imperceptible impact along the existing road network. In the context of the existing noise environment, the overall effects from noise contribution of increased traffic is considered to be of neutral, imperceptible and permanent effect to nearby noise sensitive locations.

10.0 LANDSCAPE AND VISUAL IMPACT ASSESSMENT

10.1 Introduction

PC Roche & Associates have been engaged to complete the Landscape and Visual Impact Assessment chapter of an EIAR to support an SHD application to be submitted to An Bord Pleanala for 363 no. Build to Rent Apartments, 18 no. dwelling houses, 189 no. student bedspaces, creche, retail units, facilities building, landscaping and all site works at Canal Bank, Pa Healy Road, Limerick.

This chapter has been prepared by Cass Roche, the principal of PC Roche and Associates. Cass is a qualified Landscape Architect with over 20 years of experience. He holds a Diploma in Physical Planning from Trinity College Dublin, along with continued professional development courses in Computer Aided Design and Town Planning Development from University College Dublin. He is also a lecturer of Landscape Planning and Garden Design at Beechfield College. Cass is a full member of the Landscape Institute London.

The Landscape and Visual Impact Assessment of the proposed development examines the impact of the proposed development on the receiving environment in terms of both the physical landscape and the visual appearance.

10.2 Methodology

The methodology used for the landscape and visual assessment was as follows;

1. Desktop Evaluation – A desktop survey was undertaken which included an examination of detailed maps, Ordinance Survey data, Topographical Survey data, aerial photography. This also included the Limerick City Development Plan 2010-2016 and the Southern Environs Plan 2021-2017.
2. Site Inspection – The site was inspected on various dates from 2019-2021 with September 2021 the most recent visit. Site visits included photographical surveys of the subject site and the surrounding area.
3. Evaluation of Design - The Landscape plan and visual impact was developed in close consultation with the project Design Team to determine appropriate locations for different scales of development (open space, houses, apartment blocks etc). This was conducted on a continuous basis as the development design evolved to the final design concept.

10.2.1 Guidance Documents

The structure for assessing the landscape impact of the proposed development is based upon the following guidelines:

- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports – *EPA, July 2017*
- Guidelines for Landscape and Visual Impact Assessment – *Landscape Institute & I.E.M.A., UK 2013)*
- Limerick City Development Plan 2010-2016 (as amended) – *Limerick City and County Council 2010*

The criteria for describing the significance, quality and duration of the effects of the proposed development are outlined in Table 10.1 below as provided within the 2017 EPA report *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*:

Significance of Effects	**Criteria**
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effects	An effect which obliterates sensitive characteristics.
Quality of Effects	**Criteria**
Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).

Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative/Adverse Effects	A change which reduces the quality of the environment (for example, lessoning species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Duration and Frequency of Effects	**Criteria**
Momentary Effects	Effects Lasting from seconds to minutes.
Brief Effects	Effects lasting less than a day.
Temporary Effects	Effects lasting less than a year.
Short-Term Effects	Effects lasting one to seven years.
Medium-Term Effects	Effects lasting seven to fifteen years.
Long-Term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years.
Reversible Effects	Effects that can be undone, for example through remediation or restoration.

Table 10.1: Assessment Criteria Relating to Assessment of Landscape and Visual Impact.

In terms of visual impact, classification of the magnitude of change takes into account the size or scale of the intrusion of development into the view (relative to the other elements and features in the composition, i.e. its relative visual dominance), the degree to which it contrasts or integrates with the other elements and the general character of the view, and the way in which the change will be experienced (e.g. in full view, partial or peripheral, or glimpses). It also takes into account the geographical extent of the change, the duration and the reversibility of the visual effects. Five categories are used to classify magnitude of change to a view. These range from Very High to Negligible as shown in Table 10.2.

Magnitude of Change	Description
Very High	Full or extensive intrusion of the development in the view, or partial intrusion that obstructs valued features or characteristics, or introduction of elements that are completely out of character in the context, to the extent that the development becomes the dominant the composition and defines the character of the view and the visual amenity.
High	Extensive intrusion of the development in the view, or partial intrusion that obstructs valued features, or introduction of elements that may be considered uncharacteristic in the context, to the extent that the development becomes co-dominant with other elements in the composition and affects the character of the view and the visual amenity.
Medium	Partial intrusion of the development in the view, or introduction of elements that may be prominent but not necessarily uncharacteristic in the context, resulting in change to the composition but not necessarily the character of the view or the visual amenity.
Low	Minor intrusion of the development into the view, or introduction of elements that are not uncharacteristic in the context, resulting in minor alteration to the composition and character of the view but no change to visual amenity.
Negligible	Barely discernible intrusion of the development into the view, or introduction of elements that are characteristic in the context, resulting in slight change to the composition of the view and no change in visual amenity.

Table 10.2: Magnitude of Visual Change

Visual receptor sensitivity is a function of two main considerations: Susceptibility of the visual receptor to change. This depends on the occupation or activity of the people experiencing the view, and the extent to which their attention or interest is focussed on the views or visual amenity they experience at that location. Value attached to the view. This depends to a large extent on the subjective opinion of the visual receptor but also on factors such as policy and designations (e.g. scenic routes, protected views), or the view or setting being associated with a heritage asset, visitor attraction or having some other cultural status (e.g. by appearing in arts). For the purpose of assessment, five categories are used to classify a viewpoint's sensitivity as shown in Table 10.3.

Sensitivity	Description
Very High	Viewers at iconic viewpoints - towards or from a landscape feature or area - that are recognised in policy or otherwise designated as being of high value or national value. This may also include residential viewers who are focussed to a large extent on the view.
High	Viewers at viewpoints that are recognised in policy or otherwise designated as being of value, or viewpoints that are highly valued by people that experience them regularly (such as views from houses or outdoor recreation features) and views which are valued by the local community. This would include tourist attractions, and heritage features of regional or county value, and viewers travelling on scenic routes.
Medium	Viewers at viewpoints representing people travelling at slow or moderate speed through or past the affected landscape in cars or on public transport, where they are partly but not entirely focused on the landscape, or where the landscape has some valued views. The views are generally not designated, but which include panoramic views or views judged to be of some scenic quality, which demonstrate some sense of naturalness, tranquillity or some rare element in the view.
Low	Viewers at viewpoints reflecting people involved in activities not focused on the landscape e.g. people at their place of work or engaged in similar activities such as shopping, etc. The view may present an attractive backdrop to these activities but there is no evidence of that the view is valued, and not regarded as an important element of these activities. Viewers travelling at high speeds (e.g. motorways) may also be considered of low susceptibility.
Negligible	Viewpoints reflecting people involved in activities not focused on the landscape e.g. people at their place of work or engaged in similar activities such as shopping where the view has no relevance or is of poor quality and not valued.

Table 10.3: Sensitivity of Visual Receptor

The significance of effects can be measured as a function of the magnitude of change (i.e. the degree of change from the baseline) and the sensitivity of the receptor. Table 10.4 below is a guide in determining the significance of effects. It is noted that the assessor’s judgement and common sense are also factors when determining significance of effects.

		Sensitivity of the Resource				
		Very High	**High**	**Medium**	**Low**	**Negligible**
Magnitude of Change	**Very High**	Profound	Profound-Very Significant	Very Significant-Significant	Moderate	Slight
	High	Profound-Very Significant	Very Significant	Significant	Moderate-Slight	Slight-Not Significant
	Medium	Very Significant-Significant	Significant	Moderate	Slight	Not Significant
	Low	Moderate	Moderate-Slight	Slight	Not Significant	Imperceptible
	Negligible	Slight	Slight-Not Significant	Not Significant	Imperceptible	Imperceptible

Table 10.4: Significance of Effect

The criteria outlined in Table 10.1, Table 10.2, Table 10.3 and Table 10.4 above landscape and visual assessment methodology will be utilised in conjunction with a professional evaluation of the proposed development to determine the likely significant effects of the project and the degree of effect. The term 'study area' as used in this report refers to the site itself and its wider landscape context in the study of the physical landscape and landscape character. This may extend for approximately 1km in all directions from the site in order to achieve an understanding of the overall landscape. In terms of the visual assessment, the study of visual amenity may extend outside the study area, from areas where views of the site are available, but the majority of visual effects for a development of this nature would be most significant within 100m.

10.3 Baseline Environment

The proposed development site is located at Canal Bank, Pa Healy Road, Limerick. The ca. 4 hectare site is a triangular shaped site of vacant land. It forms one of the last remaining development sites within walking distance of the city centre. There is no current active use on the site. There is one disused industrial building complex near the eastern boundary of the site. This building is no longer in use and is vacant. The site is generally level, is located adjoining the canal and has been filled in.

Figure 10.1: Site Location Context

The site is bounded to the south by Pa Healy Road, a relatively recently constructed road which provides an important connecting road linking Dooradoyle to Corbally and the general inner-city circular bypass route. Pa Healy road rises to a bridge over the canal near the northwestern corner of the site. As a result the road is above the level of the site near the south western portion of the site.

The site is adjoined to the east by Park Road and to the north by the canal. Along the canal on the side of the development site, there is a pedestrian walkway linking the University of Limerick grounds with the city centre. The site is immediately accessible from this walkway.

Along the southern site boundary the site adjoins established industrial development. To the north the area consists of generally open fields which form part of the Lower River Shannon SAC and public open space lands attached to residential development. To the east the site is adjoined by a mixture of residential and industrial development. To the northwest the site is adjoined by a shopping complex. A currently functioning commercial building stands near the south eastern corner of the site at the junction between Pa Healy Road and Park Road. This building is in active use and has separate vehicular access.

There are no protected views recorded within the proposed site or within the immediate surrounding area.

10.4 Sensitivity of Landscape

In landscape terms this site is categorised as being within the Limerick City and County Council Administrative Area and is not included in any other Landscape Character Assessment designations. In September 2015, in accordance with Section 28 of the Electoral, Local Government and Planning and Development Act 2013, the Planning Authority proposed not to commence the review of the Limerick County Development Plan 2010 - 2016 and the Limerick City Development Plan 2010 - 2016. Therefore the City Development Plan will continue to have effect until a new Development Plan for Limerick City and County is adopted.

There are no protected views or prospects and no Tree Preservation Orders within the site. Furthermore, the site is zoned for development within the Development Plan. Within the site the ecological assessment has identified some habitats as being of Local Importance. There are no Natura 2000 Protected Areas or nationally designated NHA or pNHA within the site.

It is considered that the subject site has relatively Low Sensitivity in terms of development. While the proposed development would significantly change the existing landscape of the site, this is deemed typical of any residential development that would occur on a site zoned for such a use.

10.5 Visual Sensitivity

Visual receptors have greater potential sensitivity to change in the landscape. This sensitivity is reduced by the following existing factors:

- The distances from the site to some of the visual receptors is relatively large and therefore the sensitivity is accordingly diminished.

- There are visual barriers for many of the receptors, including fencing, existing hedgerows/trees, tree planting, etc. Sensitivity of views is also mitigated by the residential zoning designation of the lands.

Sensitivity of visual receptors is therefore considered to be generally low other than when considering existing residential dwellings on Park Road and where clear views of St John's cathedral Spire are available. This view is not protected but considered valuable at the local level.

10.6 Characteristics of Proposed Development

The proposed development is set out in the statutory notices as follows;

A ten year permission for a strategic housing development at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick. The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the east, Canal Bank, Limerick;

A. Demolition of existing 530m2 warehouse building on site.

B. Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

C. Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

D. Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

E. Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

F. Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

G. Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

H. Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;

I. Community facilities building of 1,336.90m2 and three storeys with creche, café, management offices and common accommodation for use by apartment dwellers;

J. 18 no. Executive Houses – Consisting of 2 no. detached four-bedroom houses of 194.62m2 each and 16 no. terraced four-bedroom houses of 177.82m2 each, with off street parking to front separate from communal parking;

K. 149 Car parking spaces throughout the development and 420 secured bicycle parking spaces throughout the development;

L. Ancillary works comprising; new vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy road, Park road and City Canal, bin storage for all developments adjacent to all entrances, New public park of 0.5ha along city canal, communal open space and communal roof gardens for all apartments, all ancillary drainage, civil and landscape works, public lighting within estate and Electricity Sub-station to rear of Block 1.

The total number of units is as follows;

Build to rent apartments - 363 (66x studio, 67x one bedroom, 230x two bedroom); Student apartments - 61 (9x two-bedroom, 37x three bedroom and 15x four bedroom, totalling 189 student bed spaces); 18 Dwelling houses.

Overall total of residential units is 442. Overall Gross floor area of development proposed is 45,478.65m2 on a site of circa 4ha.

A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) have been prepared in respect of the proposed development

The development is primarily residential in nature and includes apartments, houses and student accommodation units. The highest proposed building is set at ten no. storeys. The ten no. storey element of the design is located to the west on the subject site and the remaining accommodation blocks step down to generally six no. storeys. The proposed layout plan of the development is shown on Figure 10.2 below which is an extract from drawing no. 1248-18-03 as submitted within the architectural drawing pack under a separate cover.

Figure 10.2: Extract from Drawing No. 1248-18-03 Site Plan

Landscaping works within the proposed development are extensive with a .5ha public park on the northern portion of the site. The largest area of open space is located to the north-west of the site and contains a playground area. The proposed landscaping plan is submitted under a separate cover with an extract shown in Figure 10.3 below.

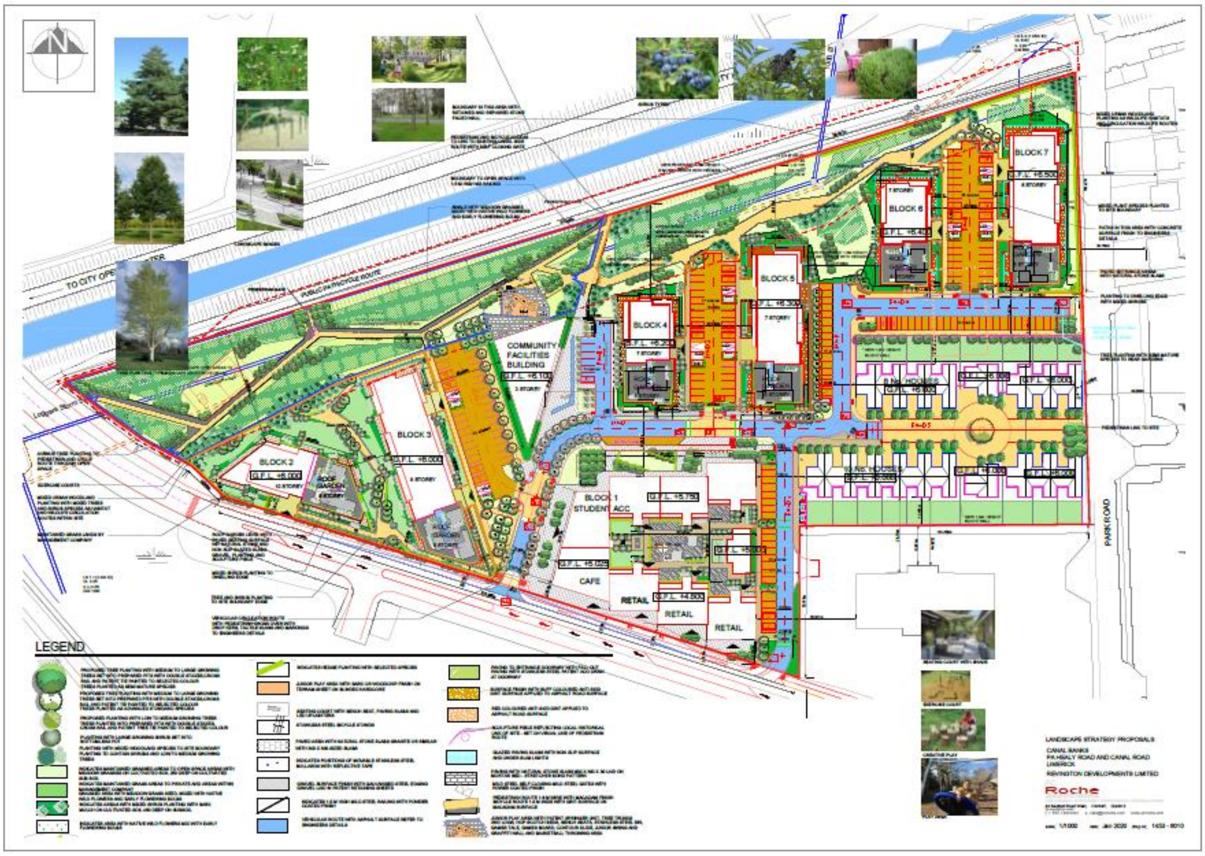

Figure 10.3: Proposed Landscaping Plan (Extract from submitted Drawing No. 1453-6010)

It is acknowledged that while all development will result in some impact on landscape and visual impact by its very nature, the landscaping and potential visual impact has informed the design of the proposed development throughout the design process in an effort to provide a sustainable development, minimising potential impacts.

10.7 Assessment of Visual Impact

13 No. Photomontages have been prepared to illustrate the visual & physical character of the proposed residential development within the surrounding landscape. All views have been taken from publicly accessible places where a visual impact can arise. The photomontages have been prepared around the site to demonstrate the appearance of the buildings and proposed landscape. The impact of the development on each viewpoint is described below. Figure 10.4 shows a key plan of where each of the viewpoints has been taken.

Figure 10.4: Viewpoint Key Plan

General Note: *The images /viewpoints 1-19 are indicative of massing and position of the proposed development set against existing views. Some interface details(eg landscaping/railings/paths etc) are not included in favour of highlightig existing features but are clearly detailed on the Architectural, Engineering or Landscape drawings included in the application*

Viewpoint No. 1

Viewpoint No. 1	
Location	Pa Healy Road looking south-east towards the subject site
Description of Existing View	The existing view of the subject site is that of a vacant site with hoarding surrounding the boundary.
Sensitivity of Visual Receptor	Low – The view is from Pa Healy Road as it is travelled at speed
Proposed View Description	The 10 storey block is immediately visible with the lower blocks visible but not as dominant

Magnitude of Change	Medium – The view is significantly altered but the development is characteristic within its context and does not obscure important views.
Significance of Effect	Slight - *An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.*

Viewpoint No. 2

Viewpoint No. 2	
Location	Pa Healy Road, as the road turns toward the subject site.
Description of Existing View	The existing view is that of the canal and public towpath with the development site visible and surrounded by hoarding.
Sensitivity of Visual Receptor	Low – The subject site is viewed while the viewer is engaged in another activity (slowing down in vehicles as the road begins to turn).
Proposed View Description	The development is immediately visible and changes the view from this location when travelling along the Pa Healy Road.

Magnitude of Change	Medium – The view is altered significantly but the development is within the character for the area and no important views are impacted.
Significance of Effect	Slight - *An effect which causes noticeable changes in the character of the environment without affecting its sensitivities*

Viewpoint No.3

Viewpoint No. 3	
Location	Travelling East along the Pa Healy Road with the subject site to the north.
Description of Existing View	The existing view is that of undeveloped, overgrown lands with site hoarding in place along the boundary of the site.
Sensitivity of Visual Receptor	Low – The site is viewed when travelling along the Pa Healy Road. There are no sensitive receptors viewing the site at this location

Proposed View Description	The proposed view consists of apartment blocks which decrease in height from the highest point of 10 storeys down to six storeys
Magnitude of Change	Medium – The development is prominent but characteristic to the area.
Significance of Effect	Slight – The change is obvious but the development does not impact on important views or features.

Viewpoint No.4

Viewpoint No. 4	
Location	Looking west along the Pa Healy Road
Description of Existing View	The existing view at this location is characterised by undeveloped land on both sides of the Pa Healy Road. The subject site has hoarding surrounding it at present.
Sensitivity of Visual Receptor	Low – There are no important views from this location and the road is travelled at speed.
Proposed View Description	The proposed view introduces the student accommodation block which is stepped to minimise the visual impact. The three small retail units face on to the Pa Healy Road

	enlivening this character along the street in this location.
Magnitude of Change	Medium – The development is prominent and within character for this area. The development contributes positively to the view through the addition of retail facades along the Pa Healy Road.
Significance of Effect	Slight - *An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.*

Viewpoint No.5

Viewpoint No. 5	
Location	Junction of Pa Healy Road and Park Road looking north-west
Description of Existing View	The existing view west along the Pa Healy Road consists of the roofs of warehouse type building and trees which break up the view. There are no important views recorded at this location
Sensitivity of Visual Receptor	Negligible – The existing view at this location is considered poor quality and people are not likely to be focused on the view at this location.

Proposed View Description	The proposed view introduces the apartment and student accommodation blocks to the east and west at this location. The blocks are some distance away at this location and not visually intrusive.
Magnitude of Change	Medium – The proposed development is visible at this location but does not impact on visual amenity
Significance of Effect	Not Significant - *An effect which causes noticeable changes in the character of the environment but without significant consequences.*

Viewpoint No.6

Viewpoint No. 6	
Location	Park Road looking north west towards the development site.
Description of Existing View	The existing view is low quality whereby the warehouse style roof of the building to the south of the subject site is visible.
Sensitivity of Visual Receptor	Negligible – The view is poor quality and those at this viewpoint are not focused on the view.
Proposed View Description	The proposed view is that of the part 7 no. / part 6 no. storey apartment blocks to the north and north west of the development site. The 10 no. storey apartment building and student

	accommodation building are also visible but at a distance which reduces the impact of the height of these buildings.
Magnitude of Change	Medium – The proposed view of the development is prominent in this location but within the character of residential development.
Significance of Effect	Slight - *An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.*

Viewpoint No.7

Viewpoint No. 7	
Location	Park Road Looking North
Description of Existing View	The existing view is that of boundary walls with overgrown shrubbery to the west and Musgrave Market Place to the east. There is nothing of note at a distance from this viewpoint
Sensitivity of Visual Receptor	Low – those travelling down this road are either moving at speed in vehicles or engaged in other activities such as retail.
Proposed View Description	The proposed view includes the low density dwelling houses and also the 6-7 storey

	apartment block at a greater distance. The development provides a focal point from this vantage point.
Magnitude of Change	Low – The development is visible but introduces elements that are characteristic to the predominantly residential area.
Significance of Effect	Not Significant - *An effect which causes noticeable changes in the character of the environment but without significant consequences.*

Viewpoint No.8

Viewpoint No. 8	
Location	Looking North on Park Road.
Description of Existing View	The view at present is that of low density detached dwellings along Park Road with a Kitchen Showroom also located along this road. The view of the development site is that of overgrown shrubbery along the site boundary. There are no notable views identified at this location.
Sensitivity of Visual Receptor	Medium – High – People travelling along this road are usually moving at speed within vehicles or travelling through the area to their destination. However, there are a small number

	of houses along Park Road which are considered to have high sensitivity.
Proposed View Description	The proposed view includes the 6 storey elevation of the apartment block on the eastern side of the subject site. The low density houses are also included on this side of the development to reduce the visual impact for the residential dwellings on Park Road.
Magnitude of Change	Medium – The proposed development at this location is highly visible to the existing residential dwellings on Park Road but in keeping with expected residential development.
Significance of Effect	Significant and neutral effect – The site is zoned for residential development and it is likely that any such development in this location would change the view from this viewpoint.

Viewpoint No.9

Viewpoint No. 9	
Location	Looking south-west along the existing towpath which runs along the canal.
Description of Existing View	The existing view of the subject site included the vacant warehouse and unmaintained shrubbery which has overgrown. In the distance, St John's Cathedral spire is visible.
Sensitivity of Visual Receptor	Medium – While the view to the Cathedral spire is considered a valued view, this is the only feature which is significant at this location.
Proposed View Description	The proposed view includes the 6 storey apartment buildings along the northern side of the development. The communal open space

	between the towpath and the apartment blocks provides landscape features which are to be retained in the long-term.
Magnitude of Change	High – The proposed view at this location is significantly altered by the introduction of the proposed development.
Significance of Effect	Significant – The site is zoned for residential development and it is likely that any such development in this location would change the view from this viewpoint.

Viewpoint No.10

Viewpoint No. 10	
Location	Looking west from Canal Bank (Northern side of the canal)
Description of Existing View	The existing view at this location includes the canal and it’s banks, low density housing and single storey corrugated metal storage structures on the southern bank of the canal. The view at a distance includes the spire of St John’s Cathedral.
Sensitivity of Visual Receptor	High – The Cathedral spire is an important visual feature at this location. It is also considered that those at this location are likely travelling slowly

	and have opportunity to appreciate the current view.
Proposed View Description	The proposed view includes the introduction of the 6 storey apartment blocks along the northern side of the subject site. The low density house units are also visible to the south at this vantage point.
Magnitude of Change	High – The proposed development is characteristic at this location but obstructs the view to St John’s Cathedral Spire which is considered valuable at this location.
Significance of Effect	Very Significant – The view at this location is significantly altered from that at present.

Viewpoint No.11

Viewpoint No. 11	
Location	Looking south from within the Abbeylock residential estate
Description of Existing View	The existing view is dominated by several electricity masts looking south towards the subject site. There are no key features recorded from this view.
Sensitivity of Visual Receptor	Low – While the existing dwellings are side-on to the subject site and views from homes are limited, people walking along the open space would have clear visibility towards the subject site.
Proposed View Description	The apartment blocks running east to west at the north of the subject site are clearly visible.

	The distance to the buildings mitigates the impact somewhat but it is considered to significantly alter the existing view.
Magnitude of Change	High – The proposed development would represent extensive intrusion to the view at this location.
Significance of Effect	Moderate-Slight – The development results in noticeable change to the landscape although it is considered consistent with impacts of residential development.

Viewpoint No.12

Viewpoint No. 12	
Location	Richmond Park looking south to the subject site
Description of Existing View	The existing view looks out over the open lands toward the development site. There are no key features visible at this location and low density development is visible beyond the subject site to the south.
Sensitivity of Visual Receptor	Low – The existing dwellings at this location are side-on with the subject site so there are no direct views from dwellings. The view at this location is unremarkable with no important views recorded.
Proposed View Description	The proposed view is that of the side of the proposed apartment blocks to the north of the subject site. The intensification of the use on the

	subject site is immediately apparent from this viewpoint.
Magnitude of Change	Medium – The development obstructs the existing view but the development is within the character of residential development.
Significance of Effect	Slight - *An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.*

Viewpoint No.13

Viewpoint No. 13	
Location	Looking South towards the subject site from Richmond Park
Description of Existing View	The existing view is poor quality with an electricity mast the dominant feature from this location
Sensitivity of Visual Receptor	Medium – The houses within Richmond Park will have a direct view across to the development site particularly from upper rear windows.
Proposed View Description	The proposed 10 storey element and the 8 storey blocks are clearly visible at this location.

	The distance from the existing dwellings to the proposed development reduced the impact of the proposed development from this location
Magnitude of Change	Medium – The development would partially obstruct the view from the rear of houses in Richmond Park
Significance of Effect	Moderate - An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.

10.8 Potential Impacts

The potential impacts are the impacts that the development could have without consideration of landscape mitigation or amelioration in place. For the sake of clarity Landscape Impacts and Visual Impacts will be assessed separately. Impacts are considered under the following headings: -

- Short-Term Impacts – Construction phase up to seven years
- Short-Term Impacts – Operation phase up to seven years
- Medium-Term Impacts – Operational phase from seven to fifteen years
- Long-Term Impacts – Operational phase from 15 to sixty years

These effects have been compiled to identify any areas where the proposed development may be injurious to the scenic and visual character of the area and represent the potential impact rather than the eventual long-term effect. For this section, it is assumed that no specific landscape works are carried out with the construction of the development and that the open spaces are as existing i.e. grassed areas. This enables recognition of potential, rather than actual, impacts which facilitates the identification of suitable landscape mitigation measures.

Do Nothing Scenario

The ‘Do Nothing’ impact refers to potential impacts should the proposed development not proceed. In relation to the subject site, it would remain vacant and the opportunity to develop 363 no. apartment units, 18 no. houses, 189 no. student bedspaces, creche facility, open space, landscaping and ancillary development would be lost. However, the subject site is zoned for residential development and it is anticipated that even if the proposed development were not to move ahead, another development proposal on the subject site would be likely in the future in line with the zoning objectives on the site. There are no landscape or visual impacts associated with the ‘Do Nothing’ scenario.

Construction Phase Landscape

This landscape will undergo a significant change from an existing vacant site to a construction site. Construction is to take place over a seven year period in three no. phases. There will be significantly negative impacts on the landscape associated with the construction works of this development. This will be due to the site clearance and the building processes required to erect the proposed development and associated works. Negative impacts in this case are considered short-term in nature and only the current, under construction, phase of development will produce negative impact.

Construction Phase Visual

During the construction phase, the following elements of the proposed development have the potential to cause visual impacts;

- Construction works entrances into the proposed development
- Temporary site works – hoarding, lighting, cranes, car parking, storage areas
- Construction traffic – dust and emissions
- Tree and vegetation clearance
- Groundworks – cut and fill excavations

The visual impacts at construction phase on the 13 no. views as detailed in section 10.7 above are described in table 10.5 below.

View	Quality	Significance	Magnitude	Probability	Duration	Sensitivity
No.1	Negative	Slight	Medium	Likely	Short-Term	Low
No.2	Negative	Slight	Medium	Likely	Short-Term	Low
No.3	Negative	Slight	Medium	Likely	Short-Term	Low
No.4	Negative	Slight	Medium	Likely	Short-Term	Low
No.5	Negative	Not Significant	Medium	Likely	Short-Term	Negligible
No.6	Negative	Slight	Medium	Likely	Short-Term	Negligible
No.7	Negative	Not Significant	Low	Likely	Short-Term	Low
No.8	Negative	Significant	Medium	Likely	Short-Term	Medium-High
No.9	Negative	Significant	High	Likely	Short-Term	Medium
No.10	Negative	Very Significant	High	Likely	Short-Term	High
No.11	Negative	Moderate-Slight	High	Likely	Short-Term	Low
No.12	Negative	Slight	Medium	Likely	Short-Term	Low
No.13	Negative	Moderate	Medium	Likely	Short-Term	Medium

Table 10.5: Construction Phase Likely Impacts Without Mitigation

Operational Phase Landscape

Following construction, the main landscape impacts of the proposed development are associated with the change in land use from vacant lands to a more intensified, residential use, as set out in the Limerick City and County Council zoning designation. This is considered to be a slight negative impact, as the existing landscape is classified as generally low sensitivity given the overgrown nature of the landscape at present. Although this is considered a short-term impact, it would likely persist into the medium and long term in the absence of mitigation measures.

Operation Phase Visual

During the operational phase the principal elements which have potential to give rise to visual impact are:

- Road entrance to the proposed development
- Height of proposed buildings
- New structures, roads, lighting, boundaries and pathways
- Proposed tree and shrub planting
- Change of character due to intensification of use, from vacant lands to residential use

10.9 Mitigation

Consideration was given to the avoidance of impacts wherever possible during the design of the proposed scheme. Mitigation and avoidance measures have been designed into the proposed development and the landscaping plan and are an integral factor reducing the potential for adverse landscape effects of the proposed development. The landscape illustrates a variety of design proposals, which will introduce a positive aesthetic quality to the area. However, as with any development some degree of impact is inevitable and wherever possible measures have been proposed to mitigate any possible adverse impacts.

10.9.1 Construction Phase

During the construction phase, site hoarding will be erected to restrict views of the site during construction. Hours of construction activity will also be restricted in accordance with local authority guidance. Tree protection measures will be installed to the existing trees and hedges identified for potential retention on site within the Tree Survey submitted under a separate cover.

Additional Landscaping measures are set out within the Landscape Specification Report as follows;

- All plant material shall be good quality nursery stock, free from fungal, bacterial or viral Infection, aphids, redspider or other insect's pests and any physical damage. It shall comply with the requirements of B.S. 3936: parts 1-10: 1965 Specification for nursery stock;

- All plants supplied shall be exactly true to name as shown in plant schedules. Unless stipulated, varieties with variegated and/or colored leaves not to be accepted, and any plant found to be of this type upon leafing out shall be replaced by the contractor at his/her own expense

Visual impact during the construction phase will be mitigated somewhat through appropriate site management measures and work practices to ensure the site is kept tidy, dust is kept to a minimum, and that public areas are kept free from building material and site rubbish.

10.9.2 Operation Phase

Mitigation measures during the operational phase of the development are as follow;

- All planting is to be undertaken in the first season following completion of site and development works of each phase of development.

- Native trees, shrubs and wildflowers will be used where possible throughout the development.

- Where possible, screening of proposed structures with tree lines and woodland planting is proposed.

Detailed landscape design details mitigating the impact of the development are included within the Landscape Report, Landscape Specification Report and Landscape drawings prepared by PC Roche & Associates and submitted under a separate cover.

10.10 Residual Impacts

Given the zoning policy for the subject site, development of this site is inevitable and it is considered likely that any proposed viable development will give rise to similar impact as those described above. While none of the proposed measures, as discussed in the previous section, can fully mitigate against the intensification of land use, as it changes from agriculture use into a residential development, the proposal will be of benefit both locally and to the wider surrounding area by:

- Increasing the quantity and quality of planning within the site.

- Provision of extensive open space and public amenity areas which were previously inaccessible to the public including a playground and dog-run area.

- Long-term maintenance of the landscape.

Whilst it is inevitable that there will be some negative impacts arising from a development of this scale, it is considered that the benefits substantially outweigh the limited negative aspects of the proposal, resulting in the potential for moderate, positive, and permanent residual impacts.

10.11 Monitoring

10.11.1 Construction Phase

Landscape tender drawings and specifications will be produced at detailed design stage to ensure that the landscape works are implemented in accordance with best practice. This document will include tree work procedures, soil handling, planting and maintenance. The contract works will be supervised by a suitably qualified landscape architect.

10.11.2 Operational Phase

Operational phase monitoring will include weed control, maintenance and replacement planting where necessary. Periodic visits will be required to ensure that any defects that may occur are rectified, that the landscape proposals are successfully establishing and being correctly maintained.

10.12 Cumulative Effects

It is not considered that there will be any cumulative impacts on landscape and visual impact as there are no developments of scale proposed within the immediate area of the site or from where the site is visible. However, any future development within the vicinity of the subject site could have the possibility of impacting on the same sensitive receptors as identified above. This could lead to potential impacts of a slightly higher level of significance on the identified receptors when assessed cumulatively. The impact of future development cannot be fully quantified at this stage but would likely involve visual impact and potential loss of vegetation.

10.13 Interactions

The assessment of the landscape and visual impact associated with the proposed development will interact with other areas of assessment contained within this EIAR. It is considered that areas of interaction are Population and Human Health and Biodiversity.

The interactions were considered as follows:

- Population and Human Health – The landscape and visual impact associated with human beings focuses on the effects to dwellings. The proposed development generates visual effects; the significance of effects and associated mitigation are discussed in sections 10.7, 10.8 and 10.9 of this chapter.

- Biodiversity – The long-term effects of the proposed development will have a positive impact on the tree cover associated with the development and the inclusion of native species of shrub planting.

11.0 TRAFFIC AND TRANSPORTATION

11.1 Introduction

This chapter of the EIAR has been prepared on behalf of Revington Developments Limited, by Matthew Steele BA (Hons) MSc FCILT FRGS MCIHT and Pamela Townley BSc (Hons), both Directors of TTRSA with over twenty years experience of assessing the impacts of traffic and transport related to development.

This chapter provides an assessment of the traffic and transport related impacts of ‘A ten year permission for a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, crèche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick’. The site will be served by two new accesses off the northern side of Pa Healy Road, the easternmost of which will operate as a left in only.

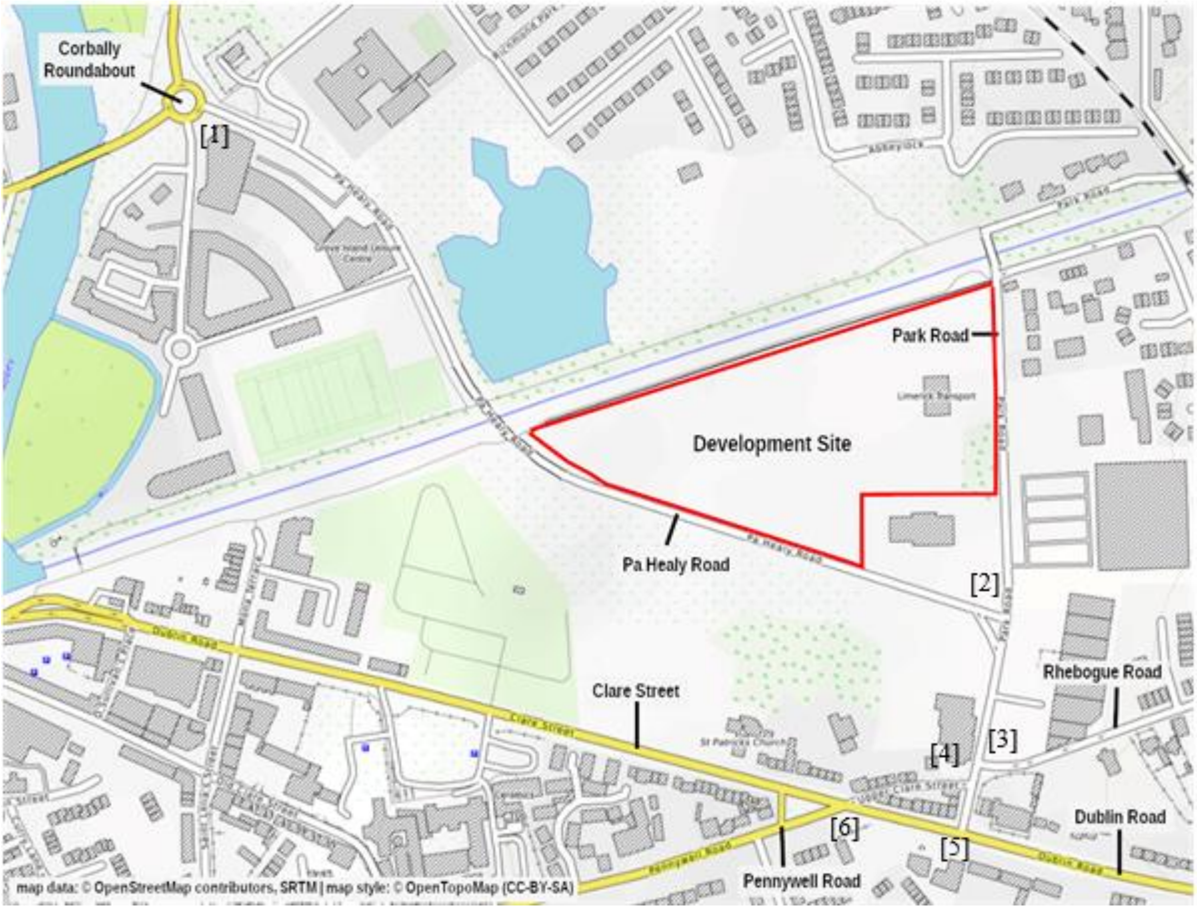

Figure 11.1 Development Site Location *[#] relate to traffic count locations detailed in Section 11.3.3*

11.2 Methodology

The methodology adopted for the production of this chapter is detailed within this section, including: relevant legislation and guidance; consultation; the approach to assessment; and, significance criteria.

11.2.1 Legislation and Guidance

Relevant guidance on assessing the impact of a development on roads, traffic and transport is contained within: the TTA guidelines produced by Transport Infrastructure Ireland (TII)[13]; and, the Environmental Protection Agency (EPA) Guidelines on the information to be contained in Environmental Impact Assessment Reports[14]. The latter states that traffic impact should be assessed for the construction phase, operational phase, and for unplanned events such as traffic collisions (road safety). These documents build on the foundation of: Directive 2011/92/EU as amended by Directive 2014/52/EU)[15], and the Planning and Development Regulations 2001 to 2021[16].

The site is an area covered by the Limerick City Development Plan 2010-2016 (as extended)[17], and the development management standards contained within the Development Plan therefore apply to this site. The guidance and standards contained within the Design Manual for Urban Roads and Streets (DMURS)[18] also apply to this development, and in part, supersede the development management standards contained within the Development Plan.The chapter is also written with cognisance of the Draft Limerick Shannon Metropolitan Area Transport Strategy[19].

11.2.2 Consultations

The technical scope of this chapter was initially discussed with Limerick City and County Council on 25th October 2018, and further discussed and agreed on 6th February 2019. The scoping defined the critical time period for the assessment as the weekday AM and PM peak hours in the operational

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[13] Transport Infrastructure Ireland (2014) PE-PDV-02045 Traffic and Transport Assessment Guidelines accessible at [www.tiipublications.ie/library/PE-PDV-02045-01.pdf]

[14] Environmental Protection Agency (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports

[15] ec.europa.eu/environment/eia/pdf/EIA_Directive_informal.pdf

[16] assets.gov.ie/135619/1ef55833-465c-48da-afc0-592a164fdd1d.pdf

[17] www.limerick.ie/sites/default/files/media/documents/2018-10/Limerick%20City%20Development%20Plan%202010-2016%20%28Including%20Variations%202-6%29%202018-10-02.pdf

[18] DTTAS (2019) Design Manual for Urban Roads and Streets (2nd Edition) accessible at [www.dmurs.ie]

[19] NTA (2020) Draft Limerick Shannon Metropolitan Area Transport Strategy accessible at [www.nationaltransport.ie/wp-content/uploads/2020/09/Draft_LSMATS_Report.pdf]

phased o the development, and the critical spatial area as Pa Healy Road and Park Road, including the Corbally Road roundabout and linked traffic signal junctions onto the R445 Dublin Road. The content of the chapter is consistent with the agreed scoping.

11.2.3 Approach to Assessment

The traffic and transport impacts of the proposed development have been assessed by utilising the following approach based on the aforementioned TTA guidelines. The assessment combines:

- Desktop study, for example of traffic collisions;
- Site based field work, for example traffic counts and on-site geometric measurement;
- Traffic modelling, including:
- The factoring of traffic count data to construction, opening and future assessment years;
- Predicting the number of daily and peak hour trips during the construction and operational phases of the development;
- Using this aforementioned information to model the capacity of the western site access junction using the PICADY traffic modelling software package, the Corbally Roundabout junction using the ARCADY traffic modelling software package; and, the linked signalised junctions including: Pa Healy Road/Park Road; Park Road/Rhebogue Road; Park Road/Upper Clare Street; Park Road/R445 Dublin Road; and, R445 Clare Street/Upper Clare Street/R445 Dublin Road/R858 Pennywell Road, using the LINSIG 3.2 traffic modelling software package.
- Reviewing the environmental impact of traffic related to the operation of the proposed development, including road safety; and,
- Recommending mitigation measures to ensure that any potential roads, traffic and transport effects are kept to a minimum.

The traffic impact assessment contained within this chapter was initially prepared as a Traffic and Transport Assessment (TTRSA Ref: T181011-001, dated 17th January 2020), and has been fully updated for the current planning application.

11.2.4 Significance Criteria

The main significance criteria when assessing traffic and transport impacts is the performance of affected junctions. Other criteria include, for example: any increase in road traffic collisions (which may result in environmental impacts due to spillage); likely damage to the road structure; and, measurable increases in noise and atmospheric pollutants. When assessing significance criteria, it is always important to remain cognisant of both the existing environment, and sensitive receptors such as facilities catering for the young or elderly, where the occupants can be more susceptible to the adverse effects of exposure to environmental impacts.

11.3 The Receiving Environment

11.3.1 Pa Healy Road

As noted in Section 11.1, the proposed development will be accessed from two new accesses off the northern side of the carriageway of Pa Healy Road. In the vicinity of the proposed development, Pa Healy Road is formed from a kerbed single carriageway, demarcated with eastbound and westbound lanes separated by a central ghost island providing right-turning lanes into accesses. The carriageway is relatively straight, flat in long-section and crowned in cross-section. To the western extremity of the development, the carriageway enters a gentle westbound right-hand horizontal curve, also rising vertically, to a canal overbridge. The carriageway is bounded by segregated footpaths and off-road cycle tracks. A zebra pedestrian crossing is provided across Pa Healy Road towards the western extremity of the development adjacent to the bridge over the City Canal, and signal controlled pedestrian crossing facilities are present at the Pa Healy Road/Park Road junction. Sections of the development site are currently bounded by: a wooden post and rail fence; a grass bank; and, a wall. The posted speed limit is 50km/h.

11.3.2 Park Road

The eastern boundary of the proposed development site is bordered by Park Road. In the vicinity of the proposed development, Park Road is formed from a kerbed single carriageway of approximately 8.5m width, demarcated with northbound and southbound right-turning lanes. The carriageway relatively straight and flat, and is bounded by footpaths on both sides of the road, backed by a rendered wall on the proposed development boundary. The posted speed limit is 50km/h on the southern section of Park Road, reducing to 30km/h approximately 90m to the south of a bridge over the canal.

11.3.3 Traffic Volumes

The traffic assessment within this chapter utilises video-based Manual Classified Traffic Counts (MCC) undertaken over a 12-hour period (07:00-19:00) on Wednesday 10th April 2019, at the following junctions. The numbers following the junction are locations depicted on Figure 11.1:

- R463 Corbally Roundabout [1];
- Pa Healy Road/Park Road [2];
- Park Road/Rhebogue Road [3];

- Park Road/Upper Clare Street [4];
- Park Road/R445 Dublin Road [5]; and,
- R445 Clare Street/Upper Clare Street/R445 Dublin Road/R858 Pennywell Road [6].

From these traffic counts, the local AM and PM peak hours assessed within this report are 08:00-08:59 and 17:39-18:29, respectively.

For the purpose of the traffic assessment contained in this chapter, the traffic count data has been converted into Passenger Car Units (PCUs), using factors of: 0.2 for pedal cycles; 0.4 for motorcycles; 1.0 for cars and light goods vehicles (LGV) including those towing trailers; and 2.3 for buses and all types of rigid and articulated Medium and Heavy Commercial Vehicle (HCVs).

Traffic counts of this type typically have a currency of three years, although this has been extended due to the impact of COVID-19 travel restrictions on 'normal' travel levels. The MCC data and the subsequent PCU values are included within Appendix 11.1.

11.3.4 Background Traffic Growth

Subject to planning being granted, it is assumed for the purpose of this traffic assessment contained within this chapter, that phase 1 of the proposed development will be fully constructed and opened during 2023. Subsequent phases will follow in future years. Local traffic has been growthed to the opening year and future assessment years of 2028 and 2038 using the TII Project Appraisal Guidelines[20] based central growth factors for the Limerick Metropolitan Area, taking into account 2.7% HCV traffic, the latter reflecting the current percentage of HCVs surveyed at the R445 Clare Street/Upper Clare Street/R445 Dublin Road/R858 Pennywell Road junction. The following growth factors have been applied:

- From 2019 to 2023 a factor of 1.073;
- From 2019 to 2028 a factor of 1.173; and,
- From 2019 to 2038 a factor of 1.273.

The impact of this traffic growth is detailed within traffic calculations (input data) for the PICADY and ARCADY traffic modelling included within Appendix 11.2, and within the output of the LINSIG traffic modelling included with Appendix 11.3.

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[20] Transport Infrastructure Ireland (2019) PE-PAG-02017 Traffic Demand Projections

11.3.5 Proposed transport schemes

As part of preparing this chapter, a review has been undertaken of proposed transport schemes in the vicinity of the proposed development. Objective T4 of the prevailing Castletroy Local Area Plan 2019-2025 highlights the objective of Limerick City and County Council to support 'the provision of a bus corridor link from the University of Limerick to the City Centre' including the upgrading of bus lanes on the R445 Dublin Road, and this scheme is also included within the Draft Limerick Shannon Metropolitan Area Transport Strategy. Limerick City and County Council's scheme to improve facilities on Park Road for cyclists, including providing a new bridge for traffic across the City Canal, whilst retaining the existing bridge for pedestrian and cycle use was approved by An Bord Pleanála on 22nd September 2021[21]. The EIA Screening Report[22] associated with this scheme states that 'during operation no significant pollution is envisaged [and] here will be no increase in traffic to the area caused by the project'. The traffic impact of this scheme is likely to be <u>not significant</u>. Limerick City and County Council also consulted in September 2020 on a Section 38 scheme to upgrade the existing facilities for pedestrians at the Corbally Road Roundabout[23], the traffic impact of which will be <u>not significant</u>.

11.3.6 Other Planned (Committed) Developments

As part of the preparation of this TTA, information contained within both the Department of Housing, Planning, Community and Local Government National Planning Application Map Viewer, and the An Bord Pleanála website in relation to Strategic Housing Development applications, has been reviewed to (25th March 2022). The only development identified that will result in local traffic growth over and above the levels detailed within the growth factors contained in Section 11.3.4, is the proposed construction of a 750 pupil[24] post-primary school for Gaelcholáiste Luimnigh on a site between Clare Street and Pa Healy Road, Limerick City and County Council grant of planning 19/1252 refers. The proposed school is accessed from a new junction on the southern side of Pa Healy Road, immediately to the south-east of the proposed left-in access to this development. Predicted trip generation for the proposed school has been included within the traffic assessment contained within this chapter as

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[21] https://www.pleanala.ie/anbordpleanala/media/abp/cases/orders/309/d309360.pdf *(accessed 30th September 2021)*

[22] https://mypoint.limerick.ie/en/system/files/materials/505/EIA%20Screening.pdf *(accessed 30th September 2021)*

[23] https://mypoint.limerick.ie/ga/consultation/corbally-road-roundabout-pedestrian-crossing-upgrade-works *(accessed 30th September 2021)*

[24] 635 of the pupils attending the new school currently attend the existing school premises at St Harry's Mall, off Mary Street, approximately 850m from the new site.

‘committed development’, and is consistent with the Traffic and Transport Assessment prepared by ORS (Report reference 191_008-ORS-XX-XX-RP-TR-7d-002) submitted as part of the planning application for the school. No developments have taken place in the local area since 2019 that would have a significant impact on traffic levels beyond the growth factors details in Section 11.3.4.

11.4 Characteristics of Proposed Development

The proposed development is ‘A ten year permission for a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, crèche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick’. The development has an overall gross floor area of 45,478.65m2 on a four hectare area bounded by the City Canal to the north, Pa Healy Road to the south and Park Road to the east.

11.4.1 Site Access Junction Geometry

Two new site access junctions will be created as part of this development, both on the northern side of the carriageway of Pa Healy Road. The westernmost access junction is formed from 6m kerbed radii, leading to a 6m wide internal spine route. The easternmost access junction is formed from a 10m kerbed radii on entry and a 6m kerbed radii on exit, only facilitating the left-in movement from Pa Healy Road. As part of the development, worded ‘Stop’ road markings and stop signing will be provided at the westernmost access. Visibility splays of 2.4m x 49m, complying with the requirements of DMURS, will be maintained.

11.4.2 Internal Layout

Internally, the layout of the development is formed from a 6m wide two-way spine road which continues to the north of the western site access for a distance of approximately 50m before transitioning to the east on an east-west alignment and then transitioning to the north for a short section length. A north south link road bounded to the west by perpendicular parking links the eastern site access to this spine road. Four further access junctions are provided off the spine road serving parking areas.

11.4.3 Internal Pedestrian Access Provision

Pedestrian routes, 2m in width, are provided throughout the development with additional pedestrian accesses linking to existing pedestrian facilities on Pa Healy Road, Park Road and the Canal Bank route. Blister type tactile paving is proposed at all uncontrolled crossing locations to create fully accessible routes.

11.4.4 Bicycle Parking

420 bicycle parking spaces will be provided at numerous locations throughout the development, including in secure enclosures inside and adjacent to the entrances to all units. This level of bicycle parking provision is broadly consistent with the requirements of the Limerick City Development Plan 2010-2016 (as extended), noting that for development where in excess of 150 cycle stands are required, the Development Plan states that the Council 'shall use discretion with regard to the number of facilities required per development'.

11.4.5 Car Parking

The main measure to reduce car dependence within the site will be limiting car parking for private vehicles, an approach that is generally consistent with the Project Ireland 2040 National Planning Framework[25] and supported by the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040. Student rentals will not include car parking spaces, whilst the built-to-rent apartments will only be provided with 0.35 shared car parking spaces per apartment. Additional space for off-street car parking is provided within the frontages of the 18 dwelling houses.

11.4.6 Service Vehicles

Loading/set-down bays are provided for servicing vehicles internal to the development. TTRSA have been informed that segregated waste collection points will be provided internally adjacent to the access of each building.

11.5 Potential Impacts

11.5.1 Traffic Impact

Traffic impact is typically assessed in terms of the impact of the traffic generated by a development on the operation of the local road network. Threshold levels for an increase in traffic volumes requiring assessment, considered to be a material impact, are typically ten percent, although it is usual to assess the performance of any access junction as the point of maximum impact, to ensure that the junction is capable of operating within capacity inclusive of the traffic generated by the development. Traffic modelling software is used to facilitate this assessment. Table 11.1 shows that no network links in the vicinity of the development are impacted to the level normally considered to be a material impact during the operational phase of the development through to 2038.

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[25] https://npf.ie/wp-content/uploads/Project-Ireland-2040-NPF.pdf *(accessed 30th September 2021)*

Network Link	Percentage impact
R463 O’Dwyers Bridge (Athlunkard St)	2.8%
R463 Corbally Rd	3.3%
Pa Healy Rd (at Corbally Roundabout)	7.8%
Pa Healy Rd (at Park Road Junction)	6.0%
Park Road (adj. To site)	1.9%
Park Road (South of Pa Healy Road)	4.8%
Rhebogue Rd	4.4%
R455 Clare St	0.6%
R455 Dublin Rd	1.0%
R858 Pennywell Rd	1.2%

Table 11.1 Percentage impact of operational phase development traffic in 2038

11.5.2 Construction Phase Trip Generation and Impact

Construction traffic will access the site via Pa Healy Road. TTRSA have been informed that a construction phase traffic management plan will be agreed with Limerick City and County Council covering for example, timings of HCV deliveries and facilities on site for the washing of vehicles. The overall level of construction phase trip generation including HCV and workforce trips is anticipated to be significantly less than the threshold for assessment detailed in Section 11.5.1 and in environmental terms will be imperceptible (no measurable impact).

11.5.3 Operational Phase Trip Generation

Each mixed-use development is unique in its composition, therefore a range of approaches have been applied to estimate trip generation. In order to provide local trip generation rates for the proposed rental and student apartments within the development video-based multimodal trip generation traffic counts were undertaken in Limerick at three student accommodation sites and two residential apartment sites on Wednesday 10th April 2019. Output from these trip generation traffic counts is included in Appendix 11.1. Trip rates for the proposed housing units relate to an existing residential estate in Limerick. Typical peak hour trip rates, consistent with industry standard databases such as TRAVL and TRICS have been applied for the crèche, cafe, management office and retail elements of the development. Peak hour arrival (in) and departure (out) trip rates for each element of the development are detailed in Table 11.2, and the number of peak hour trips generated, are detailed in Table 11.3.

Use	**Rate per GFA/Units**	**AM Peak Hour In**	**AM Peak Hour Out**	**PM Peak Hour In**	**PM Peak Hour Out**
Crèche	100m^2	5.520	3.640	2.060	2.570
Local Shops	100m^2	4.745	4.280	6.145	6.264
Cafe	100m^2	1.285	0.000	2.015	1.604
Management Office	100m^2	3.129	1.271	0.000	1.000
Student Apartments	1 bed space	0.011	0.025	0.045	0.047
Rental Apartments	1 unit	0.106	0.207	0.099	0.085
Houses	1 unit	0.203	0.551	0.319	0.232

Table 11.2 Weekday peak hour vehicular trip rates for the proposed development in PCUs

Use	**Dev GFA/Units**	**AM Peak Hour In**	**AM Peak Hour Out**	**PM Peak Hour In**	**PM Peak Hour Out**
Crèche	442m^2	24.4	16.1	9.1	11.4
Local Shops	260m^2	12.3	11.1	16.0	16.3
Cafe	237m^2	1.9	0.0	2.9	2.3
Management Office	239m^2	7.5	3.0	0.0	2.4
Student Apartments	197 bed spaces	2.1	4.8	8.9	9.2
Rental Apartments	363 units	38.3	75.2	35.8	30.7
Houses	18 units	3.7	9.9	5.7	4.2
Total development		90	120	78	76

Table 11.3 Weekday peak hour vehicular trips generated by the proposed development in PCUs

11.5.4 Operational Phase Trip Distribution and Assignment

For the purpose of the traffic assessment contained within this chapter, trips to and from the proposed development have been distributed and assigned taking account of existing proportional AM and PM peak hour traffic movements at the junctions contained within the assessment. This approach takes into account a number of factors including the distance to and availability of facilities, and commuting based trips. The distribution and assignment of trips is detailed within traffic calculations (input data) for the PICADY and ARCADY traffic modelling included within Appendix 11.2, and within the output of the LINSIG traffic modelling included with Appendix 11.3.

Although a large percentage of the trips associated with the crèche, cafe, management office and retail elements of the development are likely to be internal to the site, these have been modelled as external trips in order to assess the maximum impact of the development.

11.5.5 Assessment of Junction Operation During the Operational Phase

To fully assess the impact of the development on the local highway network, the operation of several junctions has been assessed using appropriate traffic modelling tools, as agreed through the scoping process.

The operation of the western and eastern site access junctions of the proposed development accessing onto Pa Healy Road has been assessed in the opening and future assessment years with the development in place using PICADY models.

The operation of the existing Corbally Roundabout junction has been assessed in the opening and future assessment years with and without the development in place using an ARCADY model.

The operation of the network of linked signalised junctions including: Pa Healy Road/Park Road; Park Road/Rhebogue Road; Park Road/Upper Clare Street; Park Road/R445 Dublin Road; and, R445 Clare Street/Upper Clare Street/R445 Dublin Road/R858 Pennywell Road, has been modelled in the opening and future assessment years with the development in place, as a network model in LINSIG 3.2.

Traffic movements related to all scenarios are detailed within traffic calculations (input data) for the PICADY and ARCADY traffic modelling included within Appendix 11.2, and within the output of the LINSIG traffic modelling included with Appendix 11.3, noting that for a network of linked signals LINSIG assigns traffic to and from entry/exit zones.

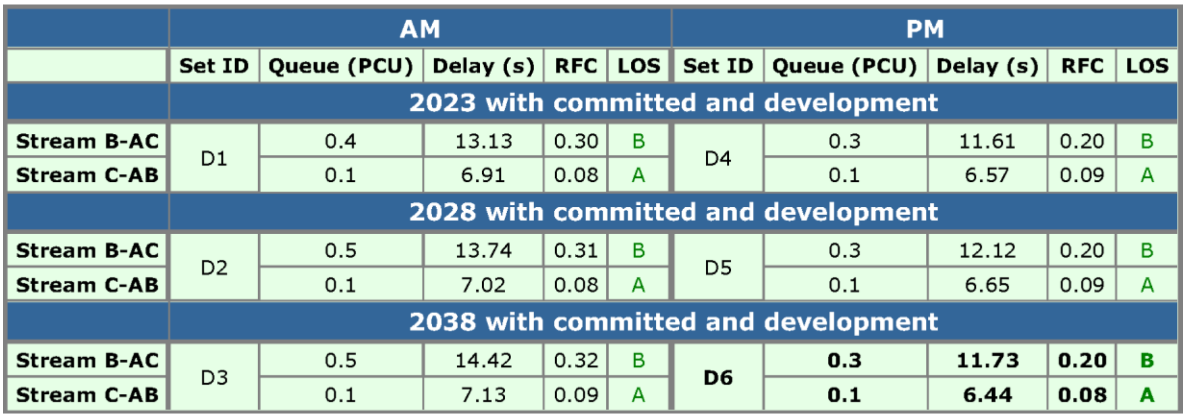
The assessments have all been undertaken using PCU values. The criteria used to assess the performance of a junction for a given traffic demand within the aforementioned traffic modelling software are:

- Ratio of Flow to Capacity (RFC) is a measure of junction performance in terms of saturation. A value of 1.00, which can also be considered as 100% saturation, represents an arm of the junction operating at maximum capacity, in that any increase in the rate of vehicles arriving on the link will result in significant additional queue lengths. Traditionally a figure of 0.85 or 85% is the maximum acceptable degree of saturation for priority and roundabout junctions, increasing to a figure of 0.90 or 90% for traffic signal control junctions. Junctions with RFC values above these 'maximums' are considered to be congested. RFC is termed Degree of Saturation (Deg Sat) in LINSIG output files.
- Practical Reserve Capacity (PRC) is a term used in LINSIG to measure spare capacity on a link, at a signalised junction, or for a signal controller. The PRC value is the amount of spare capacity based on the 90% Deg Sat. Deg Sat values of <90% therefore result in a positive PRC and Deg Sat values of >90% result in a negative PRC.

- Queue lengths (measured in PCUs) are primarily used to check for blocking back through adjacent junctions.

The results of the assessment are summarised in Tables 11.4, 11.5, and 11.6, and the modelling output files are presented in Appendix 11.3.

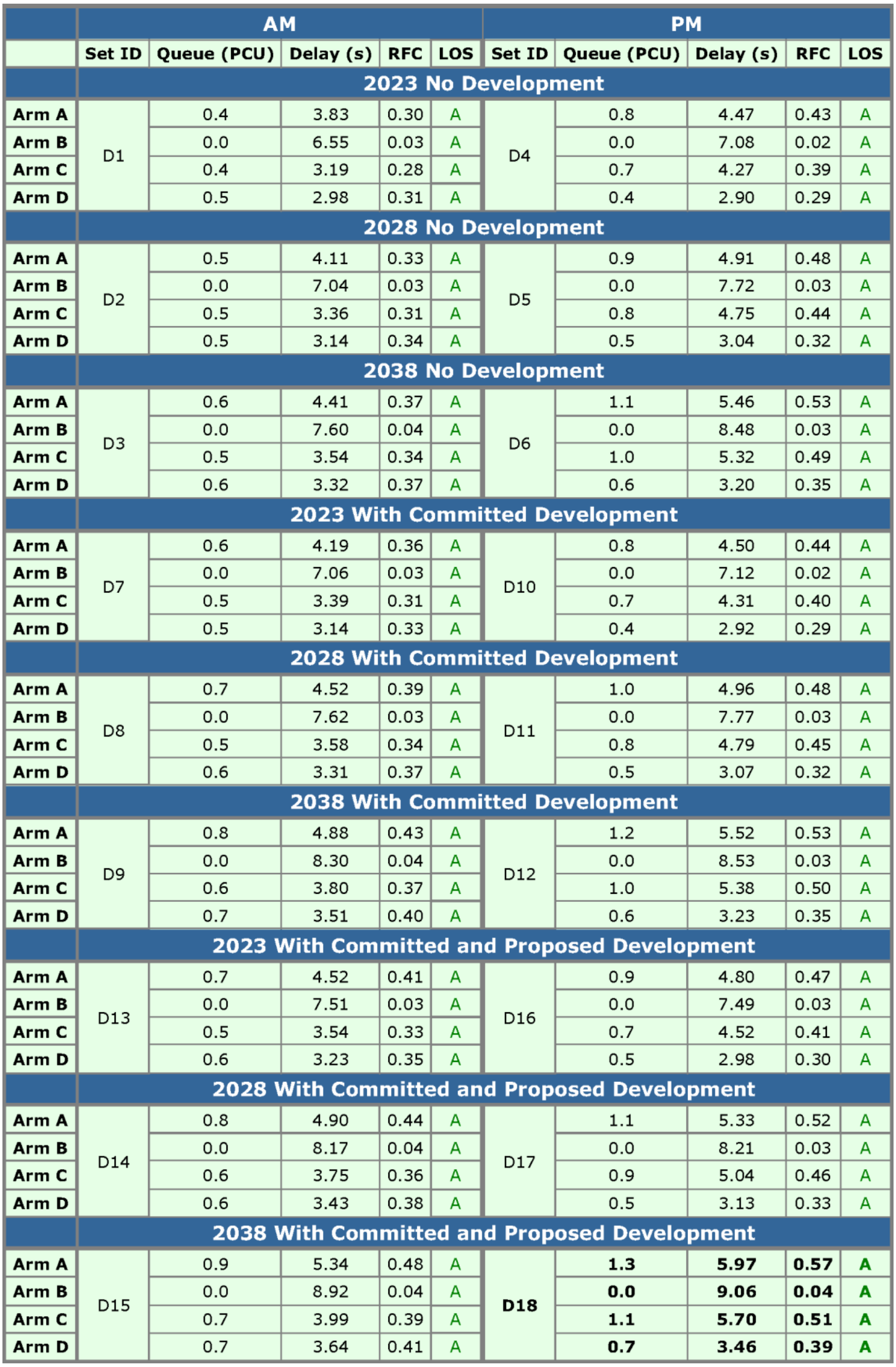
Table 11.4 shows that the proposed western site access junction onto Pa Healy road will operate with a large amount of spare capacity and minimal queueing in all of the scenarios tested. In 2038 with the proposed development in place, the junction has 68% spare capacity in the AM peak hour and 80% spare capacity in the PM peak hour.



	AM					**PM**				
	Set ID	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**	**Set ID**	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**
	2023 with committed and development									
Stream B-AC	D1	0.4	13.13	0.30	B	D4	0.3	11.61	0.20	B
Stream C-AB		0.1	6.91	0.08	A		0.1	6.57	0.09	A
	2028 with committed and development									
Stream B-AC	D2	0.5	13.74	0.31	B	D5	0.3	12.12	0.20	B
Stream C-AB		0.1	7.02	0.08	A		0.1	6.65	0.09	A
	2038 with committed and development									
Stream B-AC	D3	0.5	14.42	0.32	B	**D6**	**0.3**	**11.73**	**0.20**	**B**
Stream C-AB		0.1	7.13	0.09	A		**0.1**	**6.44**	**0.08**	**A**

Table 11.4 Summary of PICADY output for the western site access junction onto Pa Healy Road

Table 11.5 shows that the existing Corbally (4-arm) Roundabout junction has the capability to operate within capacity in all of the scenarios tested. However, it should also be noted that particularly at peak times, the operation of this roundabout can be impacted by queuing traffic from upstream junctions on the R346.



	AM					PM				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2023 No Development									
Arm A	D1	0.4	3.83	0.30	A	D4	0.8	4.47	0.43	A
Arm B		0.0	6.55	0.03	A		0.0	7.08	0.02	A
Arm C		0.4	3.19	0.28	A		0.7	4.27	0.39	A
Arm D		0.5	2.98	0.31	A		0.4	2.90	0.29	A
	2028 No Development									
Arm A	D2	0.5	4.11	0.33	A	D5	0.9	4.91	0.48	A
Arm B		0.0	7.04	0.03	A		0.0	7.72	0.03	A
Arm C		0.5	3.36	0.31	A		0.8	4.75	0.44	A
Arm D		0.5	3.14	0.34	A		0.5	3.04	0.32	A
	2038 No Development									
Arm A	D3	0.6	4.41	0.37	A	D6	1.1	5.46	0.53	A
Arm B		0.0	7.60	0.04	A		0.0	8.48	0.03	A
Arm C		0.5	3.54	0.34	A		1.0	5.32	0.49	A
Arm D		0.6	3.32	0.37	A		0.6	3.20	0.35	A
	2023 With Committed Development									
Arm A	D7	0.6	4.19	0.36	A	D10	0.8	4.50	0.44	A
Arm B		0.0	7.06	0.03	A		0.0	7.12	0.02	A
Arm C		0.5	3.39	0.31	A		0.7	4.31	0.40	A
Arm D		0.5	3.14	0.33	A		0.4	2.92	0.29	A
	2028 With Committed Development									
Arm A	D8	0.7	4.52	0.39	A	D11	1.0	4.96	0.48	A
Arm B		0.0	7.62	0.03	A		0.0	7.77	0.03	A
Arm C		0.5	3.58	0.34	A		0.8	4.79	0.45	A
Arm D		0.6	3.31	0.37	A		0.5	3.07	0.32	A
	2038 With Committed Development									
Arm A	D9	0.8	4.88	0.43	A	D12	1.2	5.52	0.53	A
Arm B		0.0	8.30	0.04	A		0.0	8.53	0.03	A
Arm C		0.6	3.80	0.37	A		1.0	5.38	0.50	A
Arm D		0.7	3.51	0.40	A		0.6	3.23	0.35	A
	2023 With Committed and Proposed Development									
Arm A	D13	0.7	4.52	0.41	A	D16	0.9	4.80	0.47	A
Arm B		0.0	7.51	0.03	A		0.0	7.49	0.03	A
Arm C		0.5	3.54	0.33	A		0.7	4.52	0.41	A
Arm D		0.6	3.23	0.35	A		0.5	2.98	0.30	A
	2028 With Committed and Proposed Development									
Arm A	D14	0.8	4.90	0.44	A	D17	1.1	5.33	0.52	A
Arm B		0.0	8.17	0.04	A		0.0	8.21	0.03	A
Arm C		0.6	3.75	0.36	A		0.9	5.04	0.46	A
Arm D		0.6	3.43	0.38	A		0.5	3.13	0.33	A
	2038 With Committed and Proposed Development									
Arm A	D15	0.9	5.34	0.48	A	**D18**	**1.3**	**5.97**	**0.57**	**A**
Arm B		0.0	8.92	0.04	A		**0.0**	**9.06**	**0.04**	**A**
Arm C		0.7	3.99	0.39	A		**1.1**	**5.70**	**0.51**	**A**
Arm D		0.7	3.64	0.41	A		**0.7**	**3.46**	**0.39**	**A**

Table 11.5 Summary of ARCADY output for the existing Corbally Roundabout junction

Table 11.6 shows that the Pa Healy Road/ Park Road junction will operate with Deg Sat values of >90%, resulting in negative PRC values, in the AM peak in 2038 with the committed and proposed developments in place, and in the PM peak in 2038 without development and with committed development in place and the PM peaks in the 2028 and 2038 with the committed and proposed developments in place. The capacity of the Pa Healy Road/Park Road junction could be increased to reduce Deg Sat values to <90%, resulting in positive PRC values, by removing the Pa Healy Road access to the neighbouring site which is located on the north-western corner of this junction to allow the provision of an additional short off-side lane on the approach to the Pa Healy Road eastbound stop-line. It should also be noted that the operation of the network of linked signalised junctions can be impacted by congestion occurring elsewhere on the road network.

Scenario	**Peak**	**Highest Deg Sat**	**Highest Deg Sat Lane**
2023 without development	AM	71.7%	Dublin Road Eastbound and Park Road Southbound Right-turn at the Dublin Road/Park Road junction
	PM	79.6%	Park Road Northbound at the Pa Healy Road/Park Road junction
2028 without development	AM	78.4%	Dublin Road Eastbound at the Dublin Road/Park Road junction
	PM	87.1%	Park Road Northbound at the Pa Healy Road/Park Road junction
2038 without development	AM	85.2%	Park Road Southbound Right-turn at the Dublin Road/Park Road junction
	PM	**94.6%**	Park Road Northbound and Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
2023 with committed development	AM	76.7%	Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
	PM	81.0%	Park Road Northbound at the Pa Healy Road/Park Road junction
2028 with committed development	AM	76.7%	Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
	PM	88.5%	Park Road Northbound at the Pa Healy Road/Park Road junction
2038 with committed development	AM	89.4%	Dublin Road Eastbound at the Dublin Road/Park Road junction
	PM	**96.0%**	Park Road Northbound at the Pa Healy Road/Park Road junction

2023 with committed and proposed development	AM	83.4%	Park Road Northbound at the Pa Healy Road/Park Road junction
	PM	87.1%	Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
2028 with committed and proposed development	AM	90.0%	Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
	PM	**93.9%**	Park Road Northbound and Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
2038 with committed and proposed development	AM	**95.2%**	Pa Healy Road Eastbound at the Pa Healy Road/Park Road junction
	PM	**101.7%**	Park Road Northbound at the Pa Healy Road/Park Road junction

Table 11.6 Summary of LINSIG output for the network of linked signalised junctions

In summary, the impact of the proposed development on the assessed junctions is a permanent moderate/slight, being a low impact on a medium sensitivity environment where background traffic growth is the main driver of change. There is potential for the Pa Healy Road/Park Road junction to be over capacity in the PM peak in the 2028 and 2038 future years with the development in place. Whilst minor works may be needed in the future at the Pa Healy Road/Park Road junction to increase capacity, there is an increasing degree of uncertainty in relation to traffic volumes and patterns when forecasting ahead over a seventeen year period. For example, changes to travel patterns due to increasing use of mobility as a service (MaaS), changes in vehicle types and ownership as the electrification of vehicles and vehicle autonomy both increase; and, changes to the road, sustainable transport and public transport networks though initiative such as the Limerick Shannon Metropolitan Area Transport Strategy.

11.5.6 Road Structure Impact

Road structure impact is initially assessed by a simple visual inspection for cracking, deformation and disintegration in the vicinity of the site[26]. If following this visual assessment, and taking account of the types and volumes of traffic likely to be generated from a proposed development, the structural ability of the road to carry the traffic is in question, tests can be undertaken to determine the structural strength of the carriageway. Current guidance for such testing is detailed in the TII publication

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[26] DTTAS (2013) Urban Flexible Roads Manual : Pavement Surface Condition Index Volume 2 of 3

'Pavement Assessment, Repair and Renewal Principles' Ref. AM-PAV-06050[27] published in March 2020. During a site visit on 8th October 2021, no significant visual defects were observed. In terms of road structure degradation, the additional traffic generated by the proposed development is not significant as it is negligible in terms of the proportion of the overall traffic volumes recorded on Pa Healy Road.

11.5.7 Road Safety Impact

Road safety impact is typically assessed in terms of the collision record on the local road network in the vicinity of a development. Safety related geometrical measurements are also assessed, for example, visibility to and from access points and junctions.

Consultation of the Road Safety Authority online collision data (for the period 2005 to 2016 inclusive), the latest publicly available, indicates that one collision resulting in injury has been reported on Pa Healy Road in the vicinity of the proposed development. This collision occurred on a Saturday evening (19:00-23:00) in 2012 and involved a car. The collision resulted in minor injuries to three casualties.

A Stage 1 Road Safety Audit (RSA) of the design of the site layout of a proposed mixed-use development, including the two proposed site access junctions onto Pa Healy Road, was prepared in December 2019 accordance with the current TII 'Road Safety Audit' (standard) Ref. GE-STY-01024[28] published in December 2017. A re-audit of the currently proposed design has been appended to this Stage 1 Road Safety Audit (Appendix 11.4).

11.5.8 Traffic Noise Impact

The environmental impact of traffic noise is fully assessed in Chapter 9 of this EIAR. The assessment concludes that 'the predicted change in noise levels associated with additional traffic is predicted to be of imperceptible impact along the existing road network'.

11.5.9 Traffic Related Air Quality and Climate Impact

The environmental impact of traffic on air quality and climate is fully assessed in Chapter 8 of this EIAR. The assessment concludes that 'construction stage traffic will have a neutral, imperceptible, localised and short-term impact on air quality due to the minor increase in site related traffic as a result of the proposed development', and that whilst 'operational phase impacts involve an increase

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[27] Transport Infrastructure Ireland (2020) AM-PAV-06050 Pavement Assessment, Repair and Renewal Principles

[28] Transport Infrastructure Ireland (2017) GE-STY-01024 Road Safety Audit' (standard)

in traffic related pollutants in the local area. The traffic data for the proposed development in conjunction with other nearby permitted and proposed developments was found to have an imperceptible, negative and long-term impact on local air quality and climate'.

11.6 Mitigation

11.6.1 Construction Phase Mitigation Measures

It is noted in Section 11.5.2 that a construction phase traffic management plan will be agreed with Limerick City and County Council covering for example, timings of HCV deliveries and facilities on site for the washing of vehicles, and that the impact of construction phase trip generation will be imperceptible (no measurable impact). As such, no additional construction phase mitigation measures are proposed.

11.6.2 Operational Phase Mitigation Measures

The predicted traffic related impact of the operational phase of the proposed development is permanent moderate/slight, the following mitigation measures are recommended to ensure that the impact of the development is as small as possible:

To minimise the impact of the development on the capacity and operation of the local road network, the action plan contained within the Mobility Management Plan prepared for the development (Appendix 11.5) should be implemented;

To minimise the risk of collisions occurring, the recommendations contained within the Stage 1 Road Safety Audit (and any subsequent Road Safety Audits) should be implemented.

11.7 Do-Nothing Scenario

The assessment containing in Section 11.5 includes a do nothing (no/without development) scenario which details the impact of changes to the existing traffic and transportation in the surrounding area. It is considered that because of the zoning of the subject site, it is likely that should the proposed development not proceed, that a similar development will take place on the proposed development site in the future with similar traffic and transport related impacts as the proposed development.

11.8 Cumulative Impacts and Interactions

The assessment containing in Section 11.5 includes the cumulative impacts of the proposed development, combined with traffic related impact of factors such as population and economic growth, changes to development patterns and employment locations, and other specific planned developments.

11.9 Residual Impacts

Taking into account the analysis contained within Section 11.5 of this chapter, and mitigation measures contained in Section 11.6 of this chapter, the residual short-term and long-term traffic and transport related environmental impacts of the proposed development are not significant.

11.10 Difficulties Encountered In Compiling Information

No difficulties (technical deficiencies or lack of know-how) were encountered in compiling this chapter.

12.0 MATERIAL ASSETS - WASTE

12.1 Introduction

This Chapter of the EIAR comprises an assessment of the likely impact of the proposed Development on the waste generated from the development as well as identifying proposed mitigation measures to minimise any associated impacts.

This Chapter was prepared by Chonaill Bradley (Bsc ENV AssocCIWM) of AWN Consulting. Chonaill Bradley is a Senior Environmental Consultant in the Environment Team at AWN. He holds a BSc in Environmental Science from Griffith University, Australia. He is an Associate Member of the Institute of Waste Management (CIWM). Chonaill has over seven years' experience in the environmental consultancy sector and specialises in waste management.

A site-specific Construction and Demolition Waste Management Plan (C&D WMP) has been prepared by AWN Consulting Ltd to deal with waste generation during the demolition, excavation and construction phases of the proposed Development and has been included as Appendix 12.1. The C&D WMP was prepared in accordance with the 'Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects' document produced by the National Construction and Demolition Waste Council (NCDWC) in conjunction with the Department of the Environment, Heritage and Local Government in July 2006.

A separate Operational Waste Management Plan (OWMP) has also been prepared for the operational phase of the proposed Development and is included as Appendix 12.2 of this Chapter.

The Chapter has been prepared in accordance with EPA Guidelines on the Information to be contained in EIAR (2017, Draft)

These documents will ensure the sustainable management of wastes arising at the Development Site in accordance with legislative requirements and best practice standards.

12.2 Methodology

The assessment of the impacts of the proposed Development, arising from the consumption of resources and the generation of waste materials, was carried out taking into account the methodology specified in relevant guidance documents, along with an extensive document review to assist in identifying current and future requirements for waste management; including national and regional waste policy, waste strategies, management plans, legislative requirements and relevant reports. A summary of the documents reviewed, and the relevant legislation is provided in the C&D WMP and in the OWMP provided in Appendices 12.1 and 12.2.

This Chapter is based on the proposed Development, as described in Chapter 3 (Description of Proposed Development) and considers the following aspects:

- Legislative context;
- Construction phase (including demolition, site preparation and excavation); and
- Operational phase.

A desktop study was carried out which included the following:

- Review of applicable policy and legislation which creates the legal framework for resource and waste management in Ireland;
- Description of the typical waste materials that will be generated during the Construction and Operational phases; and
- Identification of mitigation measures to prevent waste generation and promote management of waste in accordance with the waste hierarchy.
- Estimates of waste generation during the construction and operational phases of the proposed Development have been calculated. The waste types and estimated quantities are based on published data by the EPA in the National Waste Reports and National Waste Statistics, data recorded from similar previous developments, Irish and US EPA waste generation research as well as other available research sources.

Mitigation measures are proposed to minimise the effect of the proposed Development on the environment during the construction and operational phases, to promote efficient waste segregation and to reduce the quantity of waste requiring disposal. This information is presented in Section 12.5.

A detailed review of the existing ground conditions on a regional, local and site-specific scale are presented in Chapter 6 of this EIAR (Land, Soils and Geology). Chapter 6 also discusses the environmental quality of any soils which will have to be excavated to facilitate construction of the proposed Development.

12.2.1 Legislation and Guidance

Waste management in Ireland is subject to EU, national and regional waste legislation and control, which defines how waste materials must be managed, transported and treated. The overarching EU legislation is the Waste Framework Directive (2008/98/EC) which is transposed into national legislation in Ireland. The cornerstone of Irish waste legislation is the Waste Management Act 1996 (as amended). European and national waste management policy is based on the concept of 'waste hierarchy', which sets out an order of preference for managing waste (prevention > preparing for reuse > recycling > recovery > disposal) (Figure 12.1).

Figure 12.1: Waste Hierarchy (Source: European Commission)

The Irish government issues policy documents which outline measures to improve waste management practices in Ireland and help the country to achieve EU targets in respect of recycling and disposal of waste. The most recent policy document, Waste Action Plan for a Circular Economy – Waste Management Policy in Ireland, was published in 2020 and shifts focus away from waste disposal and moves it back up the production chain. The move away from targeting national waste targets is due to the Irish and international waste context changing in the years since the launch of the previous waste management plan, A Resource Opportunity, in 2012. The need to embed climate action in all strands of public policy aligns with the goals of the European Green Deal.

The strategy for the management of waste from the construction phase is in line with the requirements of the Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects, published by the Department of Environment, Heritage and Local Government (DoEHLG) in 2006. The guidance documents, Construction and Demolition Waste Management: A Handbook for Contractors and Site Managers (FÁS & Construction Industry Federation, 2002) and Environmental Protection Agency (EPA) 'Best Practice Guidelines for the Preparation of Resource Management Plans for Construction & Demolition Projects' Draft for public consultation (April 2021) were also consulted in the preparation of this assessment.

There are currently no Irish guidelines on the assessment of operational waste generation, and guidance is taken from industry guidelines, plans and reports including the Southern Region (SR) Waste Management Plan 2015 – 2021, BS 5906:2005 Waste Management in Buildings – Code of Practice, the Limerick City and County Council (LCCC) Limerick City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019)", the EPA National Waste Database Reports 1998 – 2018 and the EPA National Waste Statistics Web Resource.

12.2.2 Terminology

Note that the terminology used herein is generally consistent with the definitions set out in Article 3 of the Waste Framework Directive. Key terms are defined as follows:

- **Waste** - Any substance or object which the holder discards or intends or is required to discard.
- **Prevention** - Measures taken before a substance, material or product has become waste, that reduce:

  the quantity of waste, including through the re-use of products or the extension of the life span of products;
  the adverse impacts of the generated waste on the environment and human health; or
  the content of harmful substances in materials and products.

- **Reuse** - Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.
- **Preparing for Reuse** - Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.
- **Treatment** - Recovery or disposal operations, including preparation prior to recovery or disposal.
- **Recovery** - Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II of the Waste Framework Directive sets out a non-exhaustive list of recovery operations.
- **Recycling** - Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the

reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

- **Disposal** - Any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I sets out a non-exhaustive list of disposal operations.

12.3 Baseline Environment

The development will principally consist of a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the west, Canal Bank, Limerick.

In terms of waste management, the receiving environment is largely defined by LCCC as the local authority responsible for setting and administering waste management activities in the area. This is governed by the requirements set out in the SR Waste Management Plan 2015 – 2021, which sets out the following targets for waste management in the region:

- A 1% reduction per annum in the quantity of household waste generated per capita over the period of the plan;
- Achieve a recycling rate of 50% of managed municipal waste by 2020; and
- Reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.

The Regional Plan sets a specific target for C&D waste of "70% preparing for reuse, recycling and other recovery of construction and demolition waste" (excluding natural soils and stones and hazardous wastes) to be achieved by 2020.

The National Waste Statistics update published by the EPA in August 2020 identifies that Ireland's current progress against this C&D waste target is at 77% and our progress against 'Preparing for reuse and recycling of 50% by weight of household derived paper, metal, plastic & glass (includes metal and plastic estimates from household WEEE)' is at 51%. Both of these targets are required to be met by 12 December 2020 in accordance with the requirements of the Waste Framework Directive; however, the EPA are yet to confirm that these were met.

The Limerick City Development Plan 2010-2016 (as Extended) and the Draft Limerick Development Plan 2022-2028 (2021) also set out policies and objectives for the LCCC area which reflect those set out in the regional waste management plan.

In terms of physical waste infrastructure, LCCC no longer operates any municipal waste landfill in the area. There are a number of waste permitted and licensed facilities located in the Southern Waste Region and within Ireland for the management of waste from the construction industry as well as municipal sources. These include soil recovery facilities, inert C&D waste facilities, hazardous waste treatment facilities, municipal waste landfills, material recovery facilities, waste transfer stations and two waste-to-energy facilities.

12.3.1 Characteristics of the Proposed Development

A full description of the proposed Development can be found in Chapter 3 (Description of Proposed Development). The characteristics of the proposed Development that are relevant in terms of waste management are summarised below.

12.3.1.1 Demolition Phase

There will be a quantity of waste materials generated from the demolition of the existing warehouse building and hardstanding areas on site, as well as from the further excavation of the building foundations.

Further detail on the waste materials likely to be generated during the demolition works are presented in the project-specific C&D WMP in Appendix 12.1. The C&D WMP provides an estimate of the main waste types likely to be generated during the C&D phase of the proposed Development. The reuse, recycling / recovery and disposal rates have been estimated by the project engineers (PHM Consulting) and these are summarised in Table 12.1.

Waste Type	Tonnes	Reuse/Recover		Recycle		Disposal	
		%	Tonnes	%	Tonnes	%	Tonnes
Steel	27.0	0	0.0	80	21.6	20	5.4
Concrete	408.0	0	0.0	0	0.0	100	408.0
Masonry	296.0	0	0.0	40	118.4	60	117.6
Hardcore	285.0	0	0.0	0	0.0	100	285.0
ACM	10.0	0	0.0	0	0.0	100	10.0
Hardstanding Area							
Steel	7.0	0	0.0	100	7.0	0	0.0

Concrete	380.0	0	0.0	60	228.0	40	152.0
Tarmacadam	80.0	0	0.0	25	20.0	75	60.0
Hardcore	650.0	0	0.0	50	325.0	50	325.0
Total	**2143.0**		**0.0**		**720.0**		**1362.7**

Table 12.1: Estimated off-site Reuse, Recycle and Disposal Rates for Demolition Waste

12.3.1.2 Construction Phase

During the construction phase, waste will be produced from surplus materials such as broken or off-cuts of timber, plasterboard, concrete, tiles, bricks, etc. Waste from packaging (cardboard, plastic, timber) and oversupply of materials may also be generated. The appointed Contractor will be required to ensure that oversupply of materials is kept to a minimum and opportunities for reuse of suitable materials is maximised.

In addition, topsoil, subsoil, clay and made ground will require excavation to facilitate site levelling, construction of foundations, along with the installation of underground services. The project Engineers, PHM Consulting have estimated that c. 14,042 m3 of material will require excavation. It is envisaged that all of this material will be removed off-site. This estimate will be refined prior to commencement of construction.

If the material that requires removal from Site is deemed to be a waste, removal and reuse / recycling / recovery / disposal of the material will be carried out in accordance with the Waste Management Act 1996 (as amended), the Waste Management (Collection Permit) Regulations 2007 (as amended) and the Waste Management (Facility Permit & Registration) Regulations 2007 (as amended). The volume of waste requiring recovery / disposal will dictate whether a Certificate of Registration (COR), permit or licence is required for the receiving facility. Alternatively, the material may be classed as by-product under Article 27 classification (European Communities (Waste Directive) Regulations 2011, S.I. No. 126 of 2011). For more information in relation to the envisaged management of by-products, refer to the C&D WMP (Appendix 12.1).

In order to establish the appropriate reuse, recovery and / or disposal route for the soils and stones to be removed off-site, it will first need to be classified. Waste material will initially need to be classified as hazardous or non-hazardous in accordance with the EPA publication Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous (2019). Environmental soil analysis will be carried out prior to removal of the material on a number of the soil samples in accordance with the requirements for acceptance of waste at landfills (Council Decision 2003/33/EC

Waste Acceptance Criteria). This legislation sets limit values on landfills for acceptance of waste material based on properties of the waste, including potential pollutant concentrations and leachability. It is anticipated that the surplus material will be suitable for acceptance at either inert or non-hazardous soil recovery facilities / landfills in Ireland or, in the unlikely event of hazardous material being encountered, be transported for treatment / recovery or exported abroad for disposal in suitable facilities.

Waste will also be generated from construction phase workers e.g. organic / food waste, dry mixed recyclables (waste paper, newspaper, plastic bottles, packaging, aluminium cans, tins and Tetra Pak cartons), mixed non-recyclables and, potentially, sewage sludge from temporary welfare facilities provided on-site during the Construction phase. Waste printer / toner cartridges, waste electrical and electronic equipment (WEEE) and waste batteries may also be generated in small volumes from site offices.

Further detail on the waste materials likely to be generated during the excavation and construction works are presented in the project-specific C&D WMP (Appendix 12.1). The C&D WMP provides an estimate of the main waste types likely to be generated during the Construction phase of the proposed Development. These are summarised in Table 12.2.

Waste Type	Tonnes	Reuse		Recycle / Recovery		Disposal	
		%	Tonnes	%	Tonnes	%	Tonnes
Mixed C&D	893.0	10	89.3	80	714.4	10	89.3
Timber	757.7	40	303.1	55	416.7	5	37.9
Plasterboard	270.6	30	81.2	60	162.4	10	27.1
Metals	216.5	5	10.8	90	194.8	5	10.8
Concrete	162.4	30	48.7	65	105.5	5	8.1
Other	405.9	20	81.2	60	243.5	20	81.2
Total	**2706.0**		**614.3**		**1837.4**		**254.4**

Table 12.2: Estimated off-site Reuse, Recycle and Disposal Rates for Construction Waste

12.3.1.3 Operational Phase

As noted in Section 12.1, an OWMP has been prepared for the proposed Development and is included as Appendix 12.2. The OWMP provides a strategy for segregation (at source), storage and collection of all wastes generated within the building during the operational phase including dry mixed recyclables (DMR), organic waste and mixed non-recyclable waste (MNR), as well as providing a strategy for management of waste glass, batteries, WEEE, printer / toner cartridges, chemicals, textiles, waste cooking oil and furniture.

The total estimated waste generation for the proposed Development for the main waste types, based on the AWN waste generation model (WGM), is presented in Table 12.3, below, and is based on the uses and areas as advised by the Project Architects. Further unit breakdowns can be found in Appendix 12.2.

Waste Type	**Waste Volume (m^3/week)**		
	Student Units (Combined)	**Residential Units (combined)**	**Commercial Units (Combined)**
Organic Waste	1.03	5.63	0.26
DMR	7.04	39.92	3.17
Glass	0.40	1.09	0.05
MNR	4.09	20.99	1.85
Total	**12.57**	**67.63**	**5.13**

Table 12.3: Estimated Waste Generation During Operational Phase

The residents and tenants will be required to provide and maintain appropriate waste receptacles within their units to facilitate segregation at source of these waste types. The location of the bins within the units will be at the discretion of the residents. As required, the residents and tenants will need to bring these segregated wastes from their units to their allocated Waste Storage Areas (WSAs). WSAs can be viewed on the plans submitted with the application under separate cover.

The OWMP seeks to ensure that the proposed Development contributes to the targets outlined in the SR Waste Management Plan 2015 – 2021 and the LCCC City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019).

Mitigation measures proposed to manage impacts arising from wastes generated during the operational phase of the proposed Development are summarised below.

12.4 Predicted Impacts of the Proposed Development

If the proposed Development was not to go ahead (i.e. in the Do-Nothing scenario) there would be no demolition, excavation or construction or operational waste generated at this Site. There would, therefore, be a neutral effect on the environment in terms of waste.

This section details the potential waste effects associated with the proposed Development.

12.4.1 Construction Phase

The proposed Development will generate a range of non-hazardous and hazardous waste materials during site demolition, excavation and construction. General housekeeping and packaging will also generate waste materials, as well as typical municipal wastes generated by construction employees, including food waste. Waste materials will be required to be temporarily stored on-site pending collection by a waste contractor. If waste material is not managed and stored correctly, it is likely to lead to litter or pollution issues at the Development Site and in adjacent areas. The indirect effect of litter issues is the presence of vermin in areas affected. In the absence of mitigation, the effect on the local and regional environment is likely to be short-term, significant and negative.

The use of non-permitted waste contractors or unauthorised waste facilities could give rise to inappropriate management of waste, resulting in indirect negative environmental impacts, including pollution. It is essential that all waste materials are dealt with in accordance with regional and national legislation, as outlined previously, and that time and resources are dedicated to ensuring efficient waste management practices. In the absence of mitigation, the effect on the local and regional environment is likely to be Long-term, significant and negative.

Wastes arising will need to be taken to suitably registered / permitted / licenced waste facilities for processing and segregation, reuse, recycling, recovery, and / or disposal, as appropriate. There are numerous licensed waste facilities in the EMR which can accept hazardous and non-hazardous waste materials, and acceptance of waste from the Development Site would be in line with daily activities at these facilities. At present, there is sufficient capacity for the acceptance of the likely C&D waste arisings at facilities in the region. The majority of construction materials are either recyclable or recoverable. However, in the absence of mitigation, the effect on the local and regional environment is likely to be short-term, significant and negative.

There is a quantity of excavated material which will need to be excavated to facilitate the proposed Development. A detailed review of the existing ground conditions on a regional, local site-specific scale are presented in Chapter 6. It is anticipated that c. 14,043m^3 of excavated material will need to be removed off-site. Correct classification and segregation of the excavated material is required to ensure that any potentially contaminated materials are identified and handled in a way that will not impact negatively on workers as well as on water and soil environments, both on and off-site. However, in the absence of mitigation, the effect on the local and regional environment is likely to be short-term, significant and negative.

12.4.2 Operational Phase

The potential impacts on the environment of improper, or a lack of, waste management during the operational phase would be a diversion from the priorities of the waste hierarchy which would lead to small volumes of waste being sent unnecessarily to landfill. In the absence of mitigation, the effect on the local and regional environment is likely to be Long-term, significant and negative.

The nature of the development means the generation of waste materials during the operational phase is unavoidable. Networks of waste collection, treatment, recovery and disposal infrastructure are in place in the region to manage waste efficiently from this type of development. Waste which is not suitable for recycling is typically sent for energy recovery. There are also facilities in the region for segregation of municipal recyclables which is typically exported for conversion in recycled products (e.g. paper mills and glass recycling).

If waste material is not managed and stored correctly, it is likely to lead to litter or pollution issues at the Development Site and in adjacent areas. The knock-on effect of litter issues is the presence of vermin in affected areas. However, in the absence of mitigation, the effect on the local and regional environment is likely to be short-term, significant and negative.

Waste contractors will be required to service the proposed Development on a regular basis to remove waste. The use of non-permitted waste contractors or unauthorised facilities could give rise to inappropriate management of waste and result in negative environmental impacts or pollution. It is essential that all waste materials are dealt with in accordance with regional and national legislation, as outlined previously, and that time and resources are dedicated to ensuring efficient waste management practices. However, in the absence of mitigation, the effect on the local and regional environment is likely to be Long-term, significant and negative.

12.5 Mitigation Measures

This section outlines the measures that will be employed in order to reduce the amount of waste produced, manage the wastes generated responsibly and handle the waste in such a manner as to minimise the effects on the environment.

12.5.1 Construction Phase

The following mitigation measures will be implemented during the construction phase of the proposed Development:

- As previously stated, a project specific C&D WMP has been prepared in line with the requirements of the requirements of the Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, 2006), and is included as Appendix 12.1. Adherence to the high-level strategy presented in this C&D WMP will ensure effective waste management and minimisation, reuse, recycling, recovery and disposal of waste material generated during the demolition, excavation and construction phases of the proposed Development.
- Prior to commencement, the appointed Contractor(s) will be required to refine / update the C&D WMP (Appendix 12.1) in agreement with LCCC, or submit an addendum to the C&D WMP to LCCC, detailing specific measures to minimise waste generation and resource consumption, and provide details of the proposed waste contractors and destinations of each waste stream.
- The Contractor will be required to fully implement the C&D WMP throughout the duration of the proposed construction and demolition phases.
- A quantity of topsoil, sub soil, clay and made ground which will need to be excavated to facilitate the proposed Development. Project Engineers have estimated that c. 14,042m^3 of excavated material will need to be removed off-site. Correct classification and segregation of the excavated material is required to ensure that any potentially contaminated materials are identified and handled in a way that will not impact negatively on workers as well as on water and soil environments, both on and off-site.

In addition, the following mitigation measures will be implemented:

- Building materials will be chosen with an aim to 'design out waste';
- On-site segregation of waste materials will be carried out to increase opportunities for off-site reuse, recycling and recovery. The following waste types, at a minimum, will be segregated:

  Concrete rubble (including ceramics, tiles and bricks);

  Plasterboard;
  Metals;
  Glass; and

  Timber.

- Left over materials (e.g. timber off-cuts, broken concrete blocks / bricks) and any suitable construction materials shall be re-used on-site, where possible;

- All waste materials will be stored in skips or other suitable receptacles in designated areas of the site;
- Any hazardous wastes generated (such as chemicals, solvents, glues, fuels, oils) will also be segregated and will be stored in appropriate receptacles (in suitably bunded areas, where required);
- A Waste Manager will be appointed by the main Contractor(s) to ensure effective management of waste during the demolition, excavation and construction works;
- All construction staff will be provided with training regarding the waste management procedures;
- All waste leaving site will be reused, recycled or recovered, where possible, to avoid material designated for disposal;
- All waste leaving the site will be transported by suitably permitted contractors and taken to suitably registered, permitted or licenced facilities; and
- All waste leaving the site will be recorded and copies of relevant documentation maintained.

Nearby sites requiring clean fill material will be contacted to investigate reuse opportunities for clean and inert material, if required. If any of the material is to be reused on another site as by-product (and not as a waste), this will be done in accordance with Article 27 of the EC (Waste Directive) Regulations (2011). EPA approval will be obtained prior to moving material as a by-product. However, it is not currently anticipated that Article 27 will be used.

These mitigation measures will ensure that the waste arising from the construction phase of the proposed Development is dealt with in compliance with the provisions of the Waste Management Act 1996, as amended, associated Regulations and the Litter Pollution Act 1997, and the EMR Waste Management Plan 2015 – 2021. It will also ensure optimum levels of waste reduction, reuse, recycling and recovery are achieved and will promote more sustainable consumption of resources.

12.5.2 Operational Phase

As previously stated, a project specific OWMP has been prepared and is included as Appendix 12.2.

The Operator / Buildings Manager of the Site during the operational phase will be responsible for ensuring – allocating personnel and resources, as needed – the ongoing implementation of this OWMP, ensuring a high level of recycling, reuse and recovery at the Site of the proposed Development.

In addition, the following mitigation measures will be implemented:

- The Operator / Buildings Manager will ensure on-Site segregation of all waste materials into appropriate categories, including (but not limited to):

    Organic waste;

    Dry Mixed Recyclables;

    Mixed Non-Recyclable Waste;

    Glass;

    Waste electrical and electronic equipment (WEEE);

    Batteries (non-hazardous and hazardous);

    Cooking oil;

    Light bulbs;

    Cleaning chemicals (pesticides, paints, adhesives, resins, detergents, etc.);

    Furniture (and from time to time other bulky waste); and

    Abandoned bicycles.

- The Operator / Buildings Manager will ensure that all waste materials will be stored in colour coded bins or other suitable receptacles in designated, easily accessible locations. Bins will be clearly identified with the approved waste type to ensure there is no cross contamination of waste materials;
- The Operator / Buildings Manager will ensure that all waste collected from the Site of the proposed Development will be reused, recycled or recovered, where possible, with the exception of those waste streams where appropriate facilities are currently not available; and
- The Operator / Buildings Manager will ensure that all waste leaving the Site will be transported by suitable permitted contractors and taken to suitably registered, permitted or licensed facilities.

These mitigation measures will ensure the waste arising from the proposed Development during the operational phase is dealt with in compliance with the provisions of the Waste Management Act 1996, as amended, associated Regulations, the Litter Pollution Act 1997, the SR Waste Management Plan 2015 – 2021 and the LCCC "City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019)". It will also ensure optimum levels of waste reduction, reuse, recycling and recovery are achieved.

12.6 Residual Impacts

The implementation of the mitigation measures outlined in Section 12.5 will ensure that high rates of reuse, recovery and recycling are achieved at the Site of the proposed Development during the construction and operational phases. It will also ensure that European, National and Regional legislative waste requirements with regard to waste are met and that associated targets for the management of waste are achieved.

12.6.1 Construction Phase

A carefully planned approach to waste management as set out in Section 12.5 and adherence to the C&D WMP during the construction phase will ensure that the predicted effect on the environment will be short-term, imperceptible and neutral.

12.6.2 Operational Phase

During the operational phase, a structured approach to waste management as set out in Section 12.5 and adherence to the OWMP will promote resource efficiency and waste minimisation. Provided the mitigation measures are implemented and a high rate of reuse, recycling and recovery is achieved, the predicted effect of the operational phase on the environment will be long-term, imperceptible and neutral.

12.6.3 Conclusion

Assuming the full and proper implementation of the mitigation measures set out herein and in the C&D WMP (Appendix 12.1) and the OWMP (Appendix 12.2), no likely significant negative effects are predicted to occur as a result of the construction or operational of the proposed Development.

12.7 Monitoring

The management of waste during the construction phase will be monitored by the Contactor's appointed Waste Manager to ensure compliance with the above-listed mitigation measures, and relevant waste management legislation and local authority requirements, including maintenance of waste documentation.

The management of waste during the operational phase will be monitored by the Operator / Buildings Manager to ensure effective implementation of the OWMP internally and by the nominated waste contractor(s).

12.7.1 Construction Phase

The objective of setting targets for waste management is only achieved if the actual waste generation volumes are calculated and compared. This is particularly important during the demolition, excavation and construction works, where there is a potential for waste management objectives to become secondary to other objectives, i.e. progress and meeting construction schedule targets. The C&D WMP specifies the need for a Waste Manager to be appointed, who will have responsibility for monitoring the actual waste volumes being generated and ensuring that contractors and sub-contractors are segregating waste as required. Where targets are not being met, the Waste Manager will identify the reasons for this and work to resolve any issues. Recording of waste generation during the construction phase of the proposed Development will enable better management of waste contractor requirements and identify trends. The data should be maintained to advise on future Developments.

12.7.2 Operational Phase

During the operational phase, waste generation volumes will be monitored by the Operator / Buildings Manager against the predicted waste volumes outlined in the OWMP. There may be opportunities to reduce the number of bins and equipment required in the WSAs, where estimates have been too conservative. Reductions in bin and equipment requirements will improve efficiency and reduce waste contactor costs.

12.8 Interactions

This section discusses interactions between this Chapter and other specialist environmental topics considered in this EIAR.

12.8.1 Land, Soils & Geology

During the construction phase, excavated soil, stone, clay and made ground (c. 14,043m3) will be generated from the excavations required to facilitate site levelling and construction of new foundations. It is estimated that excavated material will need to be removed off-site. Where material has to be taken off-site, it will be taken for reuse or recovery, where practical, with disposal as a last resort. Adherence to the mitigation measures in Chapter 12 and the requirements of the C&D WMP (Appendix 12.1), will ensure the effect is long-term, imperceptible and neutral.

12.8.2 Traffic & Transportation

Local traffic and transportation will be impacted by the additional vehicle movements generated by removal of waste from the Site during the construction and operational phases of the proposed

Development. The increase in vehicle movements as a result of waste generated during the construction phase will be temporary in duration. There will be an increase in vehicle movements in the area as a result of waste collections during the operational phase but these movement will be imperceptible in the context of the overall traffic and transportation increase. Traffic-related impacts during the construction and operational phases are addressed in Chapter 11 (Traffic and Transportation). Provided the mitigation measures detailed in Chapter 12 and the requirements of the OWMP (included as Appendix 12.2) are adhered to, the predicted effects are short to long-term, imperceptible and neutral.

12.8.3 Population & Human Health

The potential impacts on human beings are in relation to incorrect management of waste during construction and / or operation, which could result in littering and presence of vermin – with associated potential for negative impacts on human health and residential amenity. A carefully planned approach to waste management and adherence to the project specific C&D WMP and OWMP (Appendices 12.1 and 12.2, respectively), will ensure appropriate management of waste and avoid any negative impacts on the local population. The effects should be long-term, imperceptible and neutral.

12.9 Cumulative Impacts

12.9.1 Construction Phase

There are existing residential and commercial developments close by. In a worst-case scenario, multiple developments in the area could be developed concurrently or overlap in the construction phase. Due to the high number of waste contractors in the Limerick region there would be sufficient contractors available to handle waste generated from a large number of these sites simultaneously, if required. Similar waste materials would be generated by all the developments.

Other developments in the area will be required to manage waste in compliance with national and local legislation, policies and plans which will mitigate against any potential cumulative effects associated with waste generation and waste management. As such the effect will be short-term, not significant and neutral.

12.9.2 Operational Phase

There are existing residential and commercial developments close by the subject site. All of the current and potential developments will generate similar waste types during their operational phases. Authorised waste contractors will be required to collect waste materials segregated, at a minimum, into recyclables, organic waste and non-recyclables. An increased density of development in the area is likely improve the efficiencies of waste collections in the area.

Other developments in the area will be required to manage waste in compliance with national and local legislation, policies and plans which will minimise/mitigate any potential cumulative impacts associated with waste generation and waste management. As such the effect will be a long-term, imperceptible and neutral.

12.10 Difficulties Encountered in Compiling the Chapter

Until final materials and detailed construction methodologies have been confirmed, it is difficult to predict with a high level of accuracy the construction waste that will be generated from the proposed works as the exact materials and quantities may be subject to some degree of change and variation during the construction process.

There is a number of licensed, permitted and registered waste facilities in the Limerick region and in the surrounding counties. However, these sites may not be available for use when required or may be limited by the waste contractor selected to service the development in the appropriate phase. In addition, there is potential for more suitably placed waste facilities or recovery facilities to become operational in the future which may be more beneficial from an environmental perspective.

The ultimate selection of waste contractors and waste facilities would be subject to appropriate selection criteria proximity, competency, capacity, serviceability, and cost.

12.11 References

Waste Management Act 1996 as amended. Sub-ordinate and associated legislation include:
European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended.

Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended.

Waste Management (Facility Permit and Registration) Regulations 2007 (S.I No. 821 of 2007) as amended.

Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended.

European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended.

Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended.

Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015).

European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014).

European Union (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended.

Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended.

European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 191 of 2015).

Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended.

Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended.

European Communities (Shipments of Hazardous Waste exclusively within Ireland) Regulations 2011 (S.I. No. 324 of 2011).

European Union (Properties of Waste which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended.

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FÁS and the Construction Industry Federation (CIF) (2002). Construction and Demolition Waste Management-a handbook for Contractors and Site Managers.

Forum for the Construction Industry-Recycling of Construction and Demolition Waste.

Litter Pollution Act 1997 (S.I. No. 12 of 1997) as amended.

Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended.

Protection of the Environment Act 2003, (No. 27 of 2003) as amended.

13.0 CULTURAL HERITAGE

13.1 INTRODUCTION

This section of the Environmental Impact Assessment provides a review of potential impacts on the cultural heritage of a proposed strategic housing development within a 4ha site in Limerick City (Figures 13.1–13.4). The site is on the east side of the city in an area that has existing residential, educational, retail and commercial developments. Previous work on the site included infilling with modern building rubble. The development comprises a three to six storey block for student accommodation and six residential blocks varying from six to ten storeys (Figure 13.5). Eighteen houses are also proposed. The development will include all associated site works and the demolition of an existing warehouse.

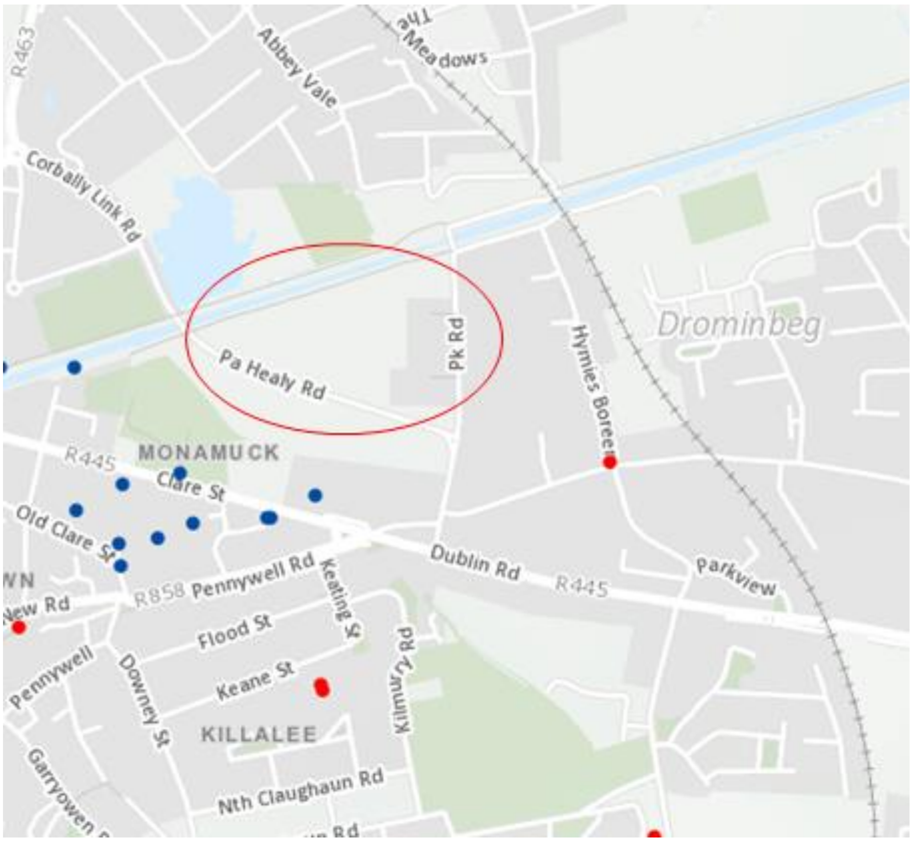

Figure 13.1: Site Location

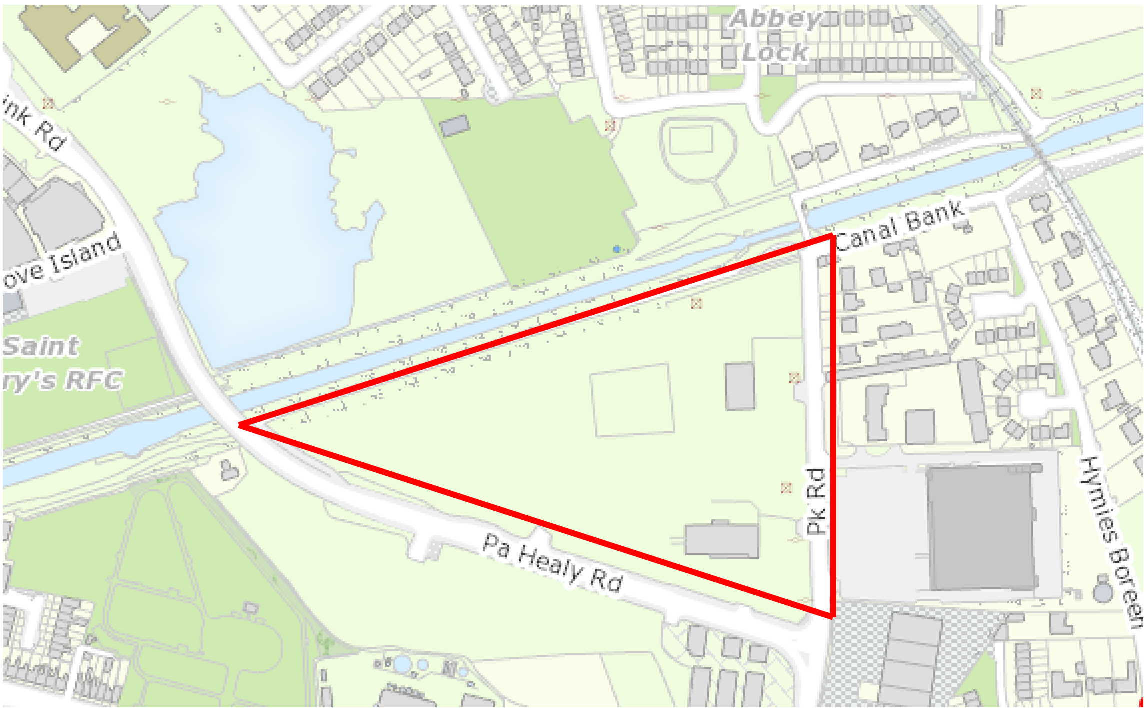

Figure 13.2: Site Location

Figure 13.3: Development Site

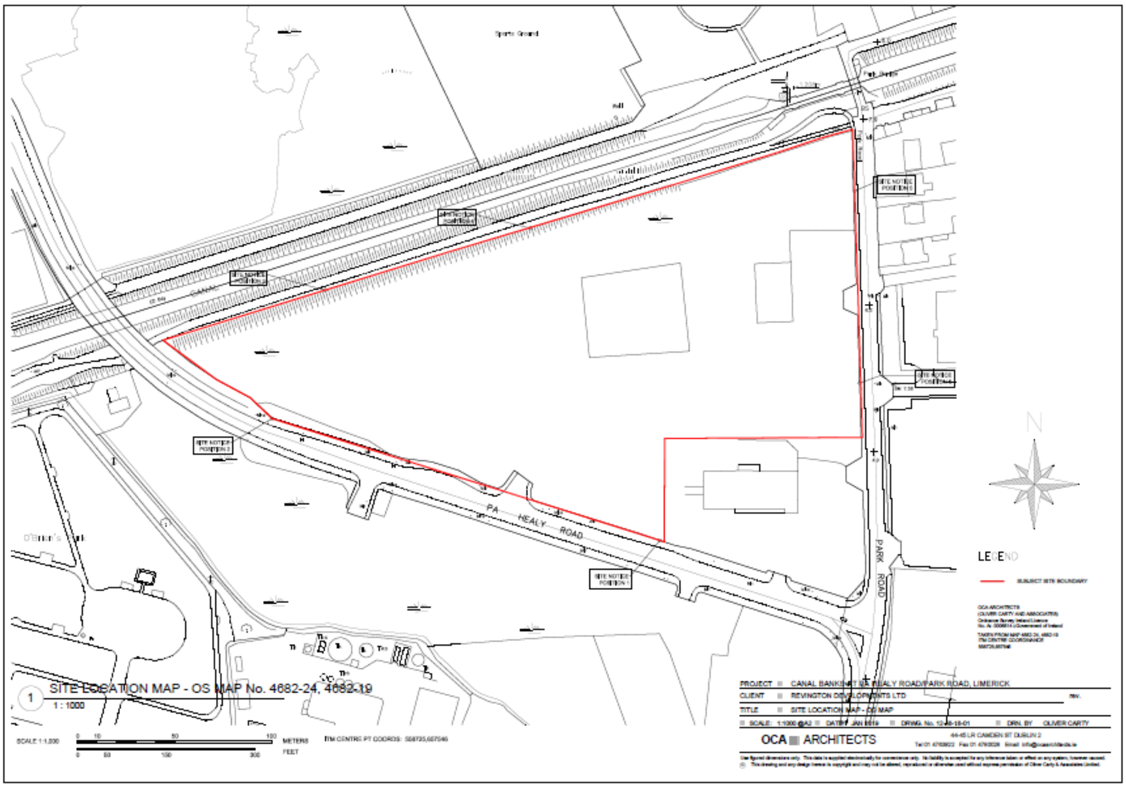

Figure 13.4: Site Location – Detail

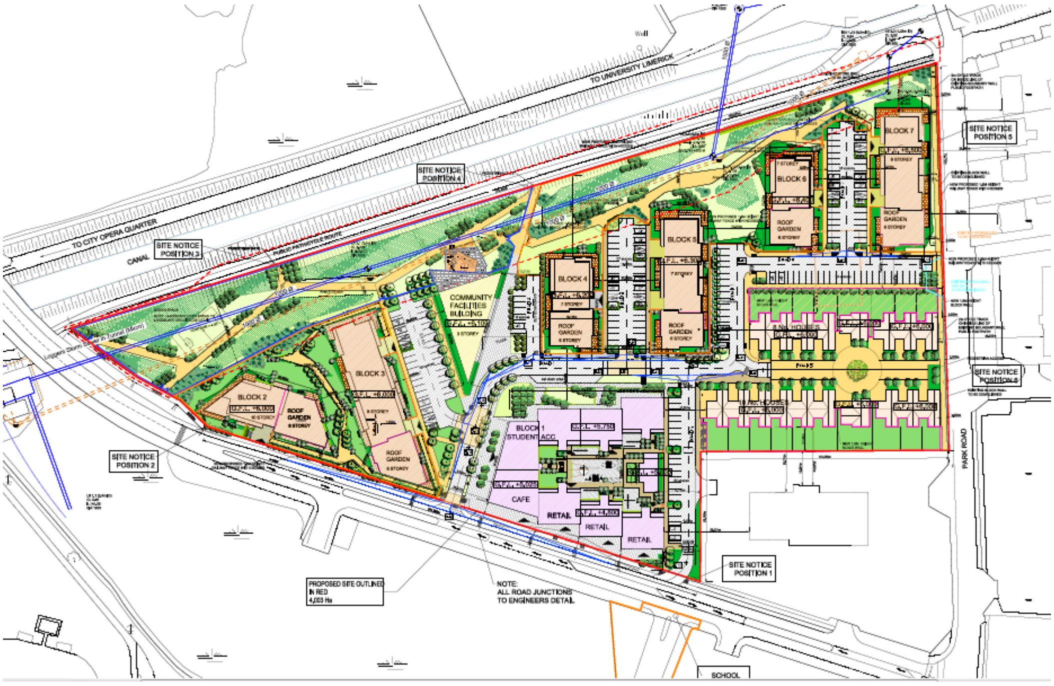

Figure 13.5: Layout of proposed development

Cultural Heritage includes visible archaeological monuments and sub-surface archaeological remains. The monuments and sub-surface sites are the vestiges of past human interaction with the landscape. Knowledge of these sites is achieved by survey and excavation and by comparison with similar sites within the archaeological record. The architectural record, both upstanding and levelled is included in Cultural Heritage and includes structures, the curtilage and setting context of structures; groups of structures and buildings and places of historic, archaeological, artistic, cultural, scientific, social or technical interest.

Guidelines for the compilation of Archaeological, Architectural and Cultural Heritage Assessments include EU Directives and Planning and Development Acts[29].

13.2 METHODOLOGY

This report was compiled using a desk-top study and field inspection. The archaeological component of this report is guided by *The National Monuments Acts and Amendments* 1930–2004; *Local Government Planning and Development Act* [2000]; *Frameworks and Principles for the Protection of the Archaeological Heritage* (DAHGI 1999) and *Policy and Guidelines on Archaeological Excavations* (DAHGI 1999).

Architectural Heritage is protected by the *Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act* (1999). National policies are outlined in the *Architectural Heritage Protection Guidelines for Planning Authorities* (DoEHLG 2004) and *Action of Architecture 2002–2005* Government Policy on Architecture. These guidelines inform this assessment.

1. The desk-top study included a review of the available Ordnance Survey Maps; the Sites and Monuments Record (SMR); the Record of Monuments and Places (RMP) and the available archaeological and historical literature for the area.
2. A site inspection was carried out in August 2021.
3. The report assesses the proximity of known archaeological, architectural sites and sites of potential historic value in the environs of the development site. There are no recorded archaeological sites or buildings listed in the Architectural Inventory within the curtilage of the development landbank.

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[29] EU Directive 85/337/EEC [Amended Directives 97/11/EC, 2003/35/EC; 2009/31/EC; 2011/92/EU; 2014/52/EU2]; Planning and Development Acts 2000–2015 and Planning and Development Regulations 2001–2015.

Desk-top study

The desk-top provides an over-arching review of the archaeological, architectural and cultural heritage of the landscape within the proposed development zone. This is informed by the following records:

- Sites and Monuments Database (www.archaeology.ie) provides the record of archaeological sites in the Limerick region.
- Lists of Monuments in State Ownership which will require Ministerial Consent to carry out works in the vicinity of the monument.
- Lists of Monuments subject to preservation orders.
- Register of Historic Monuments. The National Monuments Act (Amendment 2005) requires two-months written notice to the Minister (Culture, Heritage and the Gaeltacht) in advance of proposed works in relation to a registered archaeological or historic site listed in the register.
- National Inventory of Architectural Heritage (NIAH) for Co. Limerick. This includes building surveys and historic garden surveys of sites dating from 1700 AD to the modern period.
- Limerick City Development Plan. This includes the Record of Protected Structures and architectural conservation areas.
- Database of Irish Archaeological Excavation Reports (www.excavations.ie). This provides extra information on potential archaeological finds which may occur during on-site groundworks and guides the mitigation strategies.
- Aerial Photographs (Digital Globe; Google Earth).
- Ordnance Survey mapping (1:50000 [Discovery Series]; 1:5000; OS 6" scale [First and Second editions]; OS 25" scale).
- Published literature on the historic landscape of the area (see references).

13.3 THE RECEIVING ENVIRONMENT

13.3.1 Present Landscape

The development is located on the east site of Limerick City (Figures 13.1–13.4). The site is triangular in plan, bounded on the south by Pa Healy Road[30], on the east by Park Road and on the north by Park Canal. A path along the south side of the canal is in use as a pedestrian walkway. The landscape as indicated on Ordnance Survey maps was rural until the twentieth century (Figures 13.6–13.8). The

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[30] The road, opened in 2007, links Dooradoyle to Corbally and is named after a famous Limerick sportsman of the early 20th century.

First Edition Ordnance Survey (1842) recorded the landbank as sub-divided into fields and liable to floods indicating low-lying ground (Figure 13.6). An Ordnance Survey map of 1886 (Figure 13.7) and the Second Edition (Figure 13.8) Ordnance Survey (1905) also confirms the landscape on the development site was rural. Residential buildings along the city side of Clare St. (R445) and St. Patrick's Church built in 1816 are recorded on the First Edition (1842) Ordnance to the south-west of the development.

Park Canal (Figure 13.9) on the north side of the development was built from 1757–1799, under the stewardship of William Ockenden and linked the Shannon River at Plassey to the Estuary (Prothero and Clark1896; Rainsford 2009). The canal was constructed to facilitate the carriage of goods across the city to the docks. There was significant growth within and extending out from the original walled medieval city from 1760 and reflected in the evolution of the modern city in terms of industrial development (O'Carroll 1990). The canal construction was part of this economic growth. The canal remained in use until 1960 (Rainsford 2009).

The hinterland of the development is a mixture of residential, educational, retail units and business premises.

Figure 13.6: First Edition Ordnance Survey map (1842); Development site encircled

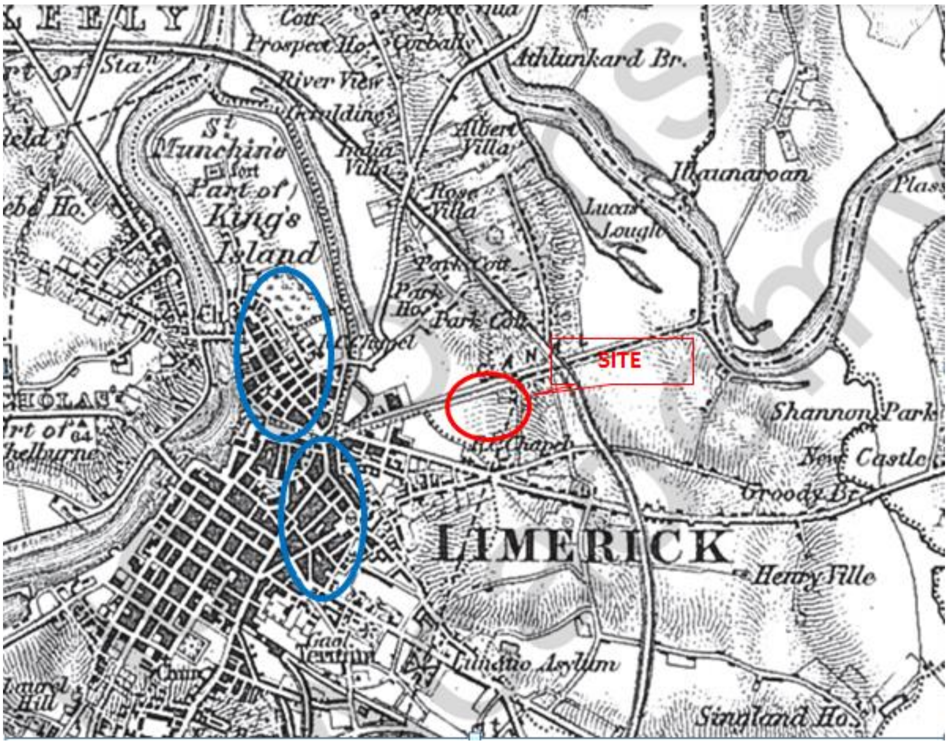

Figure 13.7: 1886 Ordnance Survey map; Development Site encircled in red; Medieval City encircled in blue

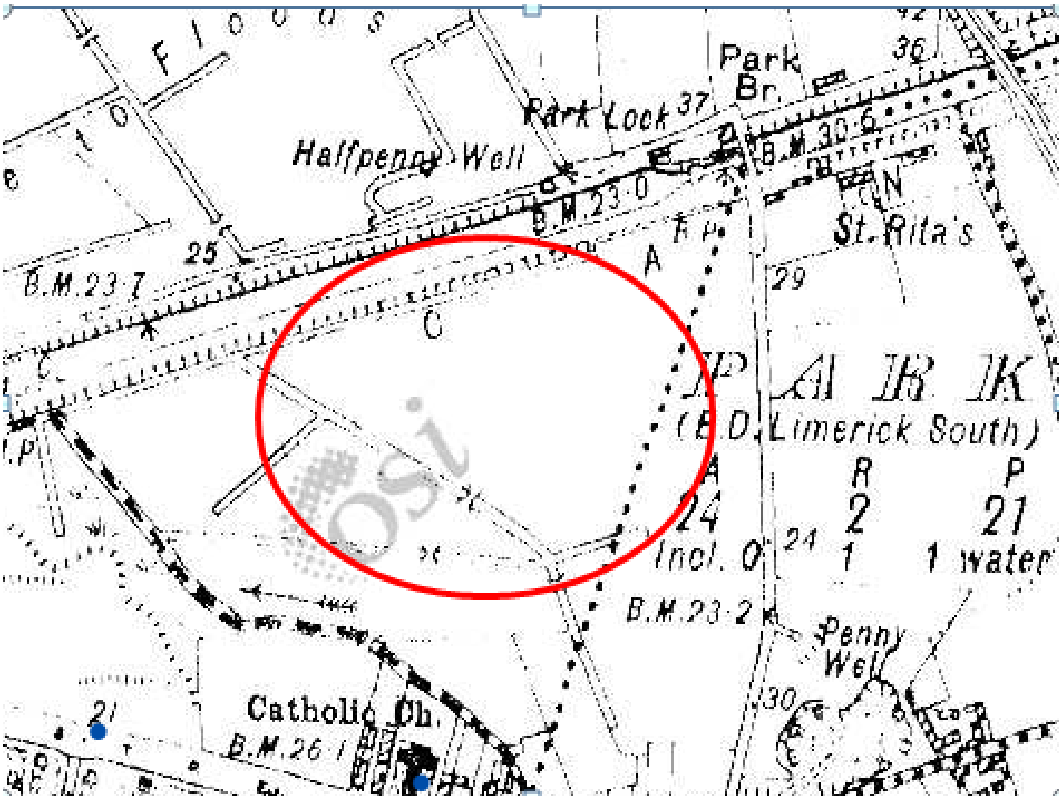

Figure 13.8: Second Edition Ordnance Survey map (1905); Development Site encircled

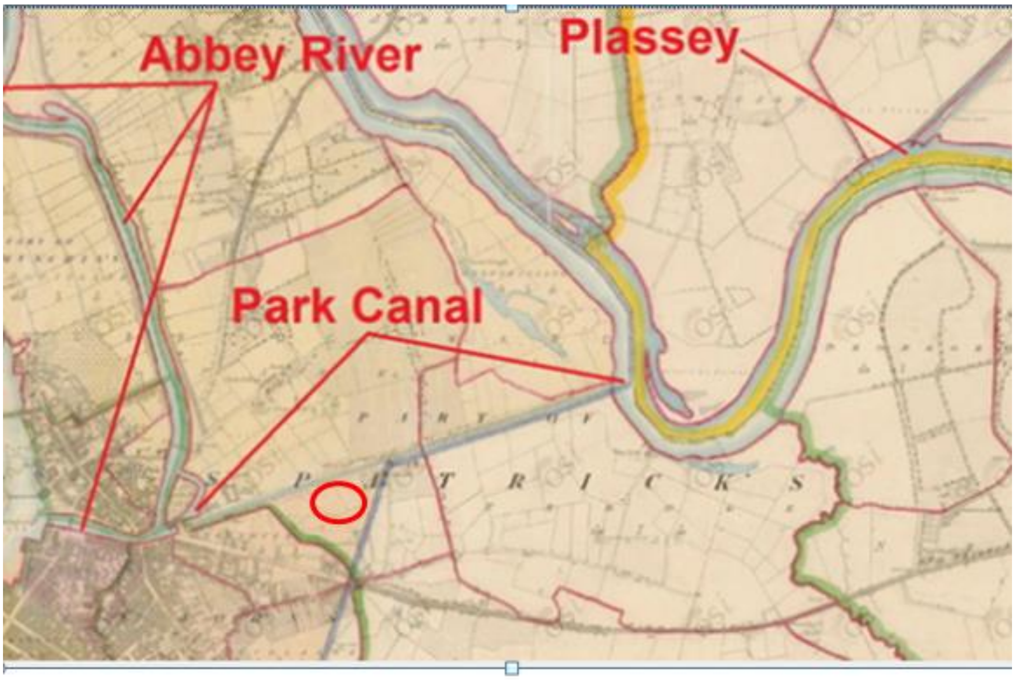

Figure 13.9: Park canal linking Shannon Estuary and Shannon River; Development Site encircled in red

The landbank is currently vacant apart from a large (530m^2) disused industrial building and car-park on the east side (Figure 13.10). The site was infilled[31] in the 1990s with imported material confirmed by 15 trial pits which established a maximum depth of 3.1m modern material[32] that is overlain by 0.3m of topsoil. The basal layer below the infill is the natural (undisturbed) soil which is dark grey or peat reflecting the original low-lying ground that is recorded on Ordnance Survey mapping (Figure 13.6) as liable to flooding. The present ground level comprises a mixture of surfaces including gravel (Figures 13.11–13.12) and scrub vegetation (Figure 13.13). Four groundwater monitoring wells were inserted during the trial pit works and remain *in situ* (Figure 13.14).

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[31] Report prepared by PHM Consulting for Construction Environmental and Waste Management Plan;

[32] Demolition concrete, brick fragments limestone cobbles, glass and metal.

Figure 13.10: Vacant building and car-park on east side of development

Figure 13.11: Development site (Looking West)

Figure 13.12: Development site (Looking East)

Figure 13.13: Scrub vegetation (Looking West)

Figure 13.14: Groundwater monitoring well in situ

13.3.2. Archaeological and Historical Background

The development site is located within the modern boundary of Limerick City but about 1 km from the original Viking and Medieval core. The earliest Viking (Norse) fortification (‘*longphort*’) on the River Shannon may have been established in the 840s at Athlunkard, Co. Clare, *c*. 2km north of the historic core of Limerick City. Earthworks at Athlunkard have been identified as the likely location of a ‘*longphort*’ (Kelly and O’Donovan 1998). Limerick City developed from a ninth century Viking settlement. Based on annalistic evidence, Ferrar (1767, 4) gives the date of 853 A.D. for the Viking settlement and Hall (2007, 88) suggested a date before 887 A.D. The precise location of the settlement within the modern city has not yet been identified by archaeological investigation but is possibly in the area around the St. Mary’s Cathedral. O’Flaherty (2010, 1) locates the Viking settlement on the south-west side King’s Island from the tenth century. The Viking settlement was captured by Brian Boru and he made it his capital by 1100. There is very little archaeological evidence for occupation in Limerick City before the twelfth century (O’Rahilly 1995).

The city expanded under Anglo-Norman influence in the late twelfth century and became the major urban centre of the west coast of Ireland (Thomas 1992, 142). The city is divided into English Town and Irish Town (Figure 13.15). The walled town of English Town extended from the bridge at Ballsbridge to the east bank of the Shannon River and northward to Thomand Gate and thereafter extended northwards; the east section continued southward along the line of Island Road to link with the bridge at Ballsbridge. Irish Town was smaller, extended south from Ballsbridge and included the area west of Charlotte's Quay to St. John's Church and the west circuit extended to West Water Gate St. Notable features in Limerick City include King John's Castle built in the early thirteenth century, St Mary's Cathedral founded by Donál Mór O'Brien in the late twelfth century, remains of medieval monasteries and upstanding medieval town walls. Limerick was captured by the Confederate Army in 1642, fell to the Cromwellian New Army under Ireton in 1651 and the Williamite forces in 1691. Like many Irish cities, Limerick expanded outside the confines of the walled town in the eighteenth century.

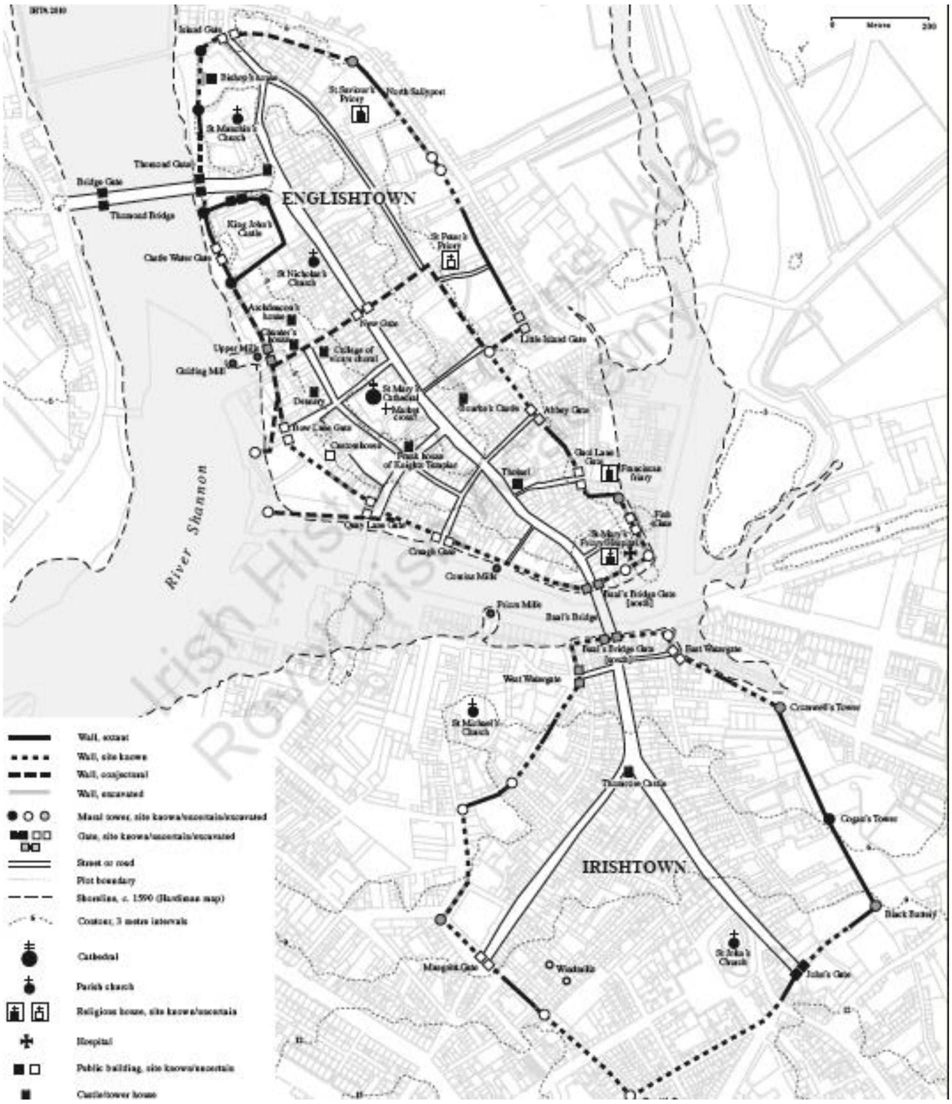

Figure 13.15: Layout of Medieval City

The east side of Limerick City was originally part of the South Liberties which extended for five miles to the east and south of the historic core (Lenihan 1866). These tracts of good farmland outside the medieval walled city of Limerick were undoubtedly the source of provisioning the city's inhabitants with agricultural produce and raw materials such as wood. The development is within St. Patrick's Parish which was outside the walled medieval city.

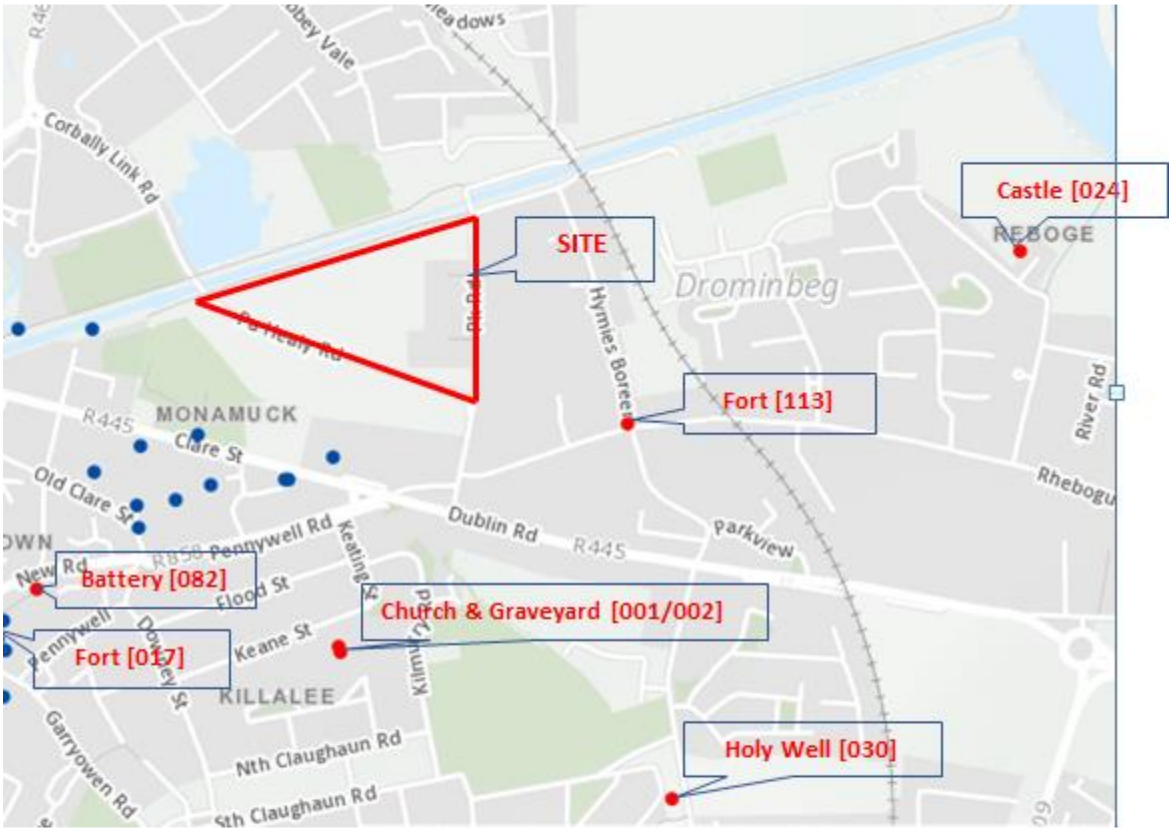

Figure 13.16: Archaeological sites in hinterland of development. All Numbers preceded by RMP LI005

There are seven recorded archaeological sites in the hinterland of but at some distance from the development site (Figure 13.16). A castle (RMP LI005-024) in Reboge townland to the west was ruinous in the mid-seventeenth century (Simington 1938; Westropp 1906–07) and there are now little above ground remains. The castle was probably a tower house, an architectural style which mainly dates from the fourteenth to sixteenth century. Tower houses were defendable residences in times of periodic political unrest and internecine strife between various powerful Anglo-Norman families and between the Anglo-Norman and Gaelic clans. Apart from defensive and administrative functions, tower houses were also a status symbol as well as a territorial marker (Donnelly 2009, 72). Their significance as territorial markers meant that tower houses were located along routeways where the inhabitants could control trade, access and egress from a region.

A church (RMP LI005-027-01) and graveyard (RMP LI005-027-02) are recorded on the Ordnance Survey mapping in Killalee townland to the south of the development. Westropp (1904–05) noted the church in use in the early fifteenth century as a medieval parish church which stood in the centre of the graveyard. The church was part of a parish system introduced by Anglo-Norman lords in the early 1400s and thereafter both Anglo-Norman lords and Gaelic chiefs were church benefactors. Similar to tower houses, medieval parish churches are a feature of rural landscapes. The church does not survive above ground and the graveyard remains as a small enclosure.

A holy well (RMP LI005-030) known as 'St. Patrick's Well' is in Singland townland and to south-east of the development. The well water is said to have curative powers and tradition has it that St. Patrick baptised Cairtheann, Chief of the Dál Cais at this well (Ó Danachair 1955).

The remaining archaeological sites comprise a bastioned fort (RMP LI005-113) in Singland townland, a bastioned fort (RMP LI005-017-089) and a battery (RMP LI005-017-082), both in Irishtown. These fortifications relate to the various sieges of Limerick City. The bastioned fort in Singland was constructed by Ireton during the Cromwellian siege of Limerick in 1651 and reused during the Williamite siege of 1690. The fort was levelled in the 1800s. The bastioned fort in Irishtown was constructed during the Cromwellian period to aid the city defence and refortified in 1690 during the Williamite siege. The battery was within the city walls and appears to have been a rampart constructed as part of the city's defences. It was also the location of a breach made in the city walls during the Williamite siege.

13.3.3. Architecture – Protected Structures

The west side of the development has a number of nineteenth and early twentieth century buildings listed in the Architectural Inventory as protected structures (Figure 13.17). The LIT School of Art and Design campus houses a former hostel (Reg. No. 21514004) which is a three-storey building constructed in 1890 as a girls' reformatory. A former convent (Reg. No. 21514003) is also three-storey and built in the Gothic Revival style in 1895. The convent chapel (Reg. No. 21514005) was constructed in 1928 and now hosts an exhibition centre. An orphanage (Reg. No. 21514007) built in 1890 is to the west of the LIT campus and is currently in use by the Health Board. The orphanage was built on the site of the Thomand Brewery. A chimney (Reg. No. 21514006) on Old Clare St. and part of the brewery complex was built in 1870. A warehouse (Reg. No. 21513048) on the south bank of the canal dates to *c.* 1840 and similar to the former Thomand Brewery are vestiges of industrial activity in the east side of Limerick City.

St. Patrick's Church (Reg. No. 21514010) on Clare St. was built in 1816. St John's Cathedral (Reg. No. 21518042), designed by Philip Charles Hardwick was built in 1855–61. St John's Hospital (Reg. No. 21513042) was originally a Fever Hospital built in 1781 under the patronage of Lady Hartstonge and latterly a general hospital run by nuns who resided in an adjacent nunnery (Reg. No. 21513043) built in 1900. A nineteenth century house (Reg. No. 21514009) on Clare St. dates to *c.* 1845 and is a protected structure.

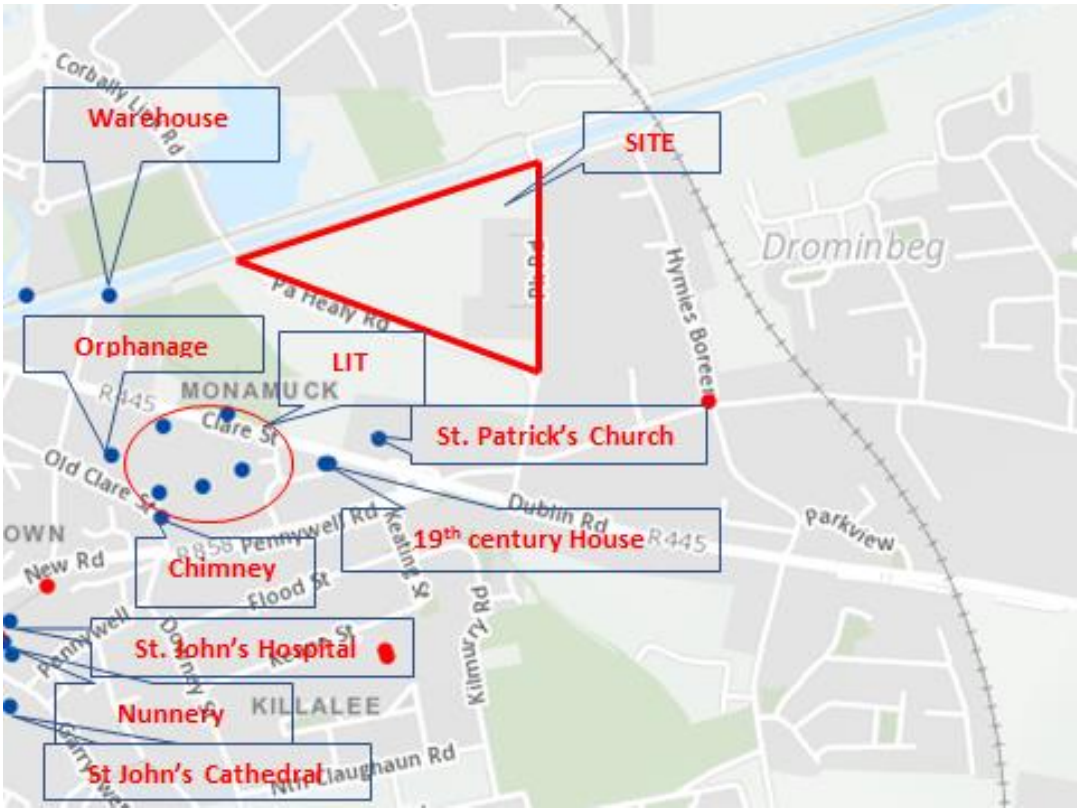

Figure 13.17: Protected Structures in environs of development

Ordnance Survey mapping (Figure 13.6) also indicates industries on the north bank of the canal which no longer survive but were part of the industrial heritage of the city. These include the Canal Brewery and Lock Mills sites.

13.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The development comprises the construction of 442 residential units within a 4ha site on the east side of Limerick City (Figure 13.5). The project is a mixed use development of build-to-rent apartments, student apartments and dwelling houses. The residential units will be in seven blocks as follows:

Block 1 – Student accommodation building of 8,238m2 stepped from three to six storeys, with ground floor café of 144.60m2 and 3 no. retail units facing onto Pa Healy road of 86.59m2 each, with 9 no. two bedroom, 37 no. three bedroom, and 15 no. four bedroom student apartments, totalling 189 bed spaces, ancillary laundry, refuse and enclosed communal courtyard with landscaping and bicycle storage;

Block 2 - A residential apartment building of 6,013.25m2 with eight storeys and two penthouse storeys, total ten storeys containing 10 no. studio, 1 no. one bedroom and 52 no. two-bedroom apartments;

Block 3 – A residential apartment building of 8,107.10m2 with six storeys and two penthouse storeys, total eight storeys containing 16 no. studio, 10 no. one bedroom, and 62 no. two-bedroom apartments;

Block 4 – A residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

Block 5 – A residential apartment building of 5,849.40m2 with six storey and one penthouse storey total seven storeys containing 14 no. studio, 16 no. one bedroom and 36 no. two-bedroom apartments;

Block 6 a residential apartment building of 3,869.18m2 with six storeys and one penthouse storey, total seven storeys containing 7 no. studio, 13 no. one bedroom and 25 no. two-bedroom apartments;

Block 7 a residential apartment building of 4,962m2 with five storeys and one penthouse storey, total six storeys containing 12 no. studio, 14 no. one bedroom and 30 no. two-bedroom apartments;

Community facilities building (1336.9m^2) with crèche, café, management offices and common accommodation for use by apartment dwellers, 3 storeys high.

18 executive houses – consisting of 2 detached 4-bed houses of 194.62m^2 and 16 terraced 4-bed houses of 177.82m^2 with off-street parking to front separate from communal parking.

Ancillary developments include:

149 car-parking spaces throughout the development and 420 secured bicycle-parking spaces throughout the development.

New vehicular entrances onto Pa Healy Road, pedestrian and cycle links to Pa Healy Road, Park Road and City Canal, bin storage for all developments adjacent to entrances, new public park of 0.5ha along

City Canal, communal open space and communal roof gardens, all ancillary drainage, civil and landscape works, public lighting within estate and electricity sub-station to rear of Block 1.

The development includes the demolition of an existing 530m^2 warehouse on the east side of the site.

13.5 REVIEW OF POTENTIAL IMPACT OF DEVELOPMENT ON THE ARCHAEOLOGICAL AND HISTORIC LANDSCAPE

Visual impact

The proposed development is located at some distance from the known archaeological sites (Figure 13.16) and apart from the Holy Well (RMP LI005-030) and graveyard (RMP LI005-027-02) there are no above ground traces of the remaining sites. The Holy Well and graveyard are some distance to the south and the development will not have a visual impact on these sites. The historic buildings (Protected Structures) are also some distance from the development site. The proposed buildings of significant heights of up to ten storeys will be seen from the complex of late nineteenth/early twentieth century buildings on the LIT campus albeit the view will be partially obscured by intermediary housing and retail units. St. Patrick's Church is south of the development and the higher buildings will be visible from the church.

Archaeological Impact

The archaeological assessment is based on documentary and cartographic records and a site inspection. This information is used to predict the archaeological potential of the development site in terms of archaeological remains. The site is to the east of and outside the medieval city of Limerick. The two bastioned forts (RMP LI005-113 and 089) and a battery (RMP LI005-017-082) are outside the development curtilage. There are no recorded archaeological monuments on the site. There is therefore no direct impact on the known archaeological landscape.

Cartographic evidence shows the development site was low-lying agricultural land until the early twentieth century and prone to flooding. The site is now infilled with a maximum depth of 3.1m modern rubble which may mask buried archaeological features or finds. Stratigraphy recorded in test pits shows the basal layers were a mixture of peat and soil. The site was probably unsuitable for permanent settlement in either prehistoric or historic times. If archaeological deposits or features lie below the infill, the proposed development may have a direct and negative impact on any remains. In order to prevent accidental damage to or loss of archaeological features, a series of mitigation strategies is presented below.

13.6 MITIGATION STRATEGIES

The proposed development area does not include any recorded archaeological sites. As a result of recent (1990s) infilling of the site with concrete, bricks, etc. from building demolition, it was not possible to determine if sub-surface archaeological sites exist below the modern surface. The method of construction will be dependent on engineering requirements and constraints. Foundations which may impact on sub-surface archaeological deposits may include piling, raft or strip foundations as determined by building height and ground conditions. If any or all of the recent 3.1m deep fill is removed, this may expose previously unrecorded subsurface archaeological features. It is therefore recommended that:

- All ground disturbance below the modern fill layer should be monitored by a suitably qualified archaeologist. The monitoring archaeologist should be empowered to halt the development if buried archaeological features or finds are uncovered. If archaeological remains are uncovered, these sites become an archaeological site and are protected by the National Monuments legislation. Further work on the site will require consultation with the archaeological staff of The Heritage Service, National Monuments Division, Department of Housing, Local Government and Heritage.
- Any newly discovered site must be archaeologically resolved. Provision, including financial and time should be made from at the outset of the project to facilitate any excavation or recording of archaeological material that may be uncovered during the developmental works.

13.7 PREDICTED IMPACTS

There is no predicted impact on any recorded archaeological site or feature. The proposed development may however, directly impact on previously unrecorded sub-surface archaeological remains. Archaeological monitoring is recommended to mitigate any potential adverse impact on archaeological remains. This is carried out during the groundworks stage.

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14.0 INTERATIONS AND CUMULATIVE IMPACTS

14.1 Introduction

Schedule 6 Item 2(d) of the Planning and Development Regulations, 2001 as amended requires that projects are examined with regard to the inter-relationship of aspects referred to in Item 2(d) of Schedule 6.

The Environmental Protection Agency "Guidelines on the Information to be Contained in Environmental Impact Statements", define a Cumulative Impact as "The addition of many small impacts to create one larger, more significant, impact", while a Synergistic Impact is defined as "Where the resultant impact is of greater significance than the sum of its constituents". This EIAR report seeks to identify all potential impacts of the subject scheme.

In preparing the EIAR, each of the specialist consultants have and will continue to liaise with each other and will consider the likely interactions between effects predicted as a result of the proposed Project during the preparation of the proposals for the subject site and this ensures that mitigation measures are incorporated into the design process.

This chapter of the EIAR seeks to identify where the environmental factors examined in the above sections may be inter-related. This chapter also examines whether there would be any cumulative impact of the proposed development in combination with other planned projects in the surrounding area.

14.2 Summary of Principle Interactions

14.2.1 Population and Human Health

All environmental factors have the potential to impact on Population and Human Health. The potential impacts and appropriate mitigation measures have been examined in Chapter 4 of this EIAR. The most likely interactions with human health are considered to be the following chapters;

- Land, Soils, Geology and Hydrogeology
- Water and Hydrology
- Air Quality and Climate
- Noise and Vibration

- Landscape and Visual Impact
- Material Assets – Waste

It is considered that once all mitigation measure recommended within this EIAR are incorporated within the final development, there will be no adverse impact on Population and Human Health.

14.2.2 Biodiversity

The habitats present within the Site are commonly occurring throughout Ireland and are evaluated to be either important at the Site level or not important. Key areas of interact are identified as the following;

- Land, Soils, Geology and Hydrogeology;
- Water and Hydrology
- Landscape and Visual Impact.

The proposed development will not result in any significant effects on the biodiversity of the Site and provided the recommended best practice and mitigation is implemented it is considered that development will not result in any residual significant effects on the biodiversity of the Site

14.2.3 Land, Soil, Geology and Hydrogeology

The key areas of interaction are identified as;

- Population and Human Health;
- Water and Hydrology

Subject to implementation and adherence with mitigation measures proposed, there are no significant impacts relating to Land, Soil and Geology anticipated as a result from the proposed development.

14.2.4 Water and Hydrology

The earthworks for the site has the potential to impact on the surface water quality, by silt generated from runoff or chemicals/oils from construction vehicles carrying out the works. Potential health effects arise mainly through the potential for soil and ground contamination. The protection of the water environment will help to ensure that Human Health is not significantly impacted by the implementation of the SHD. The key areas of interaction in this case are identified as;

- Population and Human Health;
- Land, Soils and Geology;
- Biodiversity

Subject to the implementation of the proposed mitigation measures during construction and operational phase of the development, there are no significant impacts predicted in relation to Water and Hydrology.

14.2.5 Air Quality and Climate

The most significant potential impacts to air quality are predicted to occur within the construction phase of the development. It is predicted that the impact on air quality from the operational phase of the development will not be significant. The most notable areas of interaction with Air Quality and Climate are:

- Population and Human Health
- Traffic and Transportation

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated to result from the proposed development.

14.2.6 Noise and Vibration

Noise and vibration interacts particularly with human health, especially during the construction phase of the project where there is potential disruption due to increased activity on site and associated construction traffic. Additional noise is also associated with the operational phase where additional traffic is predicted.

The key areas of interaction are therefore considered to be:

- Population and Human Health
- Roads and Traffic

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated.

14.2.7 Landscape and Visual Impact

The long-term effects of the proposed development will have a positive effect the landscape of the local area and is to include use of native species planting. The proposed project generates visual significant effects as the subject site is currently largely undeveloped lands with existing hoarding surrounding the site. The key areas of interaction are considered to be:

- Population and Human Health
- Biodiversity

Subject to adherence to the proposed mitigation measures, no significant adverse impacts are anticipated in relation to Landscape and Visual Impact.

14.2.8 Traffic and Transportation

The changes to traffic in the surrounding area during both the construction and operational phase of the development.

The key identified interactions in this case are;

- Air Quality and Climate;
- Noise and Vibration

Subject to the adherence with the proposed mitigation measures, no significant impacts relating to Traffic and Transportation are predicted.

14.2.9 Material Assets – Waste

The construction and operational phases of the proposed development will generate waste which has the potential to interact with human health. The identified areas of interaction are therefore considered to be:

- Population and Human Health

Subject to adherence to the proposed mitigation measures relating to the orderly management of waste during construction and operational phase of the development, no significant adverse impacts are anticipated.

14.2.10 Cultural Heritage

There are no interactions identified between Cultural Heritage and other environmental factors examined within this EIAR.

14.3 Cumulative Impacts

14.3.1 Introduction

This Chapter has regard to the potential cumulative impact upon the environment arising from the proposed project, in combination with other developments (committed or planned projects) in the surrounding area. Cumulative impact is defined by the EU Guidelines as:

"*Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project. For example:*

Incremental noise from a number of separate developments;

Combined effect of individual impacts, e.g. noise, dust and visual, from one development on a particular receptor; and

Several developments with insignificant impacts individually but which together have a cumulative effect."

It should be noted that the there are very few examples of significant parcels of undeveloped lands in close proximity to the subject site. As such, the number of projects that could result in cumulative impacts in this case is very low.

14.3.2 Committed Projects

Planning Reg. Ref. 19/1292 – An application was submitted on the 17th December 2019 for construction of a new 7,860sq.m post primary school to include six teaching blocks connected by a central circulation corridor, comprised of; (i) four two-storey blocks including general classrooms, specialist rooms, circulation areas, offices, plant room, dining hall and associated kitchen and storage areas, (ii) one four-storey block including specialist rooms, circulation areas, staff room and project storage, (iii) a sports hall including, fitness centre with associated changing and storage areas and ESB substation, (iv) a two-storey central circulation corridor, (v) a new vehicular access junction and entrance gate from the Pa Healy Road, (vi) formation of three new pedestrian entrances to the site, serving Clare Street, O'Briens Park and Pa Healy Road, (vii) a new on-site set down area, staff car parking, (viii) installation of hard play & landscaped social areas, (ix) the modification of the existing boundaries to Clare Street and O'Briens Park and the addition of required boundaries to the remainder of the site, (x) ancillary and site services at Clare Street, Limerick. A final Grant Order was issued on 26th August 2020. The school is currently under construction.

Each environmental issue assessed within this EIAR has been considered in respect to the cumulative impact of the proposed project with the above referenced development.

14.3.3 Planned Projects

Planning Reg. Ref. 19/8002 – A Part 8 planning application was submitted in May 2019 for development of a new bridge crossing of the canal will be constructed to the east of the current Park Road Bridge. This new bridge will connect Lower Park Road with Park Road, facilitating two-way traffic flow. Vehicle traffic on South Canal Road will change from the current one-way system to a two-way system with the carriageway being widened accordingly. The existing Park Road Bridge will be retained as a pedestrian and cycle facility and the existing traffic lights at this location will be removed. In addition to the above, the works will also include an upgrade of the junction underneath the northern span of the adjacent rail bridge to the east of Park Road Bridge which currently has poor sightlines and widths for road users. The proposed works also include for new road surfacing and the installation of LED public lighting as well as surface water drainage at Park Road and Lower Park Road, Limerick. To date, the development has not commenced but it is considered a short to medium term commitment of Limerick City and County Council to proceed with the development of a new bridge in this location.

Each environmental issue assessed within this EIAR has been considered in respect to the cumulative impact of the proposed project with the above referenced development.

15.0 SUMMARY OF MITIGATION AND MONITORING MEASURES

15.1 Introduction

The EPA Guidelines note that “for ease of reference and clarity and to facilitate enforcement, all such measures contained in an EIAR can be included in a compendium of mitigation and monitoring commitments (only). This may be a separate section or Appendix to the EIAR. Such a compendium should comprise a list of relevant measures but should not elaborate on the reasoning or expected effectiveness of those measures as the elaboration will take place within the main body of the EIAR”. This Chapter provides a consolidated list of all of the environmental commitments/ mitigation measures and monitoring that have been recommended by the various specialists throughout the Chapters of this EIAR.

The mitigation and monitoring measures have been recommended on that basis that they are considered necessary to protect the environment during both the construction and operational phases of the proposed project.

15.2 Mitigation and Monitoring Measures Summary

Table 15.1: Summary of Mitigation and Monitoring Measures Proposed

Mitigation No.	Mitigation Measure	Phase
	Biodiversity	
	Mitigation	
1	Bats: A pre-construction survey of the building should be carried out in advance of demolition to ensure that no bats have moved into or started using the building in the period between the pre-planning survey and the grant of permission. The pre-construction survey should be carried out during the optimal survey season (May–September) by an appropriately experienced ecologist and the building should be dismantled	Pre Construction

	/ demolished as soon as possible after it has been confirmed that there are no bats present. If bats, or signs of bats, are discovered during the pre-construction survey of the building then works should not commence until all necessary bat surveys are complete and, if required, a derogation licence has been granted.	
2	Otters: The following measures will be employed to minimise potential disturbance to otter: • At the project outset, the construction site will be fenced off and no construction activities will be permitted outside designated works area. No access will be gained from the construction site to the canal. • Noise and vibration control will follow BS 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites. • Work will be completed during daylight hours. There will be no constant artificial lighting of the construction site at night. Motion triggered security lighting may be used but this will be directed downwards and sited so as to avoid any light spill onto the tow path and canal. • All plant will be regularly maintained to minimise unnecessary noise. • Machines which are used intermittently will be shut down or throttled back to a minimum during those periods when they are not in use. • All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract. • Compressors will be of the “sound reduced” models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.	Construction

	• Surface water and groundwater encountered during excavations will be treated using appropriate measures in advance of discharge to the canal. If contaminated groundwater is encountered these measures would include those set out in the Verde (2021) report. Mitigation measures to prevent discharge of contaminated and / or silt laden water will include, but are not limited to, hydrocarbon interceptors, silt barriers, settlement ponds / tanks and silt traps. The equipment used in the management of surface water will be subject to weekly checks and a regular maintenance schedule. • Design and construction of attenuation measures shall be in line with current good practice. Guidance such as that produced by CIRIA shall be used to inform the development of such measures. Guidance to be considered, but not limited to, includes: *Drainage of development sites - a guide (X108)* (CIRIA, 2004). *The SuDs Manual* (CIRIA, 2015) • The surface water drainage design for the development incorporates silt traps, a hydrocarbon interceptor (Kingspan NSBE040 Class I Interceptor or similar) and hydrobrake to control surface water run-off from the development to the canal during the operational phase, refer to the Drainage – General Arrangement included in Appendix 5.3 – Design Drawings.	
3	Otters: During the operational phase, access to the canal walkway will limited to daylight hours. The development's management company will be responsible for locking pedestrian access gates each day. Signage will be put in place at the egress points of the Site to the canal walkway, requesting that dogs are kept on leads at all times.	Operational

	Information boards will be installed at the egress points to the canal, providing information on the ecology of the canal with particular focus on local otter populations. The lighting design for the development provides for reduced effect of lighting on wildlife, while meeting current safety standards. The lighting design for the development includes low luxe and directional lighting that will avoid any light spill. External security lighting will be set on motion-sensors and short (1min) timers.	
Land, Soil, Geology and Hydrogeology		
Mitigation		
4	During the Construction Stage, the following Best Management Practices (BMPs) and Waste and Materials Pollution Control (WM) procedures will apply: WM-3 Stockpile Control; WM-4 Spill Prevention and Control, and; WM-7 Contaminated Soil Management; Water Pollution Control Best Management Practices (BMPs); Temporary Soil Stabilisation BMPs; Non Storm Water Management BMPs, and; Waste Management and Materials Pollution Control.	Construction
5	During the Operational Stage, the following will be in place: Engineered capping layer; Surface water collection and management system (including attenuation and hydrocarbon interceptor)	Operational

6	The construction management of the site will take account of the recommendations of the Construction Industry Research and Information Association (CIRIA) guidance to minimise as far as possible the risk of soil, groundwater and surface water contamination. Site activities considered in the guidance note include the following: • Excavation • Earthmoving • concreting operations Additional specific guidance is provided in the CIRIA technical guidance on Control of Water Pollution from Linear Construction Projects (Murnane et al 2006). Surface run-off from wheel washing areas can contain pollutants such as: • detergents • oil and fuel • suspended solids • grease	Construction
7	Measures, as recommended in the CIRIA guidance, will be implemented to minimise the risk of spills and contamination of soils and waters include: • Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded. • All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.	Construction

	• Where at all possible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together. • Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access. • Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land. • Minimise the use of cleaning chemicals. • Use trigger-operated spray guns, with automatic water-supply cut-off. • Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt. • Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference. • The above measures will be implemented, as appropriate along with the following site specific measures: • Fuel, oil and chemical storage on site will be secure. • Site storage will be on an impervious base within a secondary containment system such as a bund.	

	- A spill kit with sand, earth or commercial products that are approved for the stored materials will be kept close to the storage area. Staff will be trained on how to use spill kits correctly. - Damaged, leaking or empty drums will be removed from site immediately and disposed of via a registered waste disposal contractor. - Mobile plant will be refuelled in a designated area, on an impermeable base away from drains or watercourses. - A wheel wash will be installed for use by all construction vehicles leaving site. - A road sweeper will be used to remove dirt and debris from roads. - Silt traps will be located around the site to collect run off, with settled solids removed regularly and water recycled and reused where possible. - A filter drain and silt pits will be located at the base of all embankments, settled solids will be removed from the silt pits regularly.	
8	A bypass petrol interceptor will be installed in the car park drainage network prior to connection to the existing drainage network to prevent any hydrocarbon spills from entering the surrounding drainage network.	Construction
9	The Verde Due Diligence report (2021) outlines the following measures to be employed on site, which relates to land, soils and hydrogeology: - Where off-site disposal of contaminated soils (waste) is required, all lorry loads will be sheeted once loaded	Construction

	and before leaving site to reduce dust generation. Provision will be made for washing vehicles' wheels at the site entrance to prevent any mud being deposited on local roads, and; • Any stockpiles, compounds and treatment areas will be positioned so as to minimise impact on neighbouring properties. In particular any stock piles containing contaminated soils will be placed on an impermeable surface while awaiting the results of validation testing. The stockpiles will be sheeted to minimise dust emissions and also to minimise the potential for leaching rainwater and run off contaminating clean areas	
Water and Hydrology		
Mitigation		
10	All surface water shall be treated prior to discharge to receiving waters. Measure to protect surface waters from contamination are outlined in Section 4 of the CEWMP - Best Management Practices	Construction
11	The proposed storm water detention ponds will provide for the storage of surface waters during storm events and will also provide a mechanism of treatment for the settlement of suspended solids prior to final discharge. The ponds will be installed as a priority item at the start of the construction stage. The storm water detention ponds will be constructed early in the construction phase in order to provide best mitigation against adverse impact on the Canal receiving waters both during and after the construction phase	Construction
12	Mitigation measures outlined in the CEWMP relating specifically to surface water include:	Construction

	• precautions will be taken during site works to prevent surface water run-off from the site affecting the local surface waters and drainage network; • provision of a wheel wash for vehicles exiting the site to prevent fugitive material on local roads which could end up in the local drainage network and surface watercourses; • A road sweeper will be used to remove dirt and debris from roads; • any stock piles containing contaminated soils will be placed on an impermeable surface while awaiting the results of validation testing. The stockpiles will be sheeted to minimise dust emissions and also to minimise the potential for leaching rainwater and run off contaminating clean areas; • Emergency procedures will be developed to deal with any environmental emergencies on site such as uncontrolled discharges to surface water. A procedure for Environmental Emergency Preparedness and Response will be developed prior to commencement of construction activities at the site; • Site clearance not to be undertaken during wet conditions when rainfall of more than 1mm/hr is forecast within the next 24hr.period; • The proposed surface water head wall to be precast concrete to be placed during low water period and no work within/adjacent the Canal is to be done within the period October to June;	

	• All surface water to be treated for the removal of Hydrocarbon and grit prior to discharge; • A penstock shut-off valve is to be provided on the outfall pipe from the detention pond in the event of an accidental spill of contaminates; • Erosion and sediment traps will be provided prior to the storm water outfall to the Park Canal. • Fuels, Lubricants, hydraulic fluid, solvents and oils to be carefully handled and spill kits provided. • Accidental spillages to be immediately contained and contaminated soil removed from site; • Waste fluids to be collected and removed from site; • Dedicated wash down area to be provided for concrete trucks and temporary batch plant /Ready mix silo washout. All washdown waters will go to a sealed basin area with no discharge to surface water or groundwater; • A filter drain and silt pits will be located at the base of all embankments, settled solids will be removed from the silt pits regularly; and • A bypass hydrocarbon interceptor will be installed in the car park drainage network prior to connection to the existing drainage network to prevent any hydrocarbon spills from entering the surrounding drainage network.	
13	Water Pollution Control Best Management Practices (BMP) will be put in place at the site during construction The BMP in relation to water pollution control include:	Construction

	• Soil Erosion Control; • Prevent Storm Water Flows from Contacting areas of disturbed soil; • Sediment Control; • Combine Soil Erosion and Sediment Control; and • Inspection and Maintenance	
14	BMP's contained within the CEWMP in relation to storm water management during construction are to be put in place. This includes measures in relation to the following: • earth dykes, drainage swales & ditches; • drain outlet protection/velocity dissipation devices; • slope drains; • silt fences; • desilting basins; • sediment traps; • check dams; • use of fibre rolls in protection; • gravel bag berm; • street sweeping and vacuuming; • sandbag barriers; • straw bale barriers; and • storm drain inlet protection	Construction
15	The storm water outfall will be set above the surveyed water level of the canal to reduce potential surcharging; a backflow	Construction

	prevention valve will fitted within the outfall pipe to prevent surcharging of the site drainage network.	
Monitoring		
16	The treated surface water discharge from the site will be monitored on a regular basis during construction to ensure that there is no adverse impact on the water quality in the receiving waters of the Park Canal. Details of surface water monitoring are included in the CEWMP for the site and include periodic inspections by the Construction Manager to address environmental issues including surface water. An EHS Inspection Audit of the construction site will be carried out by the appointed contractor and will be documented; the frequency of these audits will be weekly / monthly / other depending on the nature of contractor activity.	Construction
Air Quality and Climate		
Mitigation		
17	*Air Quality* The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. A dust management plan will be implemented onsite. The main contractor will be responsible for the coordination and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. These measures will be incorporated into the overall Construction Environmental Waste Management Plan (CEWMP) for the site. The measures which will be implemented will include: • Drop heights from conveyors, loading shovels, hoppers and other loading equipment will be	Construction

	minimised, if necessary fine water sprays will be employed. • Hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads will be restricted to essential site traffic. • Any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions. • When conditions are such that there is a risk of trackout of dust (i.e. very dry or muddy), vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads. • Vehicles using site roads will have their speed restricted through speed limit implementation, and this speed restriction will be enforced rigidly. On any site roads, this will be 20 kmph. • Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary. • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods. • During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.	

	At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust and other dust generating activities will be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.	
18	*Climate* Impacts to climate during the construction stage are predicted to be imperceptible however, good practice measures can be incorporated to ensure potential impacts are lessened. These include: • Prevention of on-site or delivery vehicles from leaving engines idling, even over short periods. • Ensure all plant and machinery are well maintained and inspected regularly. • Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.	Construction
	Monitoring	
19	Monitoring of construction dust deposition at locations along the site boundary close to the nearby sensitive receptors during the construction phase of the proposed development is recommended to ensure mitigation measures are working satisfactorily. This can be carried out using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground	Construction

	level. The TA Luft limit value is 350 mg/(m2*day)during the monitoring period between 28-32 days.	
Noise and Vibration		
Mitigation		
20	*Selection of Quiet Plant* This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible.	Construction
21	*Noise Control at Source* If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". Noise control at source relevant to the development works are set out as: • For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant should be switched off when not in use and not left idling. • For percussive tools such as pneumatic concrete breakers and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Erect localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries.	Construction

	- For concrete mixers, control measures should be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum. - For all materials handling ensure that materials are not dropped from excessive heights, lining drops chutes and dump trucks with resilient materials. - Demountable enclosures can also be used to screen operatives using hand tools/ breakers and will be moved around site as necessary. - All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.	
22	*Screening* Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver. Screening may be a useful form of noise control when works are taking place at ground level to screen noise levels at ground floor adjacent buildings.	Construction
23	*Liaison with the Public* A designated noise liaison should be appointed to site during construction works. All noise complaints should be logged and followed up in a prompt fashion by the liaison officer. In addition, prior to particularly noisy construction activity, e.g. demolition, breaking, piling, etc., the liaison officer should inform the nearest noise sensitive locations of the time and expected duration of the noisy works.	Construction

24	*Hours of Work* Construction works will be undertaken within the times below: • Monday to Friday 08:00 to 20:00hrs • Saturday 08:00 to 16:00hrs • Sunday and Public Holidays No noisy work on site.	Construction
25	During the detailed design of the development, the selection and location of mechanical and electrical plant will be undertaken in order to ensure the noise emission limits set out are not exceeded. Plant items in the proposed development are limited to domestic heating and ventilation equipment and therefore no specific mitigation measures are required.	Operational
26	At detailed design stage, appropriate glazing and venting will be determined to ensure suitable internal noise levels.	Operational
	Landscape and Visual Impact	
	Mitigation	
27	During the construction phase, site hoarding will be erected to restrict views of the site during construction. Hours of construction activity will also be restricted in accordance with local authority guidance. Tree protection measures will be installed to the existing trees and hedges identified for potential retention on site within the Tree Survey submitted under a separate cover.	Construction
28	Additional Landscaping measures are set out within the Landscape Specification Report to include; • All plant material shall be good quality nursery stock, free from fungal, bacterial or viral Infection, aphids, redspider or	Construction

	other insect's pests and any physical damage. It shall comply with the requirements of B.S. 3936: parts 1-10: 1965 Specification for nursery stock; • All plants supplied shall be exactly true to name as shown in plant schedules. Unless stipulated, varieties with variegated and/or colored leaves not to be accepted, and any plant found to be of this type upon leafing out shall be replaced by the contractor at his/her own expense	
29	All planting is to be undertaken in the first season following completion of site and development works of each phase of development.	Operational
30	Native trees, shrubs and wildflowers will be used where possible throughout the development.	Operational
31	Where possible, screening of proposed structures with tree lines and woodland planting is proposed.	Operational
Monitoring		
32	Landscape tender drawings and specifications will be produced at detailed design stage to ensure that the landscape works are implemented in accordance with best practice. This document will include tree work procedures, soil handling, planting and maintenance. The contract works will be supervised by a suitably qualified landscape architect.	Construction
33	Operational phase monitoring will include weed control, maintenance and replacement planting where necessary. Periodic visits will be required to ensure that any defects that may occur are rectified, that the landscape proposals are successfully establishing and being correctly maintained.	Operational
Traffic and Transportation		
Mitigation		

34	A construction phase traffic management plan will be agreed with Limerick City and County Council covering for example, timings of HCV deliveries and facilities on site for the washing of vehicles etc.	Construction
35	The following mitigation measures are recommended at operational stage to ensure that the impact of the development is as small as possible: • To minimise the impact of the development on the capacity and operation of the local road network, the action plan contained within the Mobility Management Plan prepared for the development should be implemented; • To minimise the risk of collisions occurring, the recommendations contained within the Stage 1 Road Safety Audit (and any subsequent Road Safety Audits) should be implemented.	Operational
Material Assets – Waste		
Mitigation		
36	A project specific C&D WMP has been prepared in line with the requirements of the requirements of the Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, 2006). Adherence to the high-level strategy presented in this C&D WMP will ensure effective waste management and minimisation, reuse, recycling, recovery and disposal of waste material generated during the demolition, excavation and construction phases of the proposed Development. • Prior to commencement, the appointed Contractor(s) will be required to refine / update the C&D WMP in agreement with LCCC, or submit an addendum to the	Construction

	C&D WMP to LCCC, detailing specific measures to minimise waste generation and resource consumption, and provide details of the proposed waste contractors and destinations of each waste stream. - The Contractor will be required to fully implement the C&D WMP throughout the duration of the proposed construction and demolition phases.	
37	Correct classification and segregation of the excavated material is required to ensure that any potentially contaminated materials are identified and handled in a way that will not impact negatively on workers as well as on water and soil environments, both on and off-site.	Construction
38	The following mitigation measures will be implemented: - Building materials will be chosen with an aim to 'design out waste'; - On-site segregation of waste materials will be carried out to increase opportunities for off-site reuse, recycling and recovery. The following waste types, at a minimum, will be segregated: Concrete rubble (including ceramics, tiles and bricks); Plasterboard; Metals; Glass; and Timber. - Left over materials (e.g. timber off-cuts, broken concrete blocks / bricks) and any suitable	Construction

	construction materials shall be re-used on-site, where possible; • All waste materials will be stored in skips or other suitable receptacles in designated areas of the site; • Any hazardous wastes generated (such as chemicals, solvents, glues, fuels, oils) will also be segregated and will be stored in appropriate receptacles (in suitably bunded areas, where required); • A Waste Manager will be appointed by the main Contractor(s) to ensure effective management of waste during the demolition, excavation and construction works; • All construction staff will be provided with training regarding the waste management procedures; • All waste leaving site will be reused, recycled or recovered, where possible, to avoid material designated for disposal; • All waste leaving the site will be transported by suitably permitted contractors and taken to suitably registered, permitted or licenced facilities; and • All waste leaving the site will be recorded and copies of relevant documentation maintained. • Nearby sites requiring clean fill material will be contacted to investigate reuse opportunities for clean and inert material, if required. If any of the material is to be reused on another site as by-product (and not as a waste), this will be done in accordance with Article 27 of the EC (Waste Directive) Regulations (2011). EPA approval will be obtained prior to moving	

	material as a by-product. However, it is not currently anticipated that Article 27 will be used.	
39	A project specific OWMP has been prepared. • The Operator / Buildings Manager of the Site during the operational phase will be responsible for ensuring – allocating personnel and resources, as needed – the ongoing implementation of this OWMP, ensuring a high level of recycling, reuse and recovery at the Site of the proposed Development.	Operational
40	The Operator / Buildings Manager will ensure on-Site segregation of all waste materials into appropriate categories, including (but not limited to): • Organic waste; • Dry Mixed Recyclables; • Mixed Non-Recyclable Waste; • Glass; • Waste electrical and electronic equipment (WEEE); • Batteries (non-hazardous and hazardous); • Cooking oil; • Light bulbs; • Cleaning chemicals (pesticides, paints, adhesives, resins, detergents, etc.); • Furniture (and from time to time other bulky waste); and • Abandoned bicycles.	Operational

41	The Operator / Buildings Manager will ensure that all waste materials will be stored in colour coded bins or other suitable receptacles in designated, easily accessible locations. Bins will be clearly identified with the approved waste type to ensure there is no cross contamination of waste materials	Operational
42	The Operator / Buildings Manager will ensure that all waste collected from the Site of the proposed Development will be reused, recycled or recovered, where possible, with the exception of those waste streams where appropriate facilities are currently not available	Operational
43	The Operator / Buildings Manager will ensure that all waste leaving the Site will be transported by suitable permitted contractors and taken to suitably registered, permitted or licensed facilities.	Operational
Monitoring		
44	The objective of setting targets for waste management is only achieved if the actual waste generation volumes are calculated and compared. This is particularly important during the demolition, excavation and construction works, where there is a potential for waste management objectives to become secondary to other objectives, i.e. progress and meeting construction schedule targets. The C&D WMP specifies the need for a Waste Manager to be appointed, who will have responsibility for monitoring the actual waste volumes being generated and ensuring that contractors and sub-contractors are segregating waste as required. Where targets are not being met, the Waste Manager will identify the reasons for this and work to resolve any issues. Recording of waste generation during the construction phase of the proposed Development will enable better management of	Construction

	waste contractor requirements and identify trends. The data should be maintained to advise on future Developments.	
45	During the operational phase, waste generation volumes will be monitored by the Operator / Buildings Manager against the predicted waste volumes outlined in the OWMP. There may be opportunities to reduce the number of bins and equipment required in the WSAs, where estimates have been too conservative. Reductions in bin and equipment requirements will improve efficiency and reduce waste contactor costs.	Operational
	Cultural Heritage	
	Mitigation	
46	All ground disturbance below the modern fill layer should be monitored by a suitably qualified archaeologist. The monitoring archaeologist should be empowered to halt the development if buried archaeological features or finds are uncovered. If archaeological remains are uncovered, these sites become an archaeological site and are protected by the National Monuments legislation. Further work on the site will require consultation with the archaeological staff of The Heritage Service, National Monuments Division, Department of Housing, Local Government and Heritage.	Pre Construction / Construction
47	Any newly discovered site must be archaeologically resolved. Provision, including financial and time should be made from at the outset of the project to facilitate any excavation or recording of archaeological material that may be uncovered during the developmental works.	Pre Construction / Construction
48	All test pits for engineering purposes should also be archaeologically monitored to prevent accidental damage to	Pre Construction / Construction

	buried archaeological features and to record any accidental discovery of features and/or finds	
Monitoring		
49	Archaeological monitoring is recommended to mitigate any potential adverse impact on archaeological remains. All ground disturbance should be monitored by a suitably qualified archaeologist. The monitoring archaeologist should be empowered to halt the development if buried archaeological features or finds are uncovered. If archaeological remains are uncovered, these sites become an archaeological site and are protected by the National Monuments legislation. Further work on the site will require consultation with the archaeological staff of The Heritage Service, National Monuments Division, Department of Housing, Local Government and Heritage. All test pits for engineering purposes should also be archaeologically monitored to prevent accidental damage to buried archaeological features and to record any accidental discovery of features and/or finds.	Pre Construction / Construction

Project No. 13.05/2022

RW Nowlan & Associates
Chartered Planning & Property Advisors

Environmental Impact Assessment Report

Part 3 - Appendices

RE: Canal Bank, Pa Healy Road, Co. Limerick SHD Application to An Bord

DATE: February 2021

on behalf of: Revington
Developments Ltd.

Table of Contents

APPENDIX 6.1 EU Directives / National Legislation and Regulations / Guidelines / Technical Standards

European Directives

- Environmental Impact Assessment. Directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment;
- Environmental Impact Assessment Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment;
- Water Framework Directive (2000/60/EC);
- Groundwater Directive (2006/118/EC);
- Flooding Directive (2007/60/EC)
- Integrated Pollution and Prevention Control Directive (2008/1/EC); and
- The management of waste from extractive industries (2006/21/EC).

Irish Government Acts, National Legislation and Regulations

- S.I. No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001);
- The Planning and Development Acts, 2000 to 2009, The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments including, S.I. No. 364 of 2005 and S.I. 685 of 2006.

National legislation on the protection of the water environment. Since 2000 water management in EU member states has primarily been directed by the Water Framework Directive (2000/60/EC) and the associate ‘daughter’ Groundwater Directive (2006/118/EC). Irish legislation implementing these, and other relevant directives currently includes:

- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010 and amendments (S.I. No. 389 of 2011 and S.I. No. 149 of 2012);
- European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014);
- S.I. No. 278 of 2007 European Communities (Drinking Water) (No. 2) Regulations;
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment (S.I. No. 327 of 2012);
- S.I. No. 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended (S.I. No. 231 of 2010);
- S.I. No. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010;

- S.I. No. 457 of 2008 European Communities (Environmental Liability) Regulations which bring into force the European Liability Directive (2004/35/EC);
- European Union (Planning and Development) (Environmental Impact Assessment) (No. 2) Regulations 2018 (S.I. No. 404 of 2018);
- Local Government (Water Pollution) Acts 1977 to 1998;
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- European Communities (Quality of Shellfish Waters) Regulations, 2006 (S.I. No. 268 of 2006) and amendments (S.I No. 55 and 464 of 2009), and;
- Bathing Water Quality Regulations, 2008 (S.I. No. 79 of 2008) and amendments (S.I No. 351 of 2011 and S.I. No. 163 of 2016);

Guidelines

- CIS (2007). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC) Guidance on preventing or limiting direct and indirect inputs in the context of the Groundwater Directive 2006/118/EC. Guidance Document No. 17.
- CIS (2010). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC). Guidance on risk assessment and the use of conceptual models for groundwater. Guidance document No. 26.
- DEHLG (2004). National Urban Waste Water Study. National Report.
- DEHLG (2009). Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities.
- DELG/EPA/GSI (1999). Groundwater Protection Schemes. Document prepared jointly by the Geological Survey of Ireland (GSI), the Environmental Protection Agency, and the Department of Environment, Heritage and Local Government.
- EPA (Draft May 2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- EPA (2010b). Methodology for Establishing Groundwater Threshold Values and the Assessment of Chemical and Quantitative Status of Groundwater, Including and Assessment of Pollution Trends and Trend Reversal.
- EPA (2011). Guidance on the Authorisation of Discharges to Groundwater. Version 1, December 2011.
- EPA (2003). Towards Setting Guideline Values for the Protection of groundwater in Ireland. Interim Report.

- EPA (2006). Ireland Water Framework Directive Monitoring Programme.
- Fitzsimons, V., Daly, D. and Deakin, J. (2003). Draft GSI guidelines for assessment and mapping of groundwater vulnerability to contamination. Groundwater Chapter, Geological Survey of Ireland.
- GSI (2006). Criteria used in aquifer classification. 1Available from http://www.gsi.ie/Programmes/Groundwater/Aquifer+Classification.htm
- IGI (2007). Guidelines on Water Well Construction. Available from http://www.igi.ie/assets/files/Water%20Well%20Guidelines/Guidelines.pdf
- Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P. and Moe, H. (2008). A Framework for the Assessment of Groundwater – Dependent Terrestrial Ecosystems under the Water Framework Directive. Environmental Research Centre Report Series No. 12.
- Institute of Geologists of Ireland, 2007. Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments.

Technical Standards

- British Standards (2015). Code of Practice for Ground Investigations BS5930:2015;.
- CIRIA (2007). The SuDS Manual. (C697). CIRIA publication, February 2007.

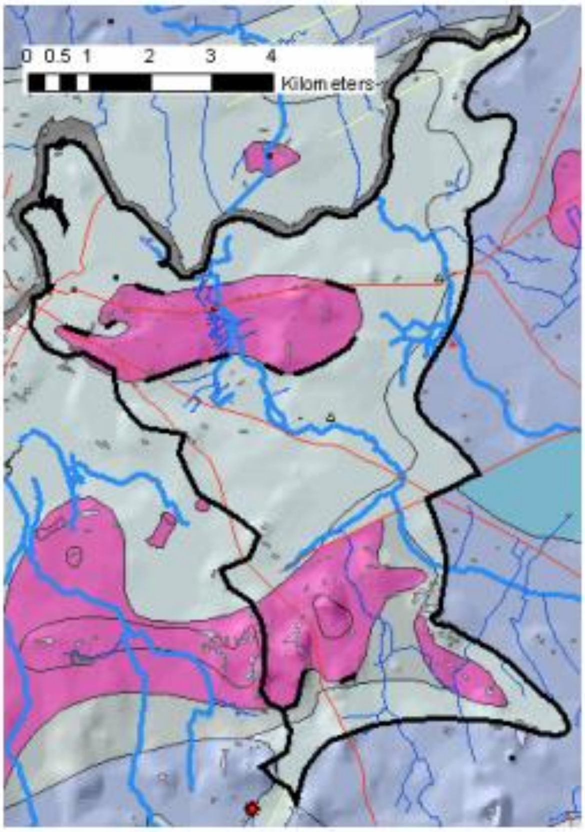
APPENDIX 6.2 Limerick City East Groundwater Body GWB Description

Limerick City East GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
25 - Shannon Estuary Limerick Co. Co.	Rivers: Shannon, Mulkear, Groody.	None.	46

Topography	Ground elevation generally increases from north to south. Much of the GWB is low-lying, with elevations ranging from < 10 mAOD to about 40 mAOD in areas underlain by the pure bedded limestones. Higher ground occurs in the areas underlain by volcanic rocks; in the west of the GWB, elevations range from 10-50 mAOD, whilst in the south, ground underlain by volcanics ranges from 30-90 mAOD in elevation. The highest ground is found along the western and SW boundary of the GWB. The land is poorly drained in the low-lying ground next to the lower reaches of the Groody River, and also along parts of the Mulkear River.	
Geology and Aquifers	Aquifer categories	The majority of the GWB comprises an **Lm:** Locally important aquifer which is generally moderately productive. The Basalts and other Volcanic rocks rock unit group is currently classified as **Lm**. In the south of the GWB there is a small area (2.5 km^2) of **Ll:** Locally important aquifer which is moderately productive only in local zones. There is a small area (< 0.1 km^2) in the SW of **Rk^d**: Regionally important karstified aquifer dominated by diffuse flow.
	Main aquifer lithologies	Dinantian Pure Bedded Limestone is the major rock unit group in the GWB. There are smaller but significant areas of Basalts and other Volcanic rocks. In the very SW of the GWB, there is a very small area (< 0.1 km^2) of Dinantian Pure Unbedded Limestone. In the south of the GWB, there is approximately 2.5 km^2 of Dinantian Upper Impure Limestones.
	Key structures	The rocks form part of the core and southern limb of a large syncline, whose axis is oriented ENE-WSW. Bedding dip angles range between 5° to 15° and are generally to the NW. Minor folds associated with the major structure are present. An ENE-WSW trending fault is mapped in the southern part of the GWB, juxtaposing volcanic and pure bedded limestones. Other, unmapped, faults are likely.
	Key properties	Transmissivities are likely to be in the range 5-150 m^2/d, with the median value towards the lower-middle end of the range. Transmissivity in the similar limestone aquifer of the Pallas Grean GWB, 15 km to the SE, was estimated as 26 m^2/d. In the Volcanic rocks, transmissivities will be similar, with median values towards the lower end of the range. Transmissivity in the Volcanic rocks in this area may be variable: in some zones, columnar cooling joints provide a connected pathway for groundwater flow. In other parts, alteration of the rocks during their emplacement in shallow seas, or subsequent weathering during subaerial exposure in a tropical environment may have clogged potential flow pathways (both cooling joints and tectonic fractures) with clays. At Herbertstown WS in the nearby Knockroe SW GWB, transmissivity is about 100 m^2/d. However, there are failed wells known in this rock unit group. Transmissivity in the Upper Impure Limestones will be significantly lower, in the range 5-20 m^2/d. Groundwater gradients in low-lying areas will be low (~0.005-0.01), ranging up to 0.03 in the steeper areas. *(data sources: Rock Unit Group Aquifer Chapters, GWPS Reports, Source Reports, see references; estimation from maps)*
	Thickness	The Dinantian Pure Bedded Limestones vary laterally in maximum thicknesses from 150 m to up to 500 m. However, most groundwater flow is likely to take place in the top ~30 m, in the zone that comprises a weathered layer of a few metres (epikarst) and a connected fractured layer below this. Deeper groundwater flow occurs along fault zones and large fractures. In the volcanics, most groundwater flux is likely to be in the top ≤ 20-30 m, in the zone comprising a weathered layer of a few metres and a connected fractured zone below this. However, more isolated water-bearing joints or faults can be intercepted at greater depths. In the lower transmissivity impure limestones, groundwater flux will be concentrated in the upper ~ 15 m of the aquifer, in a weathered zone of a few metres and connected fractured layer below this.
Overlying Strata	Lithologies	The GWB is mainly covered by Limestone Till subsoils. Undifferentiated Alluvium occurs along the River Groody, and there areas of river gravel mapped along the Groody and Mulkear Rivers. A significant gravel area occurs in the east of the GWB, where the Mulkear River is joined by several tribuataries. A significant proportion of the north part of the GWB is covered by the made ground of Limerick City and its suburbs.
	Thickness	Subsoil thickness data are sparse. Available data indicate thickness in the range 2-23 m. There is outcropping rock and 'rock close' particularly in the elevated areas and on local high points within the GWB.
	% area aquifer near surface	*[Information will be added at a later date]*
	Vulnerability	Groundwater vulnerability is Extreme and High. Extreme vulnerability occurs in more extensive areas over the Volcanic rock aquifers in the north and south of the GWB, and only in small isolated areas over the limestone aquifers. The aquifers in the remainder of the GWB are Highly vulnerable.
Recharge	Main recharge mechanisms	Diffuse recharge will occur over most of the groundwater body via rainfall soaking through the subsoil and directly to the aquifer via outcrop. Where the water table is very close to ground surface, recharge may be rejected. Recharge will be inhibited in urban, paved areas.
	Est. recharge rates	*[Information will be added at a later date]*

Discharge	Important springs and high yielding wells (m^3/d)	There are no Excellent yielding boreholes (> 400 m^3/d) known in the GWB. No significant springs are known. Two boreholes, at Dawn Dairies in the pure bedded limestones and at Cahernarry Group Water Scheme in the volcanics, are known to have yields at the lower end of the 'Good' yield range (100 m^3/d < yield < 400 m^3/d).
	Main discharge mechanisms	The main discharges are to the streams and rivers crossing the GWB, and to the River Shannon that forms the northern boundary of the GWB. Regions in which groundwater is discharging are indicated by higher stream densities, i.e. near Newtown and Singland, in the north of the GWB.
	Hydrochemical Signature	No relevant hydrochemical data are available for the limestone aquifer in this GWB for assessment. By analogy with other pure limestone aquifers, the groundwater is likely to be hard to very hard, with corresponding high alkalinity and conductivity, and a neutral pH. It is likely to have a calcium–bicarbonate signature. Water quality data from volcaniclastic aquifers in nearby GWBs indicate conductivities of between 470–700 µS/cm. In general, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. In the pure limestone aquifers, groundwater flows through an epikarstic layer and a zone in which fractures are more dense and open. The epikarst is thought to be relatively modern, being formed after the last ice age. The groundwater flow regimes in the epikarst and fractured zones will be hydraulically connected, with the degree of interconnection depending on the faults and joints associated with the structural deformation. Within the volcanic rocks, groundwater flows through the weathered zone and the connected fractured zone below this. Groundwater flows through fractures and faults and may also flow through primary structures formed when lava flows cooled causing jointing. Groundwater flux is thought to be concentrated in the top 30 m or so of the aquifer, with the exception of in the impure limestones, in which groundwater flow is generally shallower. The GWB is considered to be unconfined, with the rivers and streams in hydraulic continuity with the aquifer, which therefore represent the water table elevation. Groundwater levels are generally shallow, ranging from near ground level near streams and rivers, up to 6-12 mbgl away from surface water bodies. The water table is likely to generally follow the topography. Local groundwater flow will be from the higher ground between surface water bodies to the rivers and streams, where it discharges. Regional groundwater flow directions are generally E-W to northwards, oblique to the N-S flowing rivers, and northwards to the Shannon. Groundwater flow path lengths are on the order of 500–1500 m over the bulk of the GWB. In discharge zones, flow paths will be much shorter, at around 100–300 m.
Groundwater & Surface water interactions		Groundwater sustains flows in the gaining rivers and streams crossing the GWB. Groundwater will flow into the Inner River Shannon as direct baseflow, and via baseflow to Rivers Groody and Mulkear, which flow into the Shannon. Specific dry weather flows computed for stations at rivers in this GWB are moderate-high (0.44 and 5 l/s/km^2). This is thought to be due to the gravels and alluvium supporting baseflow along the rivers.
Conceptual model		• The groundwater body is bounded to the north by the River Shannon, to the east by the contact with the karstified Pure Unbedded Limestones of Castleconnell GWB, to the SE and south by the karstified Pure Unbedded Limestones of the Ballyneety GWB, and by a surface water catchment boundary which is an implied groundwater divide in the west. The terrain is gently undulating over much of the GWB, with small hills occurring in the north and the SW. • Groundwater flow occurs along fractures, joints and faults in the limestones and volcanic rocks. There is likely to be an epikarstic layer at the top of the limestones, which acts to redistribute recharge in the subsurface and, in high water table conditions, is a very high transmissivity layer. The aquifers have low storativity. • Recharge occurs diffusely through the subsoils and at outcrop. Potential recharge may be rejected in areas where the water table is very close to the surface. Recharge will be inhibited by urban made ground in the north of the GWB. • Groundwater flux in the limestone aquifer will be concentrated in an approximately 30 m zone at the top of the bedrock. This zone comprises an epikarstic layer of a few metres, below which is a network of joints, fractures and faults. Deeper groundwater flow can occur along permeable fault zones or deeper fractures. The flow regime in the volcanic aquifer is similar, excepting the epikarstic layer. • The aquifers in the GWB are unconfined in the main. Near rivers and streams, the water table is close to the surface. Beneath higher ground, significant unsaturated zones may exist. Depending upon topography, the water table can vary between 2 metres up to ~15 m below ground surface. Water table fluctuations in discharge areas will be relatively low (on the order of 1-2 m) whereas, in the high ground underlain by volcanic rocks or local topographic highs in the limestones, the water table elevation may vary considerably. • Flow path lengths are generally long (up to 1500 m). In discharge zones, flow paths will be much shorter, at around 100–300 m. On a local scale, groundwater discharges to the streams and smaller rivers crossing the aquifer. Local groundwater flow directions are determined by topography and local drainage patterns. Regional groundwater flow directions are roughly E-W to northwards, oblique to the major N-S rivers. • Groundwater discharges to the gaining rivers crossing the GWB, and the Shannon at the north of the GWB.
Attachments		None.
Instrumentation		Stream gauges: 25001*, 25012, 25061, 25076, 25151* *(Stations marked with * have specific dry weather flows calculated).*
Information Sources		Deakin, J. (1995) *Herbertstown Public Supply, Groundwater Source Protection Zones.* Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme.* Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Deakin, J. and Daly, D. (2000) *County Clare Groundwater Protection Scheme.* Geological Survey of Ireland Report to Clare Co. Co., 67 pp. Aquifer Chapters: Dinantian Pure Bedded Limestones, Basalts and other Volcanic rocks, Dinantian Upper Impure Limestones, Dinantian Pure Unbedded Limestones.
Disclaimer		Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae



Rock units in GWB

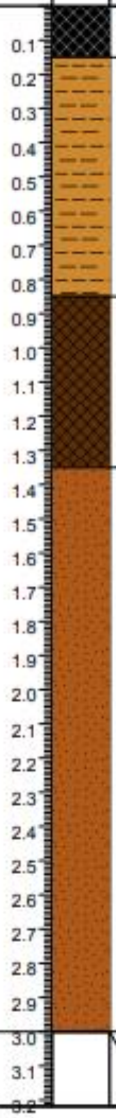
Rock unit name and code	Description	Rock unit group
Visean Limestones (Undifferentiated)		Dinantian Pure Bedded Limestones
Lough Gur Formation (LR)	Pale cherty crinoidal limestone	Dinantian Pure Bedded Limestones
Volcaniclastic Rocks (V)		Basalts and other Volcanic rocks
Basalt (B)		Basalts and other Volcanic rocks
Rathkeale Formation (RK)	Dark muddy limestone & shaly mudstone	Dinantian Upper Impure Limestones
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones

APPENDIX 6.3 Trial Pit and Borehole Logs

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

Trial Pit No.: TP101



SAMPLES AND INSITU TESTING					STRATA RECORD	
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		No PEC 0.0ppm	TP101			MADE GROUND black gravel.
	SS	No PEC 0.0ppm	TP101			MADE GROUND dark grey / black silty sandy clay with fragments of concrete block and occasional red brick.
		No PEC 0.0ppm	TP101			NATURAL GROUND dark grey / brown silty sandy CLAY.
	SS	No PEC 0.0ppm	TP101			NATURAL GROUND loose light brown mottled grey, clayey gravelly SANDwith occasional large limestone cobbles.
						End of Trial pit at 3mBGL. Trial pit terminated on possibe large boulders or bedrock. Trial pit collapsing.

Remarks

Soil Samples: TP101A (0.15-0.85m)
TP101B (0.85-3.0m)

No Physical Evidence of Contamination (PEC)

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Trial Pit No.: TP102

Site: Pa Healy Road

Client Lawlor Burns

Contractor: Fergal O'Murchu

Sheet: 1 of 1

County: Limerick

Logged By: KP

Date: 10/01/2019

Verde Job Ref: 52107

SAMPLES AND INSITU TESTING					STRATA RECORD	
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		No PEC	TP102	0.1	▨	MADE GROUND silty top soil.
		No PEC 0.0ppm	TP102	0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4	▨	MADE GROUND brown sandy clay, with frequent fragments of concrete and occasional fragments of red brick. Red electrical cucting present at the edge of the excavation at 0.75mBGL.
	SS	HC/Ch Od 2.9ppm	TP102	1.5 1.6 1.7 1.8 1.9	▨	MADE GROUND brown sandy clay fill, with frequent fragments of concrete and occasional fragments of red brick, car parts, metal panels, plastic pipe and wood.
		Organic Odour	TP102	2.0 2.1 2.2 2.3 2.4 2.5	■	NATURAL GROUND dark grey peaty CLAY.
	SS	No PEC 0.0ppm	TP102	2.6 2.7 2.8 2.9 3.0 3.1	▨	NATURAL GROUND light brown clayey silty SAND.
				3.2 3.3 3.4		End of Trial Pit at 3.2mBGL.

Remarks

Soil Samples: TP102A (0.25-2.00m)
TP102B (2.00-3.20m)

No Physical Evidence of Contamination (PEC)

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Trial Pit No.: TP103

Site: Pa Healy Road
Client Lawlor Burns
Contractor: Fergal O'Murchu
Sheet: 1 of 1
County: Limerick
Logged By: KP
Date: 10/01/2019
Verde Job Ref: 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		0.0ppm No PEC	TP103	0.1	▨	MADE GROUND brown silty top soil with abuntant fragments of rootlets.
	SS	0.0ppm No PEC	TP103	0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3	▨	MADE GROUND brown / light brown sandy clay with abundant large concrete fragments and red brick, some metal and plastic fragments and possible single fragment of Asbestos Containing Material (ACM).
		0.0ppm No PEC	TP103	1.4 1.5 1.6	▨	MADE GROUND dark brownish / grey peaty clay.
		0.0ppm No PEC	TP103	1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6	▒	NATURAL GROUND light brown mottled grey clayey gravelly SAND with large cobbles and boulders.
				2.7 2.8 2.9		End of Trial Pit at 2.7mBGL. Obstruction on boulders.

Remarks

Soil Sample: TP103A (0.2-1.4m)

No Physical Evidence of Contamination (PEC)

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP104**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
					▨	MADE GROUND grey gravel.
▽	SS	0.0ppm No PEC	TP104	0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2	▨	MADE GROUND browninsh / grey very sandy clay with frequent fragments of concrete and red brick, a single fragment of roof tile encountered, occasional fragments of wood and metal. Water encountered at 1.5mBGL.
		0.0ppm Org Od	TP104	2.3 2.4	▨	NATURAL GROUND dark brown PEAT with frequent fragments of plant material.
	SS	0.0ppm No PEC	TP104	2.5 2.6 2.7 2.8 2.9 3.0	▨	NATURAL GROUND grey mottled / light grey mottled CLAY with sand lenses.
				3.1 3.2 3.3		End of Trial Pit at 3.1mBGL. Trial Pit collapsing due to water entry.

Remarks

Soil Samples: TP104A (0.05-2.3m);
TP104B (2.5-3.1m)

No Physical Evidence of Contamination (PEC)
Water strike at 1.5mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Trial Pit No.: TP105

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
					▩	MADE GROUND grey gravel fill with tarmac bind.
▽	SS	0.0ppm Chem Od	TP105	0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4	▨	MADE GROUND brown sandy clay with abundant fragments of concrete and red brick, presence of piling concrete poles and some large fragments of flat concrete.
				2.5 2.6 2.7		End of Trial Pit at 2.5mBGL. Obstruction on very large fragments of concrete. Water strike at 2.5mBGL.

Remarks

Soil Sample: TP105 (0.05-2.5m)

Water strike at 2.5mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP106**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		No PEC	TP106	0.1 0.2	▨	MADE GROUND silty brown topsoil with abundance of roots.
		0.0ppm No PEC	TP106	0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4	▨	MADE GROUND brown clayey gravelly sand.
▽	SS	0.0ppm No PEC	TP106	1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0	▨	MADE GROUND dark greyish-brown slightly sandy clay with frequent red brick, occasional plastic, glass and metal fragments. Loose stone drain structure encountered at 2.1 mBGL with abundance of water.
				3.1 3.2 3.3		End of Trial Pit at 3.1mBGL. Trial pit collapsing due to water entry.

Remarks

Soil Sample: TP106 (0.3-3.1m)

Water strike at 2.1mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP107**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING					STRATA RECORD	
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		No PEC	TP107	0.1	▨	MADE GROUND silty brown topsoil with abundance of roots.
		0.0ppm No PEC	TP107	0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3	▨	MADE GROUND comprising brown clayey gravelly sand.
▽	SS	0.0ppm No PEC	TP107	1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7	▨	MADE GROUND grey sandy clay with abundance of very large fragments of concrete. Some Hydrocarbon sheen on water.
				2.8 2.9 3.0		End of Trial Pit at 2.8mBGL.

Remarks

Soil Sample: TP107 (0.2-2.8m)
Water Sample: TP107 (1.0-4.0mBGL)

Water strike at 2.5mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP108**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
				0.1 0.2 0.3	▨	MADE GROUND grey 804 gravel.
▽				0.4 0.5 0.6 0.7	▨	MADE GROUND brown sandy gravel.
				0.8 0.9 1.0 1.1 1.2 1.3	▨	MADE GROUND grey / brown sandy gravel with frequent concrete and red brick fragments.
	SS		TP108	1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 3.0	▨	
	SS	1.3ppm Mild HC Od	TP108	3.1 3.2 3.3	▤	NATURAL GROUND orange sandy CLAY. Mild Hydrocarbon odour.
				3.4 3.5 3.6		End of Trial Pit at 3.4mBGL. Close to the range of the digger.

Remarks

Soil Sample: TP108A (1.4-3.1m)
TP108B (3.1-3.4m)

Water strike at 0.7mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group	**Trial Pit No.: TP109**

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING					**STRATA RECORD**	
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
▽				0.1 0.2	▨	MADE GROUND comprising 804 fill.
▽	SS	0.0ppm	TP109	0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7	▨	MADE GROUND brown / grey sandy gravelly clay with frequent limestone boulders and cobbles, occasional fragments of red brick and concrete.
				2.8 2.9 3.0		End of Trial Pit at 2.8mBGL. Trial pit partially collapsing.

Remarks

Soil Sample: TP109 (0.2-2.8m)

Water strike at 0.2mBGL (small) and at 2.5mBGL

Verde Environmental Consultants Ltd | part of the Verde Environmental Group	**Trial Pit No.: TP110**

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				**STRATA RECORD**		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
					▨	MADE GROUND dark brown silty topsoil.
▽	SS	0.0ppm / 2.4 Ammonia	TP110	0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7	▨	MADE GROUND dark greyish-brown very sandy gravelly clay with frequent limestone boulders, fragments of red brick and occasional ceramic.
				2.8 2.9 3.0		End of Trial Pit at 2.8mBGL. Trial pit collapsing due to water entry at 2.5mBGL.

Remarks	
Soil Sample: TP110 (2.4-2.8m) Water strike at 2.5mBGL.	

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP111**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** DMC/KP	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				**STRATA RECORD**		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
				0.1 0.2 0.3 0.4 0.5 0.6 0.7	▨	MADE GROUND brown sandy gravelly clay with frequent large stones and cobbles.
	SS		TP111A	0.8 0.9 1.0 1.1 1.2 1.3 1.4	▨	MADE GROUND brown / grey sandy gravelly clay with occasional fragments of red brick, concrete, metal, ceramics and glass.
▽				1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7	▨	MADE GROUND grey / brown sandy gravel with fragments of metal sheeting, plastic and concrete poles present.
	SS		TP111B	2.8 2.9 3.0 3.1 3.2 3.3 3.4	▨	NATURAL GROUND wet light grey / brown silty CLAY with frequent subrounded cobbles. (Some peat overlying natural ground)
				3.5 3.6 3.7		End of Trial Pit at 3.5mBGL. Trial pit collapsing.

Remarks

Soil Sample: TP111A (0.8-2.8m)
TP111B (2.8-3.5m)

Water strike at 2.5 mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group		**Trial Pit No.: TP112**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** DMC	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
	SS	0.0ppm/No Odour	TP112	0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7	▨	MADE GROUND grey / brown sandy gravelly clay with frequent fragments of concrete, red brick, pipe, rebar, piling and mesh present
▽				2.8 2.9 3.0 3.1	▨	MADE GROUND grey / brown wet sandy very gravelly clay with frequent fragments of concrete, red brick, pip, rebar, piling and mesh present
				3.2 3.3 3.4		End of Trial Pit at 3.2mBGL. Trial pit collapsing.

Remarks

Soil Sample: TP112 (0.1-3.2m)

Water strike at 2.8mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Trial Pit No.: TP113

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** DMC	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
		0.0ppm No PEC		0.1 0.2 0.3 0.4	▨	MADE GROUND grey / brown gravel fill with large cobbles.
▽	SS	0.0ppm No PEC	TP113	0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4	▨	MADE GROUND grey / brown gravel fill with large cobbles, frequent large stones, some metal waste and very large limestone cobbles present.
				2.5 2.6 2.7		End of Trial Pit at 2.5mBGL. Trial pit collapsing.

Remarks

Soil Sample: TP113 (0.5-2.5m)

Water strike at 2.0mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Trial Pit No.: TP114

Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** DMC	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				STRATA RECORD		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
	SS	0.0ppm No PEC	TP114		▨	MADE GROUND grey sandy silty gravel with frequent limestone cobbles and some fragments of red brick.
					▨	MADE GROUND comprising grey sandy silty gravel with frequent limestone cobbles red brick plastic wood and hosing present
▽					▨	NATURAL GROUND wet light brown / grey silty CLAY with subrounded cobbles present. (natural layer of peat overlying natural ground)
						End of Trial Pit at 2.9mBGL. Target depth achieved.

Remarks

Soil Sample: TP114 (0.1-2.8m)

Water strike at 2.8mBGL.
PEC- Physical Evidence of Contamination

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Trial Pit No.: TP115**
Site: Pa Healy Road	**Client** Lawlor Burns	**Contractor:** Fergal O'Murchu	**Sheet:** 1 of 1
County: Limerick	**Logged By:** DMC	**Date:** 10/01/2019	**Verde Job Ref:** 52107

SAMPLES AND INSITU TESTING				**STRATA RECORD**		
Ground Water Depth (m)	Type	Observations	Sample ID	Depth (m)	Key	Description
						Ground Surface
	SS		TP115	0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2	▩	MADE GROUND brown sandy gravelly silt with frequent limestone cobbles and red brick, some metal pipes and fragments of concrete.
▽				2.3 2.4 2.5 2.6 2.7 2.8 2.9	▤	NATURAL GROUND wet, soft, loose light brown sandy CLAY with some small clasts present.
				3.0 3.1 3.2		End of Trial Pit at 3.0mBGL. Trial pit collapsing.

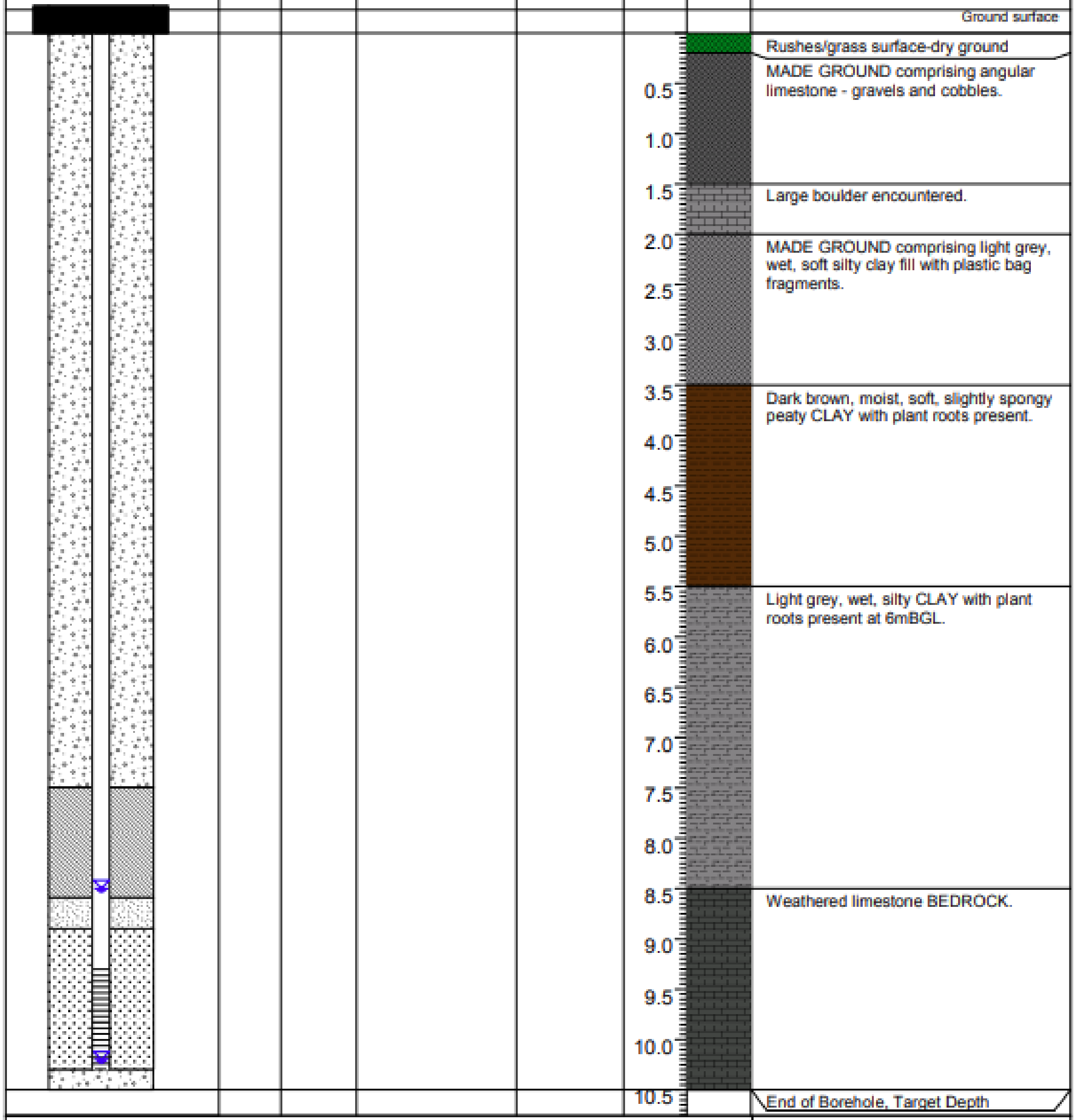
Remarks

Soil Sample: TP115 (0.1-2.3m)

Water strike at 2.4mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Borehole Log No.: MW101**
Site: Pa Healy Road	**Logged By:** DH	**Contractor:** Southern Pumps	**Sheet:** 1 of 1
Client: PHM Consulting	**Drilling method:** Rotary	**Date:** 10/01/2019	**Verde Job Ref:** 52107

GROUNDWATER	SAMPLES AND INSITU TESTING				STRATA RECORD		
Well	Depth/ Type (m)	PID (ppm)	Observations	Sample ID	Depth (m)	Key	Description



Rushes/grass surface-dry ground

MADE GROUND comprising angular limestone - gravels and cobbles.

Large boulder encountered.

MADE GROUND comprising light grey, wet, soft silty clay fill with plastic bag fragments.

Dark brown, moist, soft, slightly spongy peaty CLAY with plant roots present.

Light grey, wet, silty CLAY with plant roots present at 6mBGL.

Weathered limestone BEDROCK.

End of Borehole, Target Depth

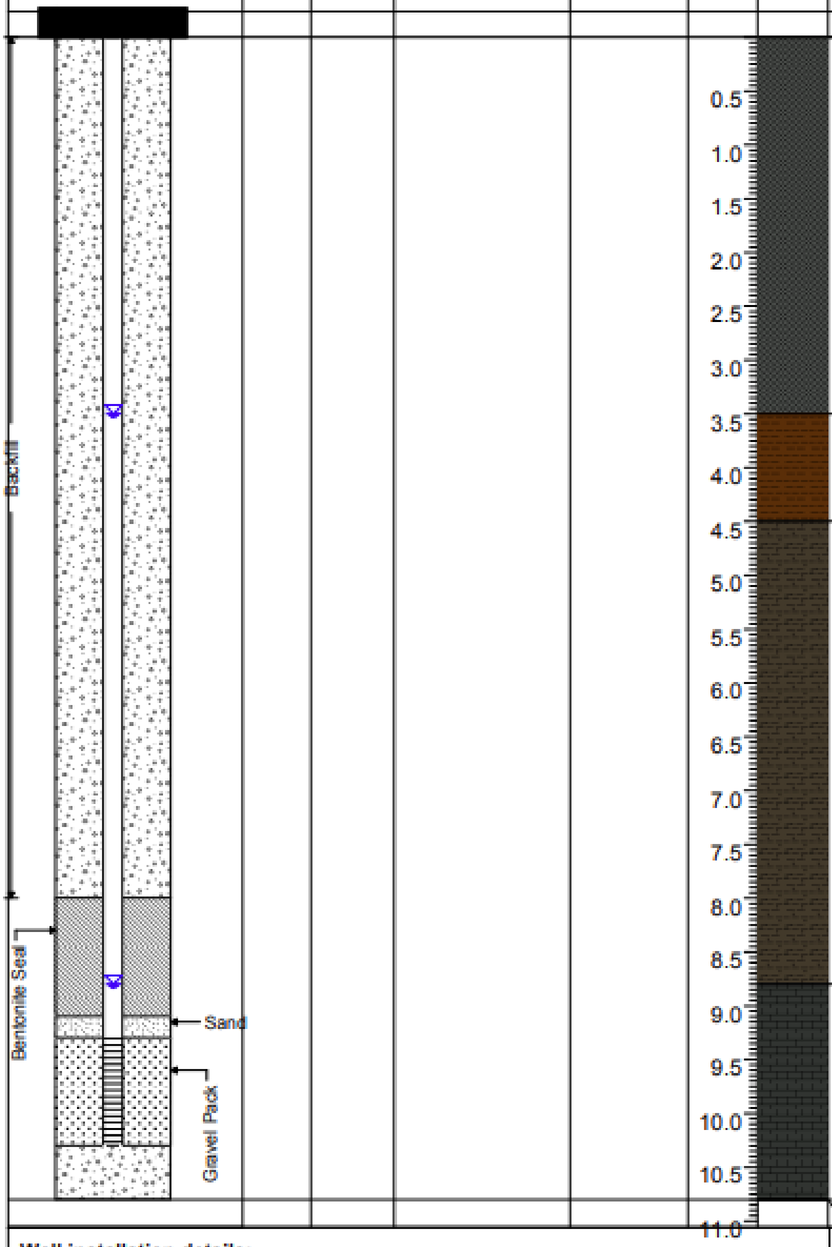
Well installation details:
Pea gravel around screened section (9.3-10.3mBGL). Bentonite seal above (7.5-8.6mBGL). Sand (8.6-8.9m). Native fill above. Well finished with flush cover.

PEC: Physical Evidence of Contamination

Groundwater remarks:
Small groundwater strike at 8.5mBGL.
Large groundwater strike at 10.2mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group			**Borehole Log No.: MW102**
Site: Pa Healy Road	**Logged By:** DH	**Contractor:** Southern Pumps	**Sheet:** 1 of 1
Client: PHM Consulting	**Drilling method:** Rotary	**Date:** 10/01/2019	**Verde Job Ref:** 52107

GROUNDWATER	SAMPLES AND INSITU TESTING					STRATA RECORD	
Well	Depth/ Type (m)	PID (ppm)	Observations	Sample ID	Depth (m)	Key	Description



Description
Ground surface
MADE GROUND comprising angular limetone fill - gravels and cobbles with red brick and concrete fragments present.
Dark brown, wet, soft spongy peaty CLAY
Brown/grey, wet silty CLAY with occasional gravels presents.
Weathered limestone BEDROCK.
End of Borehole, Target Depth

Well installation details:
Gravel pack around screened section (9.3-10.3mBGL). Sand seal above (9.1-9.3mBGL). Bentonite seal above (8.0-9.1mBGL). Native fill above. Well finished with upright cover.

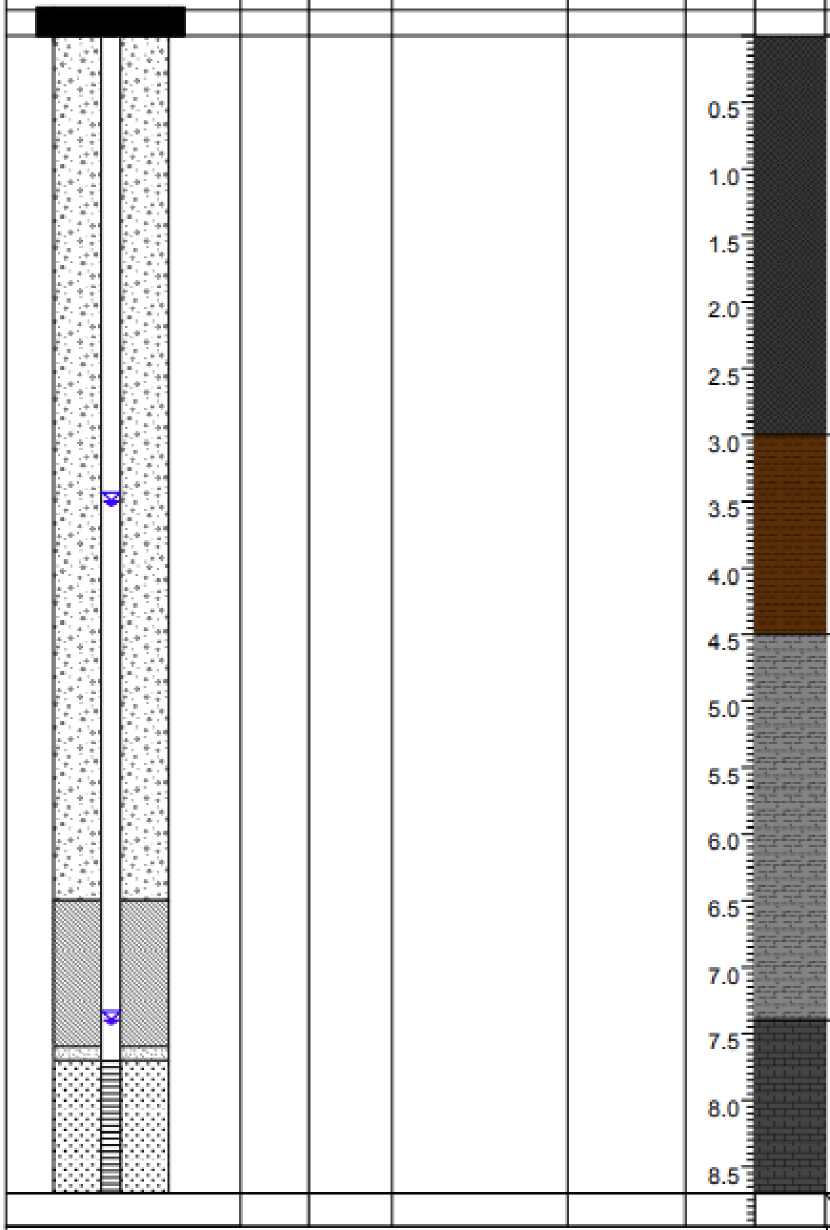
Groundwater remarks:
Small groundwater strike at 3.5mBGL.
Large groundwater strike at 8.8mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Borehole Log No.: MW103

Site: Pa Healy Road	**Logged By:** DH	**Contractor:** Southern Pumps	**Sheet:** 1 of 1
Client: PHM Consulting	**Drilling method:** Rotary	**Date:** 10/01/2019	**Verde Job Ref:** 52107

GROUNDWATER	SAMPLES AND INSITU TESTING					STRATA RECORD	
Well	Depth/ Type (m)	PID (ppm)	Observations	Sample ID	Depth (m)	Key	Description
							Ground surface
							MADE GROUND comprising black limestone chippings, gravelly silt fill.
							Dark brown, moist, soft, spongy, peaty CLAY with some plkant roots. Becoming wet at 3.5mBGL.
							Light grey, wet, silty CLAY with some gravels present.
							Weathered limestone BEDROCK.
							End of Borehole, Target Depth



Well installation details:
Gravel pack around screened section (7.7-8.7mBGL). Sand above (7.6-7.7mBGL). Bentonite seal above (6.5-7.6mBGL). Native fill above. Well finished with upright cover.

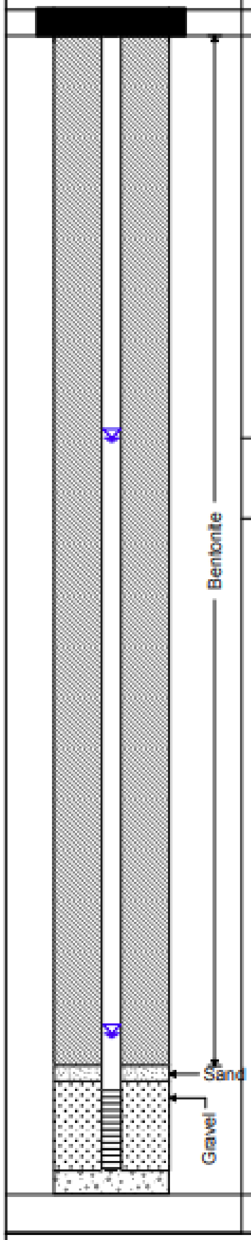
PEC: Physical Evidence of Contamination

Groundwater remarks:
Small perched groundwater strike at 3.5mBGL.
Moderate groundwater strike at 7.4mBGL.

Verde Environmental Consultants Ltd | part of the Verde Environmental Group

Borehole Log No.: MW104

Site: Pa Healy Road	**Logged By:** DH	**Contractor:** Southern Pumps	**Sheet:** 1 of 1
Client: PHM Consulting	**Drilling method:** Rotary	**Date:** 11/01/2019	**Verde Job Ref:** 52107

GROUNDWATER	**SAMPLES AND INSITU TESTING**					**STRATA RECORD**	
Well	Depth/ Type (m)	PID (ppm)	Observations	Sample ID	Depth (m)	Key	Description
							Ground surface
					0.5 1.0 1.5 2.0	▨	MADE GROUND comprising black limestone gravels and cobbles with red brick fragments grading into darkbrown silty clay becoming wet at 2.5mBGL.
			Hydrocarbon Odour		2.5 3.0		
					3.5		
					4.0 4.5 5.0	▨	Dark brown soft, peaty CLAY with some plant roots.
					5.5 6.0	▨	Grey silty CLAY
					6.5 7.0	▨	Weathered limestone BEDROCK with sand.
							End of Borehole, Target Depth

Well installation details:
Gravel pack around screened section (6.5-7.05mBGL). Sand above (6.4-6.5mBGL).
Bentonite seal above (0-6.4mBGL). Well finished with upright cover.

PEC: Physical Evidence of Contamination

Groundwater remarks:
Small perched groundwater strike at 2.5mBGL.
Moderate groundwater strike at 6.2mBGL.

APPENDIX 6.4 Groundwater Quality Test Results (Verde)

Table 6: Pa Healy Road - Groundwater Analytical Results - Metals, PAH, MTBE&BTEX, TPH, Phenols, Anions & Other Parameters

Sample Identity:			TP-107	MW-101	MW-102	MW-103	MW-104	Groundwater		Drinking Water Regs	EQS (MAC)	SoBRA Human Health GACs - Commercial	SoBRA Human Health GACs - Residential
Date:		LOD	10/1/19	21/1/19	21/1/19	21/1/19	21/1/19	GW 2016	EPA IGV				
	Units												
Dissolved Arsenic	ug/l	<0.9	-	<0.9	<0.9	<0.9	***17.3***	7.5	10	10	-	-	-
Dissolved Barium	ug/l	<1.8	-	*104.0*	*172.1*	*142.8*	*1215.0*	-	100	-	-	-	-
Dissolved Beryllium	ug/l	<0.5	-	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-
Dissolved Boron	ug/l	<12	-	56	38	45	55	750	1000	1000	-	-	-
Dissolved Cadmium	ug/l	<0.03	-	<0.03	<0.03	<0.03	<0.03	3.75	5	5	<0.45	-	-
Total Dissolved Chromium	ug/l	<0.2	-	0.3	<0.2	0.4	1.0	37.5	30	50	-	-	-
Dissolved Copper	ug/l	<3	-	<3	<3	<3	<3	1500	30	2000	-	-	-
Dissolved Lead	ug/l	<0.4	-	<0.4	<0.4	<0.4	<0.4	7.5	-	10	14	-	-
Dissolved Mercury	ug/l	<0.5	-	<0.5	<0.5	<0.5	<0.5	0.75	1	1	0.07	-	-
Dissolved Nickel	ug/l	<0.2	-	2.7	1.9	2.8	2.7	15	20	20	34	-	-
Dissolved Selenium	ug/l	<1.2	-	<1.2	<1.2	<1.2	<1.2	-	-	10	-	-	-
Dissolved Vanadium	ug/l	<0.6	-	<0.6	0.9	1.4	1.9	-	-	-	-	-	-
Dissolved Zinc	ug/l	<1.5	-	14.2	6.5	11.3	7.7	75	100	-	-	-	-
PAH MS												-	-
Naphthalene	ug/l	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	1	-	130	210000	220
Acenaphthylene	ug/l	<0.013	-	<0.013	<0.013	<0.013	<0.013	-	-	-	-	20000000	220000
Acenaphthene	ug/l	<0.013	-	<0.013	<0.013	<0.013	<0.013	-	-	-	-	15000000	170000
Fluorene	ug/l	<0.014	-	<0.014	<0.014	<0.014	<0.014	-	-	-	0.12	18000000	210000
Phenanthrene	ug/l	<0.011	-	<0.011	<0.011	<0.011	<0.011	-	-	-	-	-	-
Anthracene	ug/l	<0.013	-	<0.013	<0.013	<0.013	<0.013	-	10000	-	0.4	-	-
Fluoranthene	ug/l	<0.012	-	<0.012	<0.012	<0.012	<0.012	-	1	-	1	-	-
Pyrene	ug/l	<0.013	-	<0.013	<0.013	<0.013	<0.013	-	-	-	-	-	-
Benzo(a)anthracene	ug/l	<0.015	-	<0.015	<0.015	<0.015	<0.015	-	-	-	-	-	-
Chrysene	ug/l	<0.011	-	<0.011	<0.011	<0.011	<0.011	-	-	-	-	-	-
Benzo(bk)fluoranthene	ug/l	<0.018	-	<0.018	<0.018	<0.018	<0.018	-	0.5	0.1	-	-	-
Benzo(a)pyrene	ug/l	<0.016	-	<0.016	<0.016	<0.016	<0.016	0.0075	0.01	0.01	0.1	-	-
Indeno(123cd)pyrene	ug/l	<0.011	-	<0.011	<0.011	<0.011	<0.011	-	0.05	0.1	-	-	-
Dibenzo(ah)anthracene	ug/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	0.05	-	-	-	-
Benzo(ghi)perylene	ug/l	<0.011	-	<0.011	<0.011	<0.011	<0.011	-	0.05	0.1	0.0082	-	-
PAH 16 Total	ug/l	<0.195	-	<0.195	<0.195	<0.195	<0.195	0.075	0.1	-	-	-	-
Benzo(b)fluoranthene	ug/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	0.5	-	0.017	-	-
Benzo(k)fluoranthene	ug/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	0.05	-	0.017	-	-
												-	-
Methyl Tertiary Butyl Ether	ug/l	<0.1	<5	<0.1	<0.1	<0.1	<0.1	10	30	-	-		
Benzene	ug/l	<0.5	<5	<0.5	<0.5	<0.5	<0.5	0.75	1	1	50	20000	210
Toluene	ug/l	<5	<5	<5	<5	<5	<5	525	10	-	-	21000000	230000
Ethylbenzene	ug/l	<1	<5	<1	<1	<1	<1	-	10	-	-	960000	10000
p/m-Xylene	ug/l	<2	<5	<2	<2	<2	<2	-	10	-	-	940000	9500
o-Xylene	ug/l	<1	<5	<1	<1	<1	<1	-	10	-	-	-	-
Aliphatics													
>C5-C6	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	190000	1900
>C6-C8	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	150000	1500
>C8-C10	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	5700	57
>C10-C12	ug/l	<5	<5	<5	<5	<5	<5	-	10	-	-	3600	37
>C12-C16	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
>C16-C21	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
>C21-C35	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
Total aliphatics C5-35	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
Aromatics													
>C5-EC7	ug/l	<10	<10	<10	<10	<10	<10	-	0.75**	-	-	20000000	210000
>EC7-EC8	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	21000000	220000
>EC8-EC10	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	190000	1900
>EC10-EC12	ug/l	<5	<5	<5	<5	<5	<5	-	10	-	-	6800	6800
>EC12-EC16	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	39000	39000
>EC16-EC21	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
>EC21-EC35	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
Total aromatics C5-35	ug/l	<10	<10	<10	<10	<10	<10	-	10	-	-	-	-
Total aliphatics and aromatics(C5-35)	ug/l	<10	<10	<10	<10	<10	<10	7.5	10	-	-	-	-

Sulphate as SO4	mg/l	<0.5	-	59.8	34.7	40.9	3.7	187.5	200	250	-	-	-
Chloride	mg/l	<0.3	-	19.5	*30.6*	*36.4*	*47.0*	187.5	30	250	-	-	-
Nitrate as NO3	mg/l	<0.2	-	6.3	0.7	2.7	<0.2	37.5	25	50	-	-	-
Nitrite as NO2	mg/l	<0.02	-	0.05	<0.02	0.07	<0.02	0.375	0.1	0.5	-	-	-
Ortho Phosphate as P	mg/l	<0.06	-	<0.03	<0.03	<0.03	<0.03	-	0.03	-	-	-	-
Free Cyanide	mg/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-
Total Cyanide	mg/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	-	0.05	-	-	-
												-	-
Ammoniacal Nitrogen as NH3	mg/l	<0.03	-	0.23	0.15	0.12	0.25	-	150	-	-	-	-
Hexavalent Chromium	ug/l	<2	-	<2	<2	<2	<2	7.5	30	50	-	-	-
Total Dissolved Chromium III	ug/l	<2	-	<2	<2	<2	<2	-	30	50	32		
Sulphide	mg/l	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-
												-	-
Total Alkalinity as CaCO3	mg/l	<1	-	498	1110	678	532	-	-	-	-	-	-
Total Organic Carbon	mg/l	<2	-	7	6	7	7	-	No abnormal change	-	-	-	-
COD (settled)	mg/l	<7	-	8	<7	10	18	-	-	-	-	-	-
pH	pH Units	<0.1	-	7.48	7.33	7.23	7.48	-	6.5-9.5	6.5-9.5	4.5<pH<9	-	-
EC	µS/cm	<1	-	808	887	906	819	1875	1000	2500	-	-	-

Notes

EPA Interim Guideline Values (IGVs) for the protection of groundwater, 2003. The EPA interim guideline value for TPH is considered to "serve as a ‘catch-all’ and will present results for the GW 2016 Refers to threshold value for benzene quoted in the European Communities Environmental Objectives (Groundwater) Regulations 2016 (SI No 366 of 2016)

EQS (MAC) - Environmental Quality Standards refer to maximum allowable concentration for inland surface waters - obtained from S.I. No.386 of 2015

Bold Fomatting = exceeds GW 2016 standard

Italic Formatting = exceeds EPA IGV standards

Underlined Formatting = exceeds Drinking Water standards

Shaded Formatting = exceeds EQS standard

Table 7: Pa Healy Road - Groundwater Analytical Results -VOC

Sample Identity:			MW-101	MW-102	MW-103	MW-104	Groundwater		Drinking Water Regs	EQS	SoBRA Human Health GACs -	SoBRA Human Health GACs -
Date:			21/1/19	21/1/19	21/1/19	21/1/19						
	Units											
Dichlorodifluoromethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Methyl Tertiary Butyl Ether	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	30	10	-	-	-	-
Chloromethane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Vinyl Chloride	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	-	0.375	0.5	-	-	-
Bromomethane	ug/l	<1	<1	<1	<1	<1	-	-	-	-	-	-
Chloroethane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Trichlorofluoromethane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,1-Dichloroethene (1,1 DCE)	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Dichloromethane (DCM)	ug/l	<5	<5	<5	<5	<5	10	15	-	-	-	-
trans-1-2-Dichloroethene	ug/l	<3	<3	<3	<3	<3	3	-	-	-	-	-
1,1-Dichloroethane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
cis-1-2-Dichloroethene	ug/l	<3	<3	<3	<3	<3	3	-	-	-	-	-
2,2-Dichloropropane	ug/l	<1	<1	<1	<1	<1	-	-	-	-	-	-
Bromochloromethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Chloroform	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,1,1-Trichloroethane	ug/l	<2	<2	<2	<2	<2	500	-	-	-	-	-
1,1-Dichloropropene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Carbon tetrachloride	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,2-Dichloroethane	ug/l	<2	<2	<2	<2	<2	3	2.25	3	-	-	-
Benzene	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	1	0.75	1	50	20000	210
Trichloroethene (TCE)	ug/l	<3	<3	<3	<3	<3	70	7.5	10	-	-	-
1,2-Dichloropropane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Dibromomethane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Bromodichloromethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
cis-1-3-Dichloropropene	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Toluene	ug/l	<5	<5	<5	<5	<5	10	525	-	-	21000000	230000
trans-1-3-Dichloropropene	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,1,2-Trichloroethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Tetrachloroethene (PCE)	ug/l	<3	<3	<3	<3	<3	40	7.5	10	-	-	-
1,3-Dichloropropane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Dibromochloromethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,2-Dibromoethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Chlorobenzene	ug/l	<2	<2	<2	<2	<2	1	-	-	-	-	-
1,1,1,2-Tetrachloroethane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
Ethylbenzene	ug/l	<1	<1	<1	<1	<1	10	-	-	-	-	-
p/m-Xylene	ug/l	<2	<2	<2	<2	<2	10	-	-	-	940000	9500
o-Xylene	ug/l	<1	<1	<1	<1	<1	10	-	-	-	-	-
Styrene	ug/l	<2	<2	<2	<2	<2	-	-	-	-	810000	8800
Bromoform	ug/l	<2	<2	<2	<2	<2	-	-	-	-		
Isopropylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	86000	850
1,1,2,2-Tetrachloroethane	ug/l	<4	<4	<4	<4	<4	-	-	-	-	-	-
Bromobenzene	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,2,3-Trichloropropane	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Propylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
2-Chlorotoluene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,3,5-Trimethylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
4-Chlorotoluene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
tert-Butylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,2,4-Trimethylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	2200	24
sec-Butylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
4-Isopropyltoluene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,3-Dichlorobenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,4-Dichlorobenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
n-Butylbenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
1,2-Dichlorobenzene	ug/l	<3	<3	<3	<3	<3	10	-	-	-	-	-
1,2-Dibromo-3-chloropropane	ug/l	<2	<2	<2	<2	<2	-	-	-	-	-	-
1,2,4-Trichlorobenzene	ug/l	<3	<3	<3	<3	<3	0.4	-	-	-	-	-
Hexachlorobutadiene	ug/l	<3	<3	<3	<3	<3	0.1	-	-	0.6	-	-
1,2,3-Trichlorobenzene	ug/l	<3	<3	<3	<3	<3	-	-	-	-	-	-
Surrogate Recovery Toluene D8	%	<0	104	95	107	101	-	-	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	107	103	104	101	-	-	-	-	-	-

Notes

EPA Interim Guideline Values (IGVs) for the protection of groundwater, 2003.

GW 2016 Refers to European Communities Environmental Objectives (Groundwater) Regulations 2016 (SI No 366 of 2016)

EQS (MAC) - Environmental Quality Standards refer to maximum allowable concentration for inland surface waters - obtained from S.I. No.386 of 2015

Bold Fomatting = exceeds GW 2016 standard

Italic Formatting = exceeds EPA IGV standards

Underlined Formatting = exceeds Drinking Water standards

haded Frormating = exceeds EQS standard

Table 8: Pa Healy Road - Groundwater Analytical Results -SVOC

Sample Identity:		LOD	MW-101	MW-102	MW-103	MW-104	Groundwater		Drinking Water Regs	EQS
Date:			21/1/19	21/1/19	21/1/19	21/1/19		EPA IGV		
	Units									
Phenols										
2-Chlorophenol	ug/l	<1	<1	<1	<1	<1	-	200	200	-
2-Methylphenol	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	500	-	-
2-Nitrophenol	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
2,4-Dichlorophenol	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
2,4-Dimethylphenol	ug/l	<1	<1	<1	<1	<1	-	-	-	-
2,4,5-Trichlorophenol	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
2,4,6-Trichlorophenol	ug/l	<1	<1	<1	<1	<1	-	200	200	-
4-Chloro-3-methylphenol	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	500	-	-
4-Methylphenol	ug/l	<1	<1	<1	<1	<1	-	500	-	-
4-Nitrophenol	ug/l	<10	<10	<10	<10	<10	-	-	-	-
Pentachlorophenol	ug/l	<1	<1	<1	<1	<1	-	2	9	1
Phenol	ug/l	<1	<1	<1	<1	<1	-	500	500	-
PAHs										
2-Chloronaphthalene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
2-Methylnaphthalene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Phthalates										
Bis(2-ethylhexyl) phthalate	ug/l	<5	<5	<5	<5	<5	6	-	-	-
Butylbenzyl phthalate	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Di-n-butyl phthalate	ug/l	<1.5	<1.5	<1.5	<1.5	<1.5	-	2	6	-
Di-n-Octyl phthalate	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Diethyl phthalate	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Dimethyl phthalate	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Other SVOCs										
1,2-Dichlorobenzene	ug/l	<1	<1	<1	<1	<1	-	10	1000	-
1,2,4-Trichlorobenzene	ug/l	<1	<1	<1	<1	<1	-	0.4	20	-
1,3-Dichlorobenzene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
1,4-Dichlorobenzene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
2-Nitroaniline	ug/l	<1	<1	<1	<1	<1	-	-	-	-
2,4-Dinitrotoluene	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
2,6-Dinitrotoluene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
3-Nitroaniline	ug/l	<1	<1	<1	<1	<1	-	-	-	-
4-Bromophenylphenylether	ug/l	<1	<1	<1	<1	<1	-	-	-	-
4-Chloroaniline	ug/l	<1	<1	<1	<1	<1	-	-	-	-
4-Chlorophenylphenylether	ug/l	<1	<1	<1	<1	<1	-	-	-	-
4-Nitroaniline	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Azobenzene	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Bis(2-chloroethoxy)methane	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Bis(2-chloroethyl)ether	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Carbazole	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Dibenzofuran	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Hexachlorobenzene	ug/l	<1	<1	<1	<1	<1	-	-	-	0.05
Hexachlorobutadiene	ug/l	<1	<1	<1	<1	<1	-	-	-	0.6
Hexachlorocyclopentadiene	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Hexachloroethane	ug/l	<1	<1	<1	<1	<1	-	-	-	-
Isophorone	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
N-nitrosodi-n-propylamine	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-
Nitrobenzene	ug/l	<1	<1	<1	<1	<1	-	-	-	-

Notes

EPA Interim Guideline Values (IGVs) for the protection of groundwater, 2003.

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EQS (MAC) - Environmental Quality Standards refer to maximum allowable concentration for inland surface waters - obtained from S.I. No.386 of 2015

Bold Fomatting = exceeds GW 2016 standard

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Underlined Formatting = exceeds Drinking Water standards

haded Frormating = exceeds EQS standard

APPENDIX 6.5 Rating of Existing Environment Significance / Sensitivity

Rating of Existing Environment Significance / Sensitivity (IGI, 2013 Guidelines)

Importance	Criteria	Typical Example
High	Attribute has a high quality or value on an international scale	Groundwater/ Surface Water supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2,500 homes Inner source protection area for regionally important water source. Drinking water supply from river. Amenity use of waterbody
	Attribute has a high quality or value on a local scale	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source.

		Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source. No specific recreational use of waterbody
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes. No water supply from surface water, no abstraction designation for watercourse No amenity value of waterbody
Negligible	Attribute has negligible quality or value on a local site scale	No groundwater supply from a bedrock aquifer inn vicinity of site. Surface water not used for any specific purpose.

APPENDIX 6.6 Descriptions of Effects (EPA, 2017)

Descriptions of Effects (EPA, May 2017 - Draft)

Impact Characteristic	Term	Description
Quality of Effects	Positive Effects	A change which improves the quality of the environment
	Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative / Adverse Effects	A change which reduces the quality of the environment
Describing the Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects	An effect which obliterates sensitive characteristics
Describing the Extent and	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect

Impact Characteristic	Term	Description
Context of Effects	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of Effects	Likely Effects	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Unlikely Effects	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Duration and Frequency of Effects	Momentary Effects	Effects lasting from seconds to minutes
	Brief Effects	Effects lasting less than a day
	Temporary Effects	Effects lasting less than a year
	Short-term Effects	Effects lasting one to seven years
	Medium-term Effects	Effects lasting seven to fifteen years
	Long-term Effects	Effects lasting fifteen to sixty years
	Permanent Effects	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration

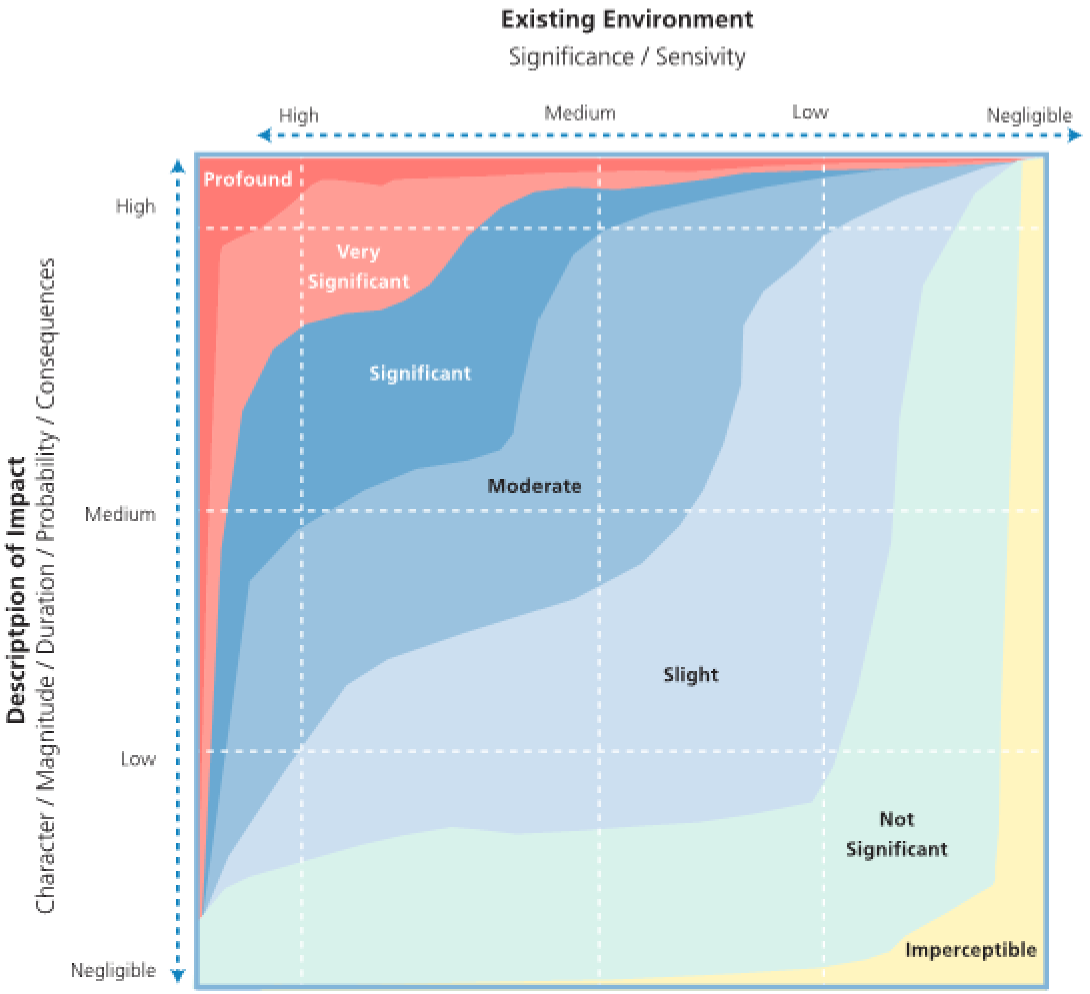
Impact Characteristic	Term	Description
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually.
Describing the Types of Effects	Indirect / Secondary Effects	Likely, significant effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	Do-Nothing Effects	The environment as it would be in the future should the subject project not be carried out.
	Worst Case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
	Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of SOx and NOx to produce smog).

APPENDIX 6.7 Classification of the Significance of Impacts

Classification of the Significance of Impacts (EPA, May 2017 – Draft)

Determining Significance

The diagram below shows how comparison of the character of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact.



APPENDIX 11.1 – Traffic Counts

Manual Classified (Video) Count Wednesday 10th April 2019 Existing R463 Corbally Roundabout (4-arm)
Arm A = Pa Healy Road
Arm B = Access
Arm C = R463 O'Dwyer's Bridge
Arm D = R463 Corbally Road

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0
07:15 – 07:29	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
07:30 – 07:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
07:45 – 07:59	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0
08:00 – 08:14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
08:15 – 08:29	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
08:30 – 08:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
08:45 – 08:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 – 09:14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
09:15 – 09:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
09:30 – 09:44	0	0	1	0	0	0	0	0	0	0	0	1	0	0	3	0
09:45 – 09:59	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0
10:00 – 10:14	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
10:15 – 10:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
10:45 – 10:59	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	0
11:00 – 11:14	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
11:15 – 11:29	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
11:30 – 11:44	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
11:45 – 11:59	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
12:00 – 12:14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30 – 12:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
13:00 – 13:14	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0
13:15 – 13:29	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
13:30 – 13:44	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2	0
13:45 – 13:59	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0
14:00 – 14:14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	0
14:30 – 14:44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0
14:45 – 14:59	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15:00 – 15:14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15:15 – 15:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
15:30 – 15:44	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0
15:45 – 15:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00 – 16:14	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1	0
16:15 – 16:29	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16:30 – 16:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45 – 16:59	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
17:00 – 17:14	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
17:15 – 17:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30 – 17:44	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0
17:45 – 17:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00 – 18:14	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
18:15 – 18:29	0	0	0	0	0	0	0	0	2	0	0	1	2	0	3	0
18:30 – 18:44	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0
18:45 – 18:59	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0

Motorcycle	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 – 07:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 – 07:44	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
07:45 – 07:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 – 08:14	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
08:15 – 08:29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
08:30 – 08:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 – 08:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 – 09:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:15 – 09:29	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
09:30 – 09:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15 – 10:29	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
11:15 – 11:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 – 11:44	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
11:45 – 11:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
12:30 – 12:44	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
12:45 – 12:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15 – 13:29	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
13:30 – 13:44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
14:30 – 14:44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14:45 – 14:59	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
15:00 – 15:14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
15:15 – 15:29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15:30 – 15:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
15:45 – 15:59	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
16:15 – 16:29	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
16:30 – 16:44	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
16:45 – 16:59	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
17:00 – 17:14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
17:15 – 17:29	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
17:30 – 17:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
17:45 – 17:59	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18:00 – 18:14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
18:15 – 18:29	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
18:30 – 18:44	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18:45 – 18:59	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Car / LGV	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	2	0	24	14	1	0	0	0	7	1	0	14	54	0	76	1
07:15 – 07:29	2	2	26	18	4	0	1	0	9	1	0	21	72	1	110	1
07:30 – 07:44	2	2	34	35	0	0	1	0	21	0	0	1	45	1	119	2
07:45 – 07:59	2	1	39	39	1	0	1	1	32	0	0	45	72	0	105	1
08:00 – 08:14	0	1	41	39	1	0	1	1	32	1	1	61	42	1	111	1
08:15 – 08:29	1	1	37	47	0	0	3	0	50	1	1	76	16	0	65	0
08:30 – 08:44	0	0	47	57	0	0	0	1	33	0	0	55	22	0	92	0
08:45 – 08:59	0	2	40	56	0	0	3	0	32	1	0	58	51	1	98	1
09:00 – 09:14	0	0	37	49	0	0	1	0	30	0	0	35	81	0	93	0
09:15 – 09:29	0	3	25	47	0	0	1	0	23	1	0	41	85	0	101	2
09:30 – 09:44	0	0	32	48	1	0	2	0	26	0	1	52	80	0	108	1
09:45 – 09:59	0	0	33	35	0	0	0	1	28	1	0	35	62	1	98	2
10:00 – 10:14	0	0	38	47	0	0	2	0	28	0	0	53	61	0	86	0
10:15 – 10:29	0	0	33	34	0	0	0	0	37	0	1	43	64	1	73	1
10:30 – 10:44	1	0	34	51	0	0	0	0	33	0	1	47	59	1	82	0
10:45 – 10:59	0	0	37	35	1	0	0	0	25	0	0	59	56	0	74	0
11:00 – 11:14	0	1	36	46	0	0	0	0	37	0	0	35	49	0	82	0
11:15 – 11:29	0	0	38	57	0	0	0	0	34	0	0	65	34	0	68	0
11:30 – 11:44	0	1	24	63	0	0	1	0	33	0	1	59	51	2	78	0
11:45 – 11:59	1	1	21	48	0	0	0	0	38	0	1	62	57	0	74	0
12:00 – 12:14	1	0	25	60	0	0	0	1	46	0	1	69	70	0	55	1
12:15 – 12:29	1	1	31	63	1	0	0	0	32	1	1	75	57	2	64	2
12:30 – 12:44	0	1	34	54	0	0	0	0	32	1	1	71	56	0	74	0
12:45 – 12:59	2	1	27	64	0	0	0	0	34	1	0	75	56	0	85	0
13:00 – 13:14	1	0	33	81	0	0	0	0	43	0	1	68	49	0	69	0
13:15 – 13:29	0	0	32	97	0	0	0	0	41	0	0	77	44	0	62	1
13:30 – 13:44	0	0	40	81	0	0	0	0	28	0	1	79	59	0	68	0
13:45 – 13:59	0	0	35	68	0	0	0	0	26	2	0	72	54	2	91	0
14:00 – 14:14	1	0	20	64	1	0	0	0	33	0	0	59	58	0	82	0
14:15 – 14:29	1	0	39	73	1	0	1	1	31	2	1	68	70	0	75	0
14:30 – 14:44	0	0	40	89	0	0	0	0	33	2	0	71	49	1	68	1
14:45 – 14:59	1	1	37	72	0	0	0	0	50	1	1	65	61	1	83	0
15:00 – 15:14	1	2	42	76	0	0	2	1	33	1	1	70	58	1	70	0
15:15 – 15:29	0	0	28	63	0	0	1	0	38	3	0	3	60	1	77	1
15:30 – 15:44	1	0	39	73	0	0	0	0	32	0	2	85	55	1	70	1
15:45 – 15:59	0	0	23	85	0	0	0	0	31	1	0	94	65	0	55	1
16:00 – 16:14	2	0	41	89	0	0	0	1	40	0	0	98	57	1	68	3
16:15 – 16:29	0	2	36	116	0	0	1	0	40	1	0	89	43	0	52	1
16:30 – 16:44	0	1	38	104	0	0	1	0	47	0	0	76	55	2	57	3
16:45 – 16:59	0	0	27	98	0	0	0	0	37	1	0	80	56	0	59	1
17:00 – 17:14	1	0	29	105	1	0	0	1	34	1	1	58	47	0	59	2
17:15 – 17:29	0	1	20	95	0	0	1	0	50	1	0	84	73	0	60	0
17:30 – 17:44	0	1	30	114	1	0	2	2	34	2	0	82	59	1	64	0
17:45 – 17:59	0	0	38	118	0	0	3	0	29	1	0	79	50	0	51	1
18:00 – 18:14	0	0	32	107	0	0	0	0	50	1	0	91	51	0	63	1
18:15 – 18:29	1	1	33	105	0	0	2	2	42	0	0	107	65	1	66	3
18:30 – 18:44	0	2	44	89	0	0	1	0	42	0	1	82	58	1	49	4
18:45 – 18:59	1	0	27	87	0	0	1	1	24	0	0	79	61	0	75	1

HGV/PSV	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	0	1	0	1	0	0	0	1	0	0	0	4	3	0	2	0
07:15 – 07:29	0	1	1	0	0	0	0	0	0	0	0	55	0	0	2	0
07:30 – 07:44	0	0	1	2	0	0	1	0	1	0	0	1	2	0	3	0
07:45 – 07:59	0	1	2	3	0	0	0	1	1	0	0	0	2	0	4	0
08:00 – 08:14	0	0	2	1	0	0	1	1	0	0	0	2	1	1	3	0
08:15 – 08:29	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0
08:30 – 08:44	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0
08:45 – 08:59	0	0	1	3	0	0	0	0	3	0	0	1	0	1	0	0
09:00 – 09:14	0	0	0	1	0	0	0	0	0	0	0	6	3	0	2	0
09:15 – 09:29	0	0	2	2	0	0	0	0	2	0	0	1	2	1	1	0
09:30 – 09:44	0	1	3	1	0	0	1	0	0	1	5	0	4	1	1	0
09:45 – 09:59	1	0	0	2	1	0	0	0	1	0	0	1	5	0	6	0
10:00 – 10:14	0	0	3	4	0	0	0	0	1	0	0	3	3	0	3	0
10:15 – 10:29	0	0	3	1	0	0	0	0	0	0	0	8	1	0	3	0
10:30 – 10:44	0	0	1	3	1	0	1	0	2	0	0	1	1	1	1	0
10:45 – 10:59	0	0	1	2	1	0	1	1	1	0	0	6	3	0	7	0
11:00 – 11:14	0	1	1	2	0	0	0	0	0	0	0	0	2	0	2	0
11:15 – 11:29	0	0	0	2	0	0	1	0	1	0	0	4	2	0	2	0
11:30 – 11:44	0	0	0	2	0	0	0	0	0	1	0	3	1	0	4	0
11:45 – 11:59	0	0	1	3	0	0	1	0	0	0	0	4	1	0	2	0
12:00 – 12:14	0	1	2	0	0	0	0	0	3	0	0	3	4	0	1	0
12:15 – 12:29	0	0	0	2	2	0	0	1	1	0	0	3	1	0	3	0
12:30 – 12:44	0	0	0	2	0	0	0	0	0	0	0	2	0	0	2	0
12:45 – 12:59	0	0	0	1	0	0	0	0	2	0	0	2	3	0	4	0
13:00 – 13:14	0	1	0	4	0	0	0	0	0	0	0	4	2	0	0	0
13:15 – 13:29	0	0	1	0	0	0	0	0	0	0	0	4	2	0	1	0
13:30 – 13:44	0	0	0	2	0	0	0	0	0	0	0	1	0	0	2	1
13:45 – 13:59	0	0	0	1	0	0	0	0	0	0	0	2	0	0	1	0
14:00 – 14:14	0	0	2	4	0	0	0	0	2	0	0	2	2	0	4	0
14:15 – 14:29	1	0	1	2	0	0	0	0	1	0	0	2	1	0	3	0
14:30 – 14:44	0	0	0	1	0	0	0	0	1	0	0	5	2	0	1	0
14:45 – 14:59	0	0	1	4	0	0	0	0	1	0	0	2	0	0	2	0
15:00 – 15:14	0	0	0	1	0	0	0	0	0	0	0	1	4	0	3	0
15:15 – 15:29	0	0	1	0	0	0	0	0	1	0	0	0	2	0	2	0
15:30 – 15:44	0	0	1	0	0	0	0	0	0	0	0	4	0	0	1	0
15:45 – 15:59	0	0	0	1	0	0	0	0	0	0	0	3	1	0	2	0
16:00 – 16:14	0	0	0	2	0	0	0	0	1	0	0	3	1	0	2	0
16:15 – 16:29	0	0	0	2	0	0	0	0	0	0	0	5	0	0	5	0
16:30 – 16:44	0	0	0	2	0	0	0	0	0	0	0	2	3	1	1	0
16:45 – 16:59	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	0
17:00 – 17:14	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
17:15 – 17:29	0	0	0	2	0	0	1	0	0	0	0	0	0	0	1	0
17:30 – 17:44	0	0	0	2	0	0	0	0	0	0	0	1	1	0	0	0
17:45 – 17:59	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
18:00 – 18:14	0	0	0	2	0	0	0	0	1	0	0	1	1	0	2	0
18:15 – 18:29	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
18:30 – 18:44	1	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0
18:45 – 18:59	0	0	1	0	0	0	0	0	0	0	0	3	0	0	1	0

Total Vehicles	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	2	1	24	15	1	0	0	1	7	1	0	18	58	0	80	1
07:15 – 07:29	2	3	27	19	4	0	1	0	9	1	0	76	72	1	113	1
07:30 – 07:44	2	2	35	37	0	0	2	0	22	0	0	2	48	1	125	2
07:45 – 07:59	2	2	41	42	1	0	1	2	35	0	0	45	74	0	112	1
08:00 – 08:14	0	1	44	40	1	0	2	2	33	1	1	63	44	2	114	1
08:15 – 08:29	1	1	38	47	0	0	3	0	51	1	1	78	20	0	66	0
08:30 – 08:44	0	0	47	57	0	0	0	1	33	0	0	58	22	0	95	0
08:45 – 08:59	0	2	41	59	0	0	3	0	35	1	0	59	51	2	98	1
09:00 – 09:14	0	0	37	50	0	0	1	0	31	0	0	41	84	0	96	0
09:15 – 09:29	0	3	27	49	0	0	1	0	25	1	0	42	88	1	103	2
09:30 – 09:44	0	1	36	49	1	0	3	0	26	1	6	53	84	1	112	1
09:45 – 09:59	1	0	33	37	1	0	0	1	29	1	0	37	68	1	105	2
10:00 – 10:14	0	0	41	51	0	0	2	0	29	0	0	56	65	1	90	0
10:15 – 10:29	0	0	36	36	0	0	0	0	37	0	1	51	65	1	76	1
10:30 – 10:44	1	0	35	54	1	0	1	0	36	0	1	48	60	2	83	0
10:45 – 10:59	0	0	39	37	2	0	1	2	26	0	0	66	59	0	82	0
11:00 – 11:14	0	2	37	49	0	0	0	0	37	0	0	35	52	0	85	0
11:15 – 11:29	0	0	38	59	0	0	1	0	35	0	0	70	36	0	71	0
11:30 – 11:44	0	1	25	65	0	0	1	0	33	1	1	64	54	2	82	0
11:45 – 11:59	1	1	23	51	0	0	1	0	38	0	1	66	58	0	77	0
12:00 – 12:14	1	1	27	61	0	0	0	1	49	0	1	72	74	0	56	1
12:15 – 12:29	1	1	31	65	3	0	0	1	33	1	1	79	58	2	68	2
12:30 – 12:44	0	1	34	56	0	0	0	0	32	1	1	73	57	0	76	0
12:45 – 12:59	2	1	27	65	0	0	0	0	36	1	0	78	59	0	90	0
13:00 – 13:14	1	1	33	86	0	0	0	0	43	0	1	72	52	0	70	0
13:15 – 13:29	0	0	33	97	0	0	0	0	41	0	0	82	47	0	63	1
13:30 – 13:44	0	0	41	84	0	0	0	0	29	0	1	80	59	0	72	1
13:45 – 13:59	0	0	35	69	0	0	0	0	27	2	0	74	54	2	95	0
14:00 – 14:14	1	0	22	68	1	0	0	0	36	0	0	62	60	0	86	0
14:15 – 14:29	2	0	40	75	1	0	1	1	34	2	1	72	72	0	79	0
14:30 – 14:44	0	0	40	92	0	0	0	0	34	2	0	76	51	1	71	1
14:45 – 14:59	1	1	38	77	0	0	0	0	51	1	1	68	61	1	85	0
15:00 – 15:14	1	2	43	77	0	0	2	1	33	1	1	72	62	1	74	0
15:15 – 15:29	0	0	30	63	0	0	1	0	39	3	0	3	62	1	80	1
15:30 – 15:44	1	0	42	73	0	0	0	0	32	0	2	89	55	1	73	1
15:45 – 15:59	0	0	23	86	0	0	0	0	31	1	0	98	66	0	57	1
16:00 – 16:14	2	0	41	92	0	0	0	1	41	0	0	101	60	1	72	3
16:15 – 16:29	0	2	36	119	0	0	1	0	43	1	0	94	43	0	57	1
16:30 – 16:44	0	1	38	106	0	0	1	0	47	0	0	78	59	3	58	3
16:45 – 16:59	0	0	28	99	0	0	0	0	37	1	0	80	59	0	61	2
17:00 – 17:14	1	0	29	106	1	0	0	1	35	1	1	60	49	0	59	2
17:15 – 17:29	0	1	20	97	0	0	2	0	50	1	0	85	73	0	61	0
17:30 – 17:44	0	1	30	116	1	0	2	2	34	2	0	83	62	1	66	0
17:45 – 17:59	0	0	38	119	0	0	3	0	29	1	0	81	51	0	51	1
18:00 – 18:14	0	0	33	110	0	0	0	0	51	1	0	93	52	0	66	1
18:15 – 18:29	1	1	33	106	0	0	2	2	44	0	0	109	68	1	70	3
18:30 – 18:44	1	2	44	90	0	0	1	0	43	0	1	84	60	1	52	4
18:45 – 18:59	1	0	28	88	0	0	1	1	25	0	0	83	62	0	77	1

PCUS	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
07:00 – 07:14	2	2	24	16	1	0	0	2	7	1	0	23	61	0	81	1
07:15 – 07:29	2	4	28	18	4	0	1	0	9	1	0	148	72	1	115	1
07:30 – 07:44	2	2	36	40	0	0	3	0	23	0	0	3	50	1	127	2
07:45 – 07:59	2	3	44	46	1	0	1	3	35	0	0	45	77	0	115	1
08:00 – 08:14	0	1	46	41	1	0	3	3	32	1	1	66	45	3	118	1
08:15 – 08:29	1	1	37	47	0	0	3	0	52	1	1	81	19	0	65	0
08:30 – 08:44	0	0	47	57	0	0	0	1	33	0	0	62	22	0	97	0
08:45 – 08:59	0	2	42	63	0	0	3	0	39	1	0	60	51	3	98	1
09:00 – 09:14	0	0	37	51	0	0	1	0	30	0	0	49	88	0	98	0
09:15 – 09:29	0	3	30	52	0	0	1	0	28	1	0	43	90	2	104	2
09:30 – 09:44	0	2	39	50	1	0	4	0	26	2	13	52	89	2	111	1
09:45 – 09:59	2	0	33	40	2	0	0	1	30	1	0	38	74	1	112	2
10:00 – 10:14	0	0	45	56	0	0	2	0	30	0	0	60	68	0	93	0
10:15 – 10:29	0	0	40	37	0	0	0	0	37	0	1	61	66	1	80	1
10:30 – 10:44	1	0	36	58	2	0	2	0	38	0	1	49	61	3	84	0
10:45 – 10:59	0	0	40	40	3	0	2	3	27	0	0	73	63	0	90	0
11:00 – 11:14	0	3	38	51	0	0	0	0	37	0	0	35	54	0	87	0
11:15 – 11:29	0	0	38	62	0	0	2	0	36	0	0	74	39	0	73	0
11:30 – 11:44	0	1	24	68	0	0	1	0	33	2	1	66	54	2	87	0
11:45 – 11:59	1	1	24	55	0	0	2	0	38	0	1	71	59	0	79	0
12:00 – 12:14	1	2	30	60	0	0	0	1	53	0	1	76	79	0	57	1
12:15 – 12:29	1	1	31	68	6	0	0	2	34	1	1	82	59	2	71	2
12:30 – 12:44	0	1	34	59	0	0	0	0	32	1	1	76	56	0	79	0
12:45 – 12:59	2	1	27	66	0	0	0	0	39	1	0	80	63	0	94	0
13:00 – 13:14	1	2	33	90	0	0	0	0	43	0	1	77	54	0	69	0
13:15 – 13:29	0	0	34	97	0	0	0	0	41	0	0	86	49	0	64	1
13:30 – 13:44	0	0	40	86	0	0	0	0	28	0	1	81	59	0	73	2
13:45 – 13:59	0	0	35	70	0	0	0	0	26	2	0	77	54	2	94	0
14:00 – 14:14	1	0	25	73	1	0	0	0	38	0	0	64	63	0	91	0
14:15 – 14:29	3	0	41	78	1	0	1	1	34	2	1	73	73	0	82	0
14:30 – 14:44	0	0	40	92	0	0	0	0	35	2	0	83	54	1	71	1
14:45 – 14:59	1	1	39	82	0	0	0	0	52	1	1	70	61	1	88	0
15:00 – 15:14	1	2	42	78	0	0	2	1	33	1	1	73	67	1	77	0
15:15 – 15:29	0	0	31	63	0	0	1	0	40	3	0	3	65	1	82	1
15:30 – 15:44	1	0	42	73	0	0	0	0	32	0	2	94	55	1	73	1
15:45 – 15:59	0	0	23	87	0	0	0	0	31	1	0	101	67	0	60	1
16:00 – 16:14	2	0	41	94	0	0	0	1	42	0	0	105	60	1	73	3
16:15 – 16:29	0	2	36	121	0	0	1	0	41	1	0	101	43	0	64	1
16:30 – 16:44	0	1	38	109	0	0	1	0	47	0	0	81	62	4	59	3
16:45 – 16:59	0	0	29	98	0	0	0	0	37	1	0	80	61	0	64	1
17:00 – 17:14	1	0	29	105	1	0	0	1	34	1	1	61	52	0	59	2
17:15 – 17:29	0	1	20	100	0	0	3	0	50	1	0	84	73	0	62	0
17:30 – 17:44	0	1	30	119	1	0	2	2	34	2	0	84	62	1	65	0
17:45 – 17:59	0	0	38	120	0	0	3	0	29	1	0	84	50	0	51	1
18:00 – 18:14	0	0	32	112	0	0	0	0	52	1	0	94	53	0	68	1
18:15 – 18:29	1	1	33	107	0	0	2	2	42	0	0	108	66	1	69	3
18:30 – 18:44	2	2	44	91	0	0	1	0	42	0	1	85	61	1	52	4
18:45 – 18:59	1	0	29	87	0	0	1	1	24	0	0	86	61	0	78	1

PCUs are rounded to the nearest whole number

PCUS	A-A	A-B	A-C	A-D	B-A	B-B	B-C	B-D	C-A	C-B	C-C	C-D	D-A	D-B	D-C	D-D
08:00 – 08:59	1	4	173	208	1	0	9	4	157	3	2	268	136	7	378	2
17:30 – 18:29	1	2	133	458	1	0	7	4	158	4	0	369	231	2	252	5

Manual Classified (Video) Count Wednesday 10th April 2019 Existing Pa Healy Road/Park Road Junction (3-arm signalised)
Arm A = Park Road (to/from South)
Arm B = Pa Healy Road
Arm C = Park Road (to/from North)

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	0	0
07:15 – 07:29	1	0	0	0	0	0
07:30 – 07:44	0	1	0	0	0	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	0	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	0	0	0	0	0
09:00 – 09:14	0	1	0	0	0	0
09:15 – 09:29	0	1	0	0	0	0
09:30 – 09:44	1	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0
10:30 – 10:44	0	0	1	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	0	0
11:30 – 11:44	1	0	0	0	0	0
11:45 – 11:59	1	0	0	0	0	0
12:00 – 12:14	1	0	0	0	0	0
12:15 – 12:29	0	0	0	0	1	0
12:30 – 12:44	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	1	0	1	0	0	0
13:15 – 13:29	0	0	0	0	0	0
13:30 – 13:44	0	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	1	0
14:15 – 14:29	0	1	0	0	0	0
14:30 – 14:44	0	0	0	1	2	0
14:45 – 14:59	1	0	0	0	0	0
15:00 – 15:14	0	0	1	0	0	0
15:15 – 15:29	0	0	0	0	0	0
15:30 – 15:44	0	0	0	1	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	1	0	0	0	0	0
16:15 – 16:29	1	0	0	0	0	0
16:30 – 16:44	0	0	0	0	0	0
16:45 – 16:59	0	0	0	0	0	0
17:00 – 17:14	0	0	0	0	1	0
17:15 – 17:29	0	0	0	0	0	0
17:30 – 17:44	0	0	0	0	1	0
17:45 – 17:59	1	0	0	0	0	0
18:00 – 18:14	0	0	0	0	0	0
18:15 – 18:29	0	0	0	0	1	0
18:30 – 18:44	0	0	0	0	0	0
18:45 – 18:59	0	0	0	0	1	0

Motorcycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	0	0
07:15 – 07:29	0	0	0	0	0	0
07:30 – 07:44	0	0	1	0	0	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	0	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	0	1	0	0	0
09:00 – 09:14	0	0	1	0	0	0
09:15 – 09:29	0	0	1	0	0	0
09:30 – 09:44	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	1	0	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	0	0
11:30 – 11:44	0	0	2	0	0	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0
12:30 – 12:44	0	0	1	0	0	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0
13:15 – 13:29	0	0	1	0	0	0
13:30 – 13:44	1	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	1	0	0	0	0
14:45 – 14:59	0	0	0	0	0	0
15:00 – 15:14	1	0	0	0	0	0
15:15 – 15:29	1	0	0	0	0	0
15:30 – 15:44	0	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0
16:15 – 16:29	0	0	1	0	0	0
16:30 – 16:44	1	0	0	0	0	0
16:45 – 16:59	0	1	0	0	0	0
17:00 – 17:14	0	0	0	0	0	0
17:15 – 17:29	0	0	0	0	0	0
17:30 – 17:44	1	0	0	0	0	0
17:45 – 17:59	0	0	0	0	0	0
18:00 – 18:14	2	0	0	0	0	0
18:15 – 18:29	1	0	0	0	0	0
18:30 – 18:44	0	0	2	0	0	0
18:45 – 18:59	2	0	1	0	0	0

Car / LGV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	21	4	59	1	3	1
07:15 – 07:29	23	6	73	4	6	3
07:30 – 07:44	54	8	126	7	0	4
07:45 – 07:59	70	21	107	7	16	3
08:00 – 08:14	93	9	78	15	29	2
08:15 – 08:29	104	13	73	20	34	1
08:30 – 08:44	79	30	53	12	26	4
08:45 – 08:59	75	27	47	12	18	2
09:00 – 09:14	69	8	77	10	8	2
09:15 – 09:29	56	13	70	15	7	1
09:30 – 09:44	50	9	77	11	16	4
09:45 – 09:59	52	18	61	11	15	5
10:00 – 10:14	56	12	60	13	21	4
10:15 – 10:29	58	14	51	11	12	7
10:30 – 10:44	55	21	66	15	12	4
10:45 – 10:59	61	18	60	9	16	4
11:00 – 11:14	51	14	45	14	10	5
11:15 – 11:29	72	15	41	13	13	2
11:30 – 11:44	73	17	52	16	14	4
11:45 – 11:59	58	21	53	16	19	3
12:00 – 12:14	69	14	84	16	21	6
12:15 – 12:29	86	20	69	11	12	3
12:30 – 12:44	65	32	60	21	9	10
12:45 – 12:59	73	25	54	13	17	6
13:00 – 13:14	82	22	44	13	18	4
13:15 – 13:29	96	26	44	21	10	5
13:30 – 13:44	71	11	57	11	16	5
13:45 – 13:59	82	17	51	18	16	4
14:00 – 14:14	85	22	61	23	13	6
14:15 – 14:29	76	21	74	19	17	4
14:30 – 14:44	98	31	47	9	10	3
14:45 – 14:59	109	25	47	16	11	5
15:00 – 15:14	87	27	78	25	9	5
15:15 – 15:29	80	31	60	16	10	5
15:30 – 15:44	89	28	52	29	19	8
15:45 – 15:59	99	32	55	15	18	7
16:00 – 16:14	128	28	67	16	12	6
16:15 – 16:29	140	29	52	17	17	5
16:30 – 16:44	139	35	57	13	7	2
16:45 – 16:59	151	31	46	12	14	5
17:00 – 17:14	154	31	61	18	13	1
17:15 – 17:29	129	43	58	27	5	6
17:30 – 17:44	147	52	66	15	11	4
17:45 – 17:59	140	47	48	6	8	2
18:00 – 18:14	117	28	50	11	4	3
18:15 – 18:29	122	19	64	14	5	1
18:30 – 18:44	116	18	58	14	5	1
18:45 – 18:59	90	12	64	8	10	1

HGV/PSV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	3	1	3	1	5	0
07:15 – 07:29	2	0	0	0	1	0
07:30 – 07:44	2	0	3	0	0	1
07:45 – 07:59	7	2	3	0	1	0
08:00 – 08:14	2	2	1	0	3	0
08:15 – 08:29	0	0	0	3	2	0
08:30 – 08:44	0	4	1	0	3	0
08:45 – 08:59	3	1	0	1	1	0
09:00 – 09:14	3	2	1	1	2	0
09:15 – 09:29	6	2	5	0	0	0
09:30 – 09:44	1	1	4	0	0	1
09:45 – 09:59	2	1	3	2	0	1
10:00 – 10:14	2	0	3	0	7	1
10:15 – 10:29	2	1	1	0	1	0
10:30 – 10:44	4	1	1	1	0	1
10:45 – 10:59	2	2	3	0	0	1
11:00 – 11:14	4	2	2	0	0	0
11:15 – 11:29	3	2	3	0	2	0
11:30 – 11:44	2	1	2	0	2	0
11:45 – 11:59	3	4	2	1	1	1
12:00 – 12:14	2	4	7	0	0	2
12:15 – 12:29	1	2	3	1	2	1
12:30 – 12:44	2	3	1	0	0	0
12:45 – 12:59	2	0	3	0	2	0
13:00 – 13:14	4	0	3	2	0	0
13:15 – 13:29	1	1	3	0	3	0
13:30 – 13:44	4	0	0	0	0	0
13:45 – 13:59	2	1	0	0	0	0
14:00 – 14:14	4	1	5	0	2	2
14:15 – 14:29	1	2	3	0	0	0
14:30 – 14:44	0	2	1	0	1	0
14:45 – 14:59	4	0	1	1	2	1
15:00 – 15:14	1	3	4	0	0	0
15:15 – 15:29	1	0	3	0	2	1
15:30 – 15:44	2	2	0	0	1	1
15:45 – 15:59	0	0	2	0	0	0
16:00 – 16:14	3	1	0	1	1	0
16:15 – 16:29	2	1	1	0	0	0
16:30 – 16:44	2	1	2	0	0	0
16:45 – 16:59	0	2	1	0	0	0
17:00 – 17:14	0	0	2	0	2	0
17:15 – 17:29	2	1	0	0	0	0
17:30 – 17:44	2	0	1	0	0	0
17:45 – 17:59	1	1	0	0	0	0
18:00 – 18:14	2	0	1	0	0	0
18:15 – 18:29	0	0	0	0	0	0
18:30 – 18:44	3	0	1	0	0	0
18:45 – 18:59	1	0	1	0	0	0

Total Vehicles	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	24	5	62	2	8	1
07:15 – 07:29	26	6	73	4	7	3
07:30 – 07:44	56	9	130	7	0	5
07:45 – 07:59	77	23	110	7	17	3
08:00 – 08:14	95	11	79	15	32	2
08:15 – 08:29	104	13	73	23	36	1
08:30 – 08:44	79	34	54	12	29	4
08:45 – 08:59	78	28	48	13	19	2
09:00 – 09:14	72	11	79	11	10	2
09:15 – 09:29	62	16	76	15	7	1
09:30 – 09:44	52	10	81	11	16	5
09:45 – 09:59	54	19	64	13	15	6
10:00 – 10:14	58	12	63	13	28	5
10:15 – 10:29	61	15	52	11	13	7
10:30 – 10:44	59	22	68	16	12	5
10:45 – 10:59	63	20	63	9	16	5
11:00 – 11:14	55	16	47	14	10	5
11:15 – 11:29	75	17	44	13	15	2
11:30 – 11:44	76	18	56	16	16	4
11:45 – 11:59	62	25	55	17	20	4
12:00 – 12:14	72	18	91	16	21	8
12:15 – 12:29	87	22	72	12	15	4
12:30 – 12:44	67	35	62	21	9	10
12:45 – 12:59	75	25	57	13	19	6
13:00 – 13:14	87	22	48	15	18	4
13:15 – 13:29	97	27	48	21	13	5
13:30 – 13:44	76	11	57	11	16	5
13:45 – 13:59	84	18	51	18	16	4
14:00 – 14:14	89	23	66	23	16	8
14:15 – 14:29	77	24	77	19	17	4
14:30 – 14:44	98	34	48	10	13	3
14:45 – 14:59	114	25	48	17	13	6
15:00 – 15:14	89	30	83	25	9	5
15:15 – 15:29	82	31	63	16	12	6
15:30 – 15:44	91	30	52	30	20	9
15:45 – 15:59	99	32	57	15	18	7
16:00 – 16:14	132	29	67	17	13	6
16:15 – 16:29	143	30	54	17	17	5
16:30 – 16:44	142	36	59	13	7	2
16:45 – 16:59	151	34	47	12	14	5
17:00 – 17:14	154	31	63	18	16	1
17:15 – 17:29	131	44	58	27	5	6
17:30 – 17:44	150	52	67	15	12	4
17:45 – 17:59	142	48	48	6	8	2
18:00 – 18:14	121	28	51	11	4	3
18:15 – 18:29	123	19	64	14	6	1
18:30 – 18:44	119	18	61	14	5	1
18:45 – 18:59	93	12	66	8	11	1

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	28	6	66	3	15	1
07:15 – 07:29	28	6	73	4	8	3
07:30 – 07:44	59	8	133	7	0	6
07:45 – 07:59	86	26	114	7	18	3
08:00 – 08:14	98	14	80	15	36	2
08:15 – 08:29	104	13	73	27	39	1
08:30 – 08:44	79	39	55	12	33	4
08:45 – 08:59	82	29	47	14	20	2
09:00 – 09:14	76	13	80	12	13	2
09:15 – 09:29	70	18	82	15	7	1
09:30 – 09:44	53	11	86	11	16	6
09:45 – 09:59	57	20	68	16	15	7
10:00 – 10:14	61	12	67	13	37	6
10:15 – 10:29	63	16	53	11	14	7
10:30 – 10:44	64	23	69	17	12	6
10:45 – 10:59	66	23	67	9	16	6
11:00 – 11:14	60	19	50	14	10	5
11:15 – 11:29	79	20	48	13	18	2
11:30 – 11:44	78	19	57	16	19	4
11:45 – 11:59	65	30	58	18	21	5
12:00 – 12:14	74	23	100	16	21	11
12:15 – 12:29	88	25	76	13	17	5
12:30 – 12:44	70	39	63	21	9	10
12:45 – 12:59	78	25	61	13	22	6
13:00 – 13:14	91	22	51	18	18	4
13:15 – 13:29	98	28	51	21	17	5
13:30 – 13:44	81	11	57	11	16	5
13:45 – 13:59	87	19	51	18	16	4
14:00 – 14:14	94	24	73	23	18	11
14:15 – 14:29	78	26	81	19	17	4
14:30 – 14:44	98	36	49	9	13	3
14:45 – 14:59	118	25	49	18	16	7
15:00 – 15:14	90	34	87	25	9	5
15:15 – 15:29	83	31	67	16	15	7
15:30 – 15:44	94	33	52	29	21	10
15:45 – 15:59	99	32	60	15	18	7
16:00 – 16:14	135	30	67	18	14	6
16:15 – 16:29	145	31	55	17	17	5
16:30 – 16:44	144	37	62	13	7	2
16:45 – 16:59	151	36	48	12	14	5
17:00 – 17:14	154	31	66	18	18	1
17:15 – 17:29	134	45	58	27	5	6
17:30 – 17:44	152	52	68	15	11	4
17:45 – 17:59	143	49	48	6	8	2
18:00 – 18:14	122	28	52	11	4	3
18:15 – 18:29	122	19	64	14	5	1
18:30 – 18:44	123	18	61	14	5	1
18:45 – 18:59	93	12	67	8	10	1

PCUs are rounded to the nearest whole number

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
08:00 – 08:59	363	95	256	68	128	9
17:30 – 18:29	539	148	233	46	28	10

Manual Classified (Video) Count Wednesday 10th April 2019 Existing Park Road/Rhebouge Road Junction (3-arm signalised)
Arm A = Park Road (to/from North)
Arm B = Rhebogue Road
Arm C = Park Road (to/from South)

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	1	0
07:15 – 07:29	0	0	0	0	1	0
07:30 – 07:44	0	0	0	0	1	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	0	0	0	2	0
08:15 – 08:29	0	0	1	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	0	0	2	0	0
09:00 – 09:14	0	0	0	0	1	0
09:15 – 09:29	0	0	0	0	2	0
09:30 – 09:44	0	0	0	1	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0
10:30 – 10:44	0	1	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	1	0
11:30 – 11:44	0	0	1	0	0	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	1	0	0	0	0
12:30 – 12:44	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	1	1	0	0	0
13:15 – 13:29	0	0	0	0	0	0
13:30 – 13:44	0	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	1	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	2	0	0	0	0
14:45 – 14:59	0	0	0	0	1	0
15:00 – 15:14	0	1	0	0	0	0
15:15 – 15:29	0	0	0	0	1	0
15:30 – 15:44	0	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0
16:15 – 16:29	0	0	1	0	0	0
16:30 – 16:44	0	0	0	1	0	0
16:45 – 16:59	0	0	0	0	1	0
17:00 – 17:14	0	1	0	0	0	0
17:15 – 17:29	0	0	0	1	0	0
17:30 – 17:44	0	1	0	1	1	0
17:45 – 17:59	0	0	0	0	1	0
18:00 – 18:14	0	0	0	0	0	0
18:15 – 18:29	0	1	0	0	1	0
18:30 – 18:44	0	0	0	0	0	0
18:45 – 18:59	0	1	1	0	0	0

Motorcycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	0	0
07:15 – 07:29	0	0	0	0	0	0
07:30 – 07:44	0	1	0	0	0	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	0	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	1	0	0	0	0
09:00 – 09:14	0	1	0	0	0	0
09:15 – 09:29	0	1	0	0	0	0
09:30 – 09:44	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	1	0
10:30 – 10:44	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	0	0
11:30 – 11:44	0	2	0	0	0	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0
12:30 – 12:44	0	1	0	0	1	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0
13:15 – 13:29	0	1	0	0	0	0
13:30 – 13:44	0	0	0	0	1	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	0	0	0	0	0
14:45 – 14:59	0	0	0	0	0	0
15:00 – 15:14	0	0	0	0	2	0
15:15 – 15:29	0	0	0	0	1	0
15:30 – 15:44	0	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0
16:15 – 16:29	0	1	0	0	0	0
16:30 – 16:44	0	0	0	0	1	0
16:45 – 16:59	0	0	0	0	2	0
17:00 – 17:14	0	0	0	0	0	0
17:15 – 17:29	0	0	0	0	0	0
17:30 – 17:44	0	0	0	0	1	0
17:45 – 17:59	0	0	0	0	0	0
18:00 – 18:14	0	0	1	0	1	0
18:15 – 18:29	0	0	0	0	1	0
18:30 – 18:44	0	2	0	1	0	0
18:45 – 18:59	0	1	0	0	1	0

Car / LGV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	62	3	0	28	0
07:15 – 07:29	0	79	7	6	21	0
07:30 – 07:44	0	126	9	7	47	0
07:45 – 07:59	0	123	19	7	81	0
08:00 – 08:14	0	107	29	12	72	0
08:15 – 08:29	0	107	48	25	71	0
08:30 – 08:44	0	79	46	21	62	0
08:45 – 08:59	0	65	41	25	69	0
09:00 – 09:14	0	85	20	14	60	0
09:15 – 09:29	0	77	16	11	54	0
09:30 – 09:44	0	93	12	9	45	0
09:45 – 09:59	0	76	13	5	60	0
10:00 – 10:14	0	81	10	3	69	0
10:15 – 10:29	0	63	15	8	65	0
10:30 – 10:44	0	78	10	1	69	0
10:45 – 10:59	0	76	24	6	58	0
11:00 – 11:14	0	55	13	2	57	0
11:15 – 11:29	0	54	14	6	80	0
11:30 – 11:44	0	66	20	9	69	0
11:45 – 11:59	0	72	17	5	67	0
12:00 – 12:14	0	105	20	3	67	0
12:15 – 12:29	0	81	19	6	78	0
12:30 – 12:44	0	69	22	11	75	0
12:45 – 12:59	0	71	24	4	72	0
13:00 – 13:14	0	62	28	6	81	0
13:15 – 13:29	0	54	28	7	90	0
13:30 – 13:44	0	73	20	13	67	0
13:45 – 13:59	0	67	38	5	68	0
14:00 – 14:14	0	74	29	4	78	0
14:15 – 14:29	0	91	21	9	77	0
14:30 – 14:44	0	57	38	6	110	0
14:45 – 14:59	0	58	34	9	93	0
15:00 – 15:14	0	87	27	8	86	0
15:15 – 15:29	0	70	33	12	93	0
15:30 – 15:44	0	71	24	10	87	0
15:45 – 15:59	0	73	33	10	92	0
16:00 – 16:14	0	79	43	7	113	0
16:15 – 16:29	0	69	53	4	123	0
16:30 – 16:44	0	64	47	4	119	0
16:45 – 16:59	0	60	66	4	121	0
17:00 – 17:14	0	74	44	10	137	0
17:15 – 17:29	0	63	49	10	129	0
17:30 – 17:44	0	77	55	10	146	0
17:45 – 17:59	0	56	66	7	129	0
18:00 – 18:14	0	54	49	7	91	0
18:15 – 18:29	0	69	42	7	102	0
18:30 – 18:44	0	63	43	8	88	0
18:45 – 18:59	0	74	22	0	81	0

HGV/PSV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	8	0	0	6	0
07:15 – 07:29	0	1	0	0	3	0
07:30 – 07:44	0	3	0	0	1	0
07:45 – 07:59	0	4	1	0	7	0
08:00 – 08:14	0	4	0	0	3	0
08:15 – 08:29	0	2	0	1	0	0
08:30 – 08:44	0	4	0	0	4	0
08:45 – 08:59	0	1	0	1	4	0
09:00 – 09:14	0	3	0	0	3	0
09:15 – 09:29	0	5	3	0	6	0
09:30 – 09:44	0	4	0	0	1	0
09:45 – 09:59	0	3	0	0	4	0
10:00 – 10:14	0	10	0	0	2	0
10:15 – 10:29	0	2	0	0	1	0
10:30 – 10:44	0	1	0	1	3	0
10:45 – 10:59	0	3	0	0	2	0
11:00 – 11:14	0	2	0	0	8	0
11:15 – 11:29	0	5	0	0	5	0
11:30 – 11:44	0	4	1	0	3	0
11:45 – 11:59	0	3	0	0	7	0
12:00 – 12:14	0	7	0	0	6	0
12:15 – 12:29	0	5	0	0	4	0
12:30 – 12:44	0	1	1	0	6	0
12:45 – 12:59	0	5	0	0	2	0
13:00 – 13:14	0	3	0	0	4	0
13:15 – 13:29	0	6	1	0	1	0
13:30 – 13:44	0	0	0	0	4	0
13:45 – 13:59	0	0	0	0	7	0
14:00 – 14:14	0	7	0	0	3	0
14:15 – 14:29	0	3	0	0	4	0
14:30 – 14:44	0	2	1	0	3	0
14:45 – 14:59	0	3	0	0	2	0
15:00 – 15:14	0	4	0	0	3	0
15:15 – 15:29	0	5	0	0	2	0
15:30 – 15:44	0	1	0	0	4	0
15:45 – 15:59	0	2	0	0	3	0
16:00 – 16:14	0	1	0	0	6	0
16:15 – 16:29	0	1	0	0	5	0
16:30 – 16:44	0	2	1	0	2	0
16:45 – 16:59	0	1	0	0	3	0
17:00 – 17:14	0	4	0	0	0	0
17:15 – 17:29	0	0	0	0	3	0
17:30 – 17:44	0	1	1	0	1	0
17:45 – 17:59	0	0	0	0	2	0
18:00 – 18:14	0	1	1	0	1	0
18:15 – 18:29	0	0	0	0	0	0
18:30 – 18:44	0	1	0	0	3	0
18:45 – 18:59	0	1	0	0	0	0

Total Vehicles	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	70	3	0	35	0
07:15 – 07:29	0	80	7	6	25	0
07:30 – 07:44	0	130	9	7	49	0
07:45 – 07:59	0	127	20	7	88	0
08:00 – 08:14	0	111	29	12	77	0
08:15 – 08:29	0	109	49	26	71	0
08:30 – 08:44	0	83	46	21	66	0
08:45 – 08:59	0	67	41	28	73	0
09:00 – 09:14	0	89	20	14	64	0
09:15 – 09:29	0	83	19	11	62	0
09:30 – 09:44	0	97	12	10	46	0
09:45 – 09:59	0	79	13	5	64	0
10:00 – 10:14	0	91	10	3	71	0
10:15 – 10:29	0	65	15	8	67	0
10:30 – 10:44	0	80	10	2	72	0
10:45 – 10:59	0	79	24	6	60	0
11:00 – 11:14	0	57	13	2	65	0
11:15 – 11:29	0	59	14	6	86	0
11:30 – 11:44	0	72	22	9	72	0
11:45 – 11:59	0	75	17	5	74	0
12:00 – 12:14	0	112	20	3	73	0
12:15 – 12:29	0	87	19	6	82	0
12:30 – 12:44	0	71	23	11	82	0
12:45 – 12:59	0	76	24	4	74	0
13:00 – 13:14	0	66	29	6	85	0
13:15 – 13:29	0	61	29	7	91	0
13:30 – 13:44	0	73	20	13	72	0
13:45 – 13:59	0	67	38	5	75	0
14:00 – 14:14	0	82	29	4	81	0
14:15 – 14:29	0	94	21	9	81	0
14:30 – 14:44	0	61	39	6	113	0
14:45 – 14:59	0	61	34	9	96	0
15:00 – 15:14	0	92	27	8	91	0
15:15 – 15:29	0	75	33	12	97	0
15:30 – 15:44	0	72	24	10	91	0
15:45 – 15:59	0	75	33	10	95	0
16:00 – 16:14	0	80	43	7	119	0
16:15 – 16:29	0	71	54	4	128	0
16:30 – 16:44	0	66	48	5	122	0
16:45 – 16:59	0	61	66	4	127	0
17:00 – 17:14	0	79	44	10	137	0
17:15 – 17:29	0	63	49	11	132	0
17:30 – 17:44	0	79	56	11	149	0
17:45 – 17:59	0	56	66	7	132	0
18:00 – 18:14	0	55	51	7	93	0
18:15 – 18:29	0	70	42	7	104	0
18:30 – 18:44	0	66	43	9	91	0
18:45 – 18:59	0	77	23	0	82	0

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	80	3	0	42	0
07:15 – 07:29	0	81	7	6	28	0
07:30 – 07:44	0	133	9	7	50	0
07:45 – 07:59	0	132	21	7	97	0
08:00 – 08:14	0	116	29	12	79	0
08:15 – 08:29	0	112	48	27	71	0
08:30 – 08:44	0	88	46	21	71	0
08:45 – 08:59	0	68	41	28	78	0
09:00 – 09:14	0	92	20	14	67	0
09:15 – 09:29	0	89	23	11	68	0
09:30 – 09:44	0	102	12	9	47	0
09:45 – 09:59	0	83	13	5	69	0
10:00 – 10:14	0	104	10	3	74	0
10:15 – 10:29	0	68	15	8	68	0
10:30 – 10:44	0	81	10	3	76	0
10:45 – 10:59	0	83	24	6	63	0
11:00 – 11:14	0	60	13	2	75	0
11:15 – 11:29	0	66	14	6	92	0
11:30 – 11:44	0	76	23	9	76	0
11:45 – 11:59	0	79	17	5	83	0
12:00 – 12:14	0	121	20	3	81	0
12:15 – 12:29	0	93	19	6	87	0
12:30 – 12:44	0	72	24	11	89	0
12:45 – 12:59	0	83	24	4	77	0
13:00 – 13:14	0	69	28	6	90	0
13:15 – 13:29	0	68	30	7	92	0
13:30 – 13:44	0	73	20	13	77	0
13:45 – 13:59	0	67	38	5	84	0
14:00 – 14:14	0	90	29	4	85	0
14:15 – 14:29	0	98	21	9	86	0
14:30 – 14:44	0	62	40	6	117	0
14:45 – 14:59	0	65	34	9	98	0
15:00 – 15:14	0	96	27	8	94	0
15:15 – 15:29	0	82	33	12	98	0
15:30 – 15:44	0	73	24	10	96	0
15:45 – 15:59	0	78	33	10	99	0
16:00 – 16:14	0	81	43	7	127	0
16:15 – 16:29	0	72	53	4	135	0
16:30 – 16:44	0	69	49	4	124	0
16:45 – 16:59	0	62	66	4	129	0
17:00 – 17:14	0	83	44	10	137	0
17:15 – 17:29	0	63	49	10	136	0
17:30 – 17:44	0	80	57	10	149	0
17:45 – 17:59	0	56	66	7	134	0
18:00 – 18:14	0	56	52	7	94	0
18:15 – 18:29	0	69	42	7	103	0
18:30 – 18:44	0	66	43	8	95	0
18:45 – 18:59	0	77	22	0	81	0

PCUs are rounded to the nearest whole number

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
08:00 – 08:59	0	384	164	88	300	0
17:30 – 18:29	0	261	217	31	479	0

Manual Classified (Video) Count Wednesday 10th April 2019Existing Park Road/Upper Clare Street Road Junction (3-arm priority/freeflow)
Arm A = Park Road (to/from South)
Arm B = Upper Clare Street
Arm C = Park Road (to/from North)

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	1	0	0	0	0
07:15 – 07:29	0	1	0	0	0	0
07:30 – 07:44	0	0	0	1	0	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	1	0	1	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	0	0	0	2	0
09:00 – 09:14	0	0	0	1	0	0
09:15 – 09:29	0	0	0	2	0	0
09:30 – 09:44	0	0	0	0	1	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0
10:30 – 10:44	0	0	0	0	1	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	1	0	0
11:30 – 11:44	0	0	0	0	0	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	1	0
12:30 – 12:44	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	1	0
13:15 – 13:29	0	0	0	0	0	0
13:30 – 13:44	0	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	1	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	0	0	0	2	0
14:45 – 14:59	0	1	0	0	0	0
15:00 – 15:14	0	0	0	0	1	0
15:15 – 15:29	0	0	0	1	0	0
15:30 – 15:44	0	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0
16:15 – 16:29	0	0	0	0	0	0
16:30 – 16:44	0	0	0	0	1	0
16:45 – 16:59	0	0	0	1	0	0
17:00 – 17:14	0	0	0	0	1	0
17:15 – 17:29	0	0	0	0	1	0
17:30 – 17:44	0	0	0	1	2	0
17:45 – 17:59	0	1	0	0	0	0
18:00 – 18:14	0	0	0	0	0	0
18:15 – 18:29	0	0	0	1	1	0
18:30 – 18:44	0	0	0	0	0	0
18:45 – 18:59	0	0	0	0	1	0

Motorcycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	0	0
07:15 – 07:29	0	0	0	0	0	0
07:30 – 07:44	0	0	0	0	1	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	0	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0
08:45 – 08:59	0	0	0	0	1	0
09:00 – 09:14	0	0	0	0	1	0
09:15 – 09:29	0	0	0	0	1	0
09:30 – 09:44	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	1	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	0	0
11:30 – 11:44	0	0	0	0	2	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0
12:30 – 12:44	0	1	0	0	1	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0
13:15 – 13:29	0	0	0	0	1	0
13:30 – 13:44	0	1	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0
14:00 – 14:14	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	0	0	0	0	0
14:45 – 14:59	0	0	0	0	0	0
15:00 – 15:14	0	2	0	0	0	0
15:15 – 15:29	0	0	0	1	0	0
15:30 – 15:44	0	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0
16:00 – 16:14	0	0	0	0	0	0
16:15 – 16:29	0	0	0	0	1	0
16:30 – 16:44	0	1	0	0	0	0
16:45 – 16:59	0	0	0	2	0	0
17:00 – 17:14	0	0	0	0	0	0
17:15 – 17:29	0	0	0	0	0	0
17:30 – 17:44	0	0	0	1	0	0
17:45 – 17:59	0	0	0	0	0	0
18:00 – 18:14	0	0	0	1	0	0
18:15 – 18:29	0	1	0	0	0	0
18:30 – 18:44	0	0	0	0	3	0
18:45 – 18:59	0	1	0	0	1	0

Car / LGV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	19	1	9	62	0
07:15 – 07:29	0	14	0	7	85	0
07:30 – 07:44	0	36	0	11	133	0
07:45 – 07:59	0	56	0	25	130	0
08:00 – 08:14	0	43	0	29	119	0
08:15 – 08:29	0	39	0	32	132	0
08:30 – 08:44	0	34	0	28	100	0
08:45 – 08:59	0	43	0	26	90	0
09:00 – 09:14	0	38	0	22	99	0
09:15 – 09:29	0	34	0	20	88	0
09:30 – 09:44	0	32	0	13	102	0
09:45 – 09:59	0	45	0	15	81	0
10:00 – 10:14	0	49	0	20	84	0
10:15 – 10:29	0	40	0	25	71	0
10:30 – 10:44	0	50	0	19	79	0
10:45 – 10:59	0	44	0	14	82	0
11:00 – 11:14	0	41	1	16	57	0
11:15 – 11:29	0	56	0	24	60	0
11:30 – 11:44	0	43	0	26	75	0
11:45 – 11:59	0	47	0	20	77	0
12:00 – 12:14	0	43	0	24	108	0
12:15 – 12:29	0	50	0	28	87	0
12:30 – 12:44	0	48	0	27	80	0
12:45 – 12:59	0	36	0	36	75	0
13:00 – 13:14	0	48	0	33	68	0
13:15 – 13:29	0	61	0	29	61	0
13:30 – 13:44	0	44	0	23	86	0
13:45 – 13:59	0	41	0	27	72	0
14:00 – 14:14	0	49	0	29	78	0
14:15 – 14:29	0	38	0	39	100	0
14:30 – 14:44	0	74	0	36	63	0
14:45 – 14:59	0	56	0	37	67	0
15:00 – 15:14	0	52	0	34	95	0
15:15 – 15:29	0	50	0	43	82	0
15:30 – 15:44	0	39	0	48	81	0
15:45 – 15:59	0	44	0	48	83	0
16:00 – 16:14	0	67	0	46	86	0
16:15 – 16:29	0	74	0	49	73	0
16:30 – 16:44	0	60	0	59	68	0
16:45 – 16:59	0	55	0	66	64	0
17:00 – 17:14	0	72	0	65	84	0
17:15 – 17:29	0	74	0	55	73	0
17:30 – 17:44	0	69	0	77	87	0
17:45 – 17:59	0	70	0	59	63	0
18:00 – 18:14	0	54	0	37	61	0
18:15 – 18:29	0	66	0	36	76	0
18:30 – 18:44	0	59	0	29	71	0
18:45 – 18:59	0	55	0	26	74	0

HGV/PSV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	6	0	0	8	0
07:15 – 07:29	0	3	0	0	1	0
07:30 – 07:44	0	1	0	0	3	0
07:45 – 07:59	0	5	0	2	4	0
08:00 – 08:14	0	3	0	0	4	0
08:15 – 08:29	0	0	0	0	3	0
08:30 – 08:44	0	3	0	1	4	0
08:45 – 08:59	0	4	0	0	2	0
09:00 – 09:14	0	1	0	2	3	0
09:15 – 09:29	0	4	0	2	5	0
09:30 – 09:44	0	0	0	1	4	0
09:45 – 09:59	0	3	0	1	3	0
10:00 – 10:14	0	2	0	0	10	0
10:15 – 10:29	0	0	0	1	2	0
10:30 – 10:44	0	3	0	0	2	0
10:45 – 10:59	0	2	0	0	3	0
11:00 – 11:14	0	5	0	3	2	0
11:15 – 11:29	0	4	0	1	5	0
11:30 – 11:44	0	2	1	1	4	0
11:45 – 11:59	0	7	0	0	3	0
12:00 – 12:14	0	4	0	2	7	0
12:15 – 12:29	0	3	0	1	5	0
12:30 – 12:44	0	5	0	1	1	0
12:45 – 12:59	0	2	0	0	5	0
13:00 – 13:14	0	4	0	0	3	0
13:15 – 13:29	0	0	0	1	6	0
13:30 – 13:44	0	1	0	3	0	0
13:45 – 13:59	0	5	0	2	0	0
14:00 – 14:14	0	3	0	0	7	0
14:15 – 14:29	0	4	0	0	3	0
14:30 – 14:44	0	3	0	0	2	0
14:45 – 14:59	0	2	0	0	3	0
15:00 – 15:14	0	3	0	0	4	0
15:15 – 15:29	0	2	0	0	5	0
15:30 – 15:44	0	3	0	1	1	0
15:45 – 15:59	0	2	0	1	2	0
16:00 – 16:14	0	4	0	2	1	0
16:15 – 16:29	0	5	0	0	1	0
16:30 – 16:44	0	2	0	0	2	0
16:45 – 16:59	0	2	0	1	1	0
17:00 – 17:14	0	0	0	0	4	0
17:15 – 17:29	0	2	0	1	0	0
17:30 – 17:44	0	0	0	1	1	0
17:45 – 17:59	0	1	0	1	0	0
18:00 – 18:14	0	1	0	0	1	0
18:15 – 18:29	0	0	0	0	0	0
18:30 – 18:44	0	3	0	0	1	0
18:45 – 18:59	0	0	0	0	1	0

Total Vehicles	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	26	1	9	70	0
07:15 – 07:29	0	18	0	7	86	0
07:30 – 07:44	0	37	0	12	137	0
07:45 – 07:59	0	61	0	27	134	0
08:00 – 08:14	0	47	0	30	123	0
08:15 – 08:29	0	39	0	32	135	0
08:30 – 08:44	0	37	0	29	104	0
08:45 – 08:59	0	47	0	26	95	0
09:00 – 09:14	0	39	0	25	103	0
09:15 – 09:29	0	38	0	24	94	0
09:30 – 09:44	0	32	0	14	107	0
09:45 – 09:59	0	48	0	16	84	0
10:00 – 10:14	0	51	0	20	94	0
10:15 – 10:29	0	41	0	26	73	0
10:30 – 10:44	0	53	0	19	82	0
10:45 – 10:59	0	46	0	14	85	0
11:00 – 11:14	0	46	1	19	59	0
11:15 – 11:29	0	60	0	26	65	0
11:30 – 11:44	0	45	1	27	81	0
11:45 – 11:59	0	54	0	20	80	0
12:00 – 12:14	0	47	0	26	115	0
12:15 – 12:29	0	53	0	29	93	0
12:30 – 12:44	0	54	0	28	82	0
12:45 – 12:59	0	38	0	36	80	0
13:00 – 13:14	0	52	0	33	72	0
13:15 – 13:29	0	61	0	30	68	0
13:30 – 13:44	0	46	0	26	86	0
13:45 – 13:59	0	46	0	29	72	0
14:00 – 14:14	0	52	0	29	86	0
14:15 – 14:29	0	42	0	39	103	0
14:30 – 14:44	0	77	0	36	67	0
14:45 – 14:59	0	59	0	37	70	0
15:00 – 15:14	0	57	0	34	100	0
15:15 – 15:29	0	52	0	45	87	0
15:30 – 15:44	0	42	0	49	82	0
15:45 – 15:59	0	46	0	49	85	0
16:00 – 16:14	0	71	0	48	87	0
16:15 – 16:29	0	79	0	49	75	0
16:30 – 16:44	0	63	0	59	71	0
16:45 – 16:59	0	57	0	70	65	0
17:00 – 17:14	0	72	0	65	89	0
17:15 – 17:29	0	76	0	56	74	0
17:30 – 17:44	0	69	0	80	90	0
17:45 – 17:59	0	72	0	60	63	0
18:00 – 18:14	0	55	0	38	62	0
18:15 – 18:29	0	67	0	37	77	0
18:30 – 18:44	0	62	0	29	75	0
18:45 – 18:59	0	56	0	26	77	0

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	33	1	9	80	0
07:15 – 07:29	0	21	0	7	87	0
07:30 – 07:44	0	38	0	11	140	0
07:45 – 07:59	0	68	0	30	139	0
08:00 – 08:14	0	50	0	29	128	0
08:15 – 08:29	0	39	0	32	139	0
08:30 – 08:44	0	41	0	30	109	0
08:45 – 08:59	0	52	0	26	95	0
09:00 – 09:14	0	40	0	27	106	0
09:15 – 09:29	0	43	0	25	100	0
09:30 – 09:44	0	32	0	15	111	0
09:45 – 09:59	0	52	0	17	88	0
10:00 – 10:14	0	54	0	20	107	0
10:15 – 10:29	0	40	0	27	76	0
10:30 – 10:44	0	57	0	19	84	0
10:45 – 10:59	0	49	0	14	89	0
11:00 – 11:14	0	53	1	23	62	0
11:15 – 11:29	0	65	0	27	72	0
11:30 – 11:44	0	48	2	28	85	0
11:45 – 11:59	0	63	0	20	84	0
12:00 – 12:14	0	52	0	29	124	0
12:15 – 12:29	0	57	0	30	99	0
12:30 – 12:44	0	60	0	29	83	0
12:45 – 12:59	0	41	0	36	87	0
13:00 – 13:14	0	57	0	33	75	0
13:15 – 13:29	0	61	0	31	75	0
13:30 – 13:44	0	47	0	30	86	0
13:45 – 13:59	0	53	0	32	72	0
14:00 – 14:14	0	56	0	29	94	0
14:15 – 14:29	0	47	0	39	107	0
14:30 – 14:44	0	81	0	36	68	0
14:45 – 14:59	0	61	0	37	74	0
15:00 – 15:14	0	60	0	34	104	0
15:15 – 15:29	0	55	0	44	94	0
15:30 – 15:44	0	46	0	50	83	0
15:45 – 15:59	0	49	0	50	88	0
16:00 – 16:14	0	76	0	51	88	0
16:15 – 16:29	0	86	0	49	76	0
16:30 – 16:44	0	65	0	59	73	0
16:45 – 16:59	0	60	0	69	66	0
17:00 – 17:14	0	72	0	65	93	0
17:15 – 17:29	0	79	0	57	73	0
17:30 – 17:44	0	69	0	80	90	0
17:45 – 17:59	0	73	0	61	63	0
18:00 – 18:14	0	56	0	37	63	0
18:15 – 18:29	0	66	0	36	76	0
18:30 – 18:44	0	66	0	29	75	0
18:45 – 18:59	0	55	0	26	77	0

PCUs are rounded to the nearest whole number

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
08:00 – 08:59	0	182	0	118	472	0
17:30 – 18:29	0	264	0	215	292	0

Manual Classified (Video) Count Wednesday 10th April 2019 Existing R445 Dublin Road/Park Road Junction (3-arm signalised)
Arm A = R445 Dublin Road (to/from West)
Arm B = Park Road
Arm C = R445 Dublin Road (to/from East)

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	1	2	0	0	1	0
07:15 – 07:29	0	1	0	0	0	1
07:30 – 07:44	0	0	0	0	0	0
07:45 – 07:59	0	3	0	0	1	0
08:00 – 08:14	1	1	0	0	4	0
08:15 – 08:29	0	0	1	0	1	0
08:30 – 08:44	0	2	2	0	2	0
08:45 – 08:59	0	0	2	0	3	0
09:00 – 09:14	0	1	0	0	3	0
09:15 – 09:29	0	0	0	0	1	0
09:30 – 09:44	0	1	0	0	3	0
09:45 – 09:59	0	0	1	0	2	0
10:00 – 10:14	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0
10:30 – 10:44	0	0	0	1	0	0
10:45 – 10:59	0	0	0	0	2	0
11:00 – 11:14	0	1	0	0	0	0
11:15 – 11:29	0	1	0	0	4	0
11:30 – 11:44	0	0	0	0	1	0
11:45 – 11:59	0	2	0	0	1	0
12:00 – 12:14	0	0	0	0	0	0
12:15 – 12:29	0	1	1	0	0	0
12:30 – 12:44	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	2	0
13:15 – 13:29	0	3	0	0	1	0
13:30 – 13:44	0	1	0	0	0	0
13:45 – 13:59	0	0	0	0	3	0
14:00 – 14:14	0	1	0	0	1	0
14:15 – 14:29	0	1	0	0	0	0
14:30 – 14:44	0	2	0	0	2	0
14:45 – 14:59	0	1	0	0	3	1
15:00 – 15:14	0	0	0	1	1	0
15:15 – 15:29	0	1	0	0	3	0
15:30 – 15:44	0	1	0	0	0	0
15:45 – 15:59	0	0	0	0	1	0
16:00 – 16:14	0	1	1	0	2	0
16:15 – 16:29	0	0	0	0	2	0
16:30 – 16:44	0	1	0	0	0	0
16:45 – 16:59	0	1	0	0	2	0
17:00 – 17:14	0	3	1	0	0	0
17:15 – 17:29	0	1	0	0	2	0
17:30 – 17:44	0	0	1	0	2	0
17:45 – 17:59	0	5	0	0	3	1
18:00 – 18:14	0	0	0	0	1	0
18:15 – 18:29	0	0	0	0	1	0
18:30 – 18:44	0	0	0	0	2	0
18:45 – 18:59	0	0	1	0	1	0

Motorcycle	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	0	0	0	0	0
07:15 – 07:29	0	1	0	0	0	0
07:30 – 07:44	0	0	0	1	0	0
07:45 – 07:59	0	0	0	0	0	0
08:00 – 08:14	0	1	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0
08:30 – 08:44	0	1	0	0	0	0
08:45 – 08:59	0	1	0	1	0	0
09:00 – 09:14	0	0	1	0	1	0
09:15 – 09:29	0	0	1	0	0	0
09:30 – 09:44	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	1	0
10:15 – 10:29	0	0	0	0	0	1
10:30 – 10:44	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	1	0
11:30 – 11:44	0	0	0	2	0	0
11:45 – 11:59	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	1	0
12:15 – 12:29	0	1	0	0	0	0
12:30 – 12:44	0	0	0	1	0	1
12:45 – 12:59	0	0	1	0	0	0
13:00 – 13:14	0	1	0	0	0	0
13:15 – 13:29	0	0	0	1	0	0
13:30 – 13:44	0	0	0	0	0	1
13:45 – 13:59	0	1	0	0	2	0
14:00 – 14:14	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0
14:30 – 14:44	0	1	0	0	0	0
14:45 – 14:59	0	1	0	0	1	0
15:00 – 15:14	0	1	0	0	0	2
15:15 – 15:29	0	0	0	0	0	0
15:30 – 15:44	0	0	0	0	1	0
15:45 – 15:59	0	0	0	0	1	0
16:00 – 16:14	0	1	0	0	0	0
16:15 – 16:29	0	0	0	1	1	0
16:30 – 16:44	0	1	0	0	2	1
16:45 – 16:59	0	2	0	0	0	0
17:00 – 17:14	0	1	0	0	3	0
17:15 – 17:29	0	0	0	0	1	0
17:30 – 17:44	0	0	0	0	1	0
17:45 – 17:59	0	1	0	0	0	0
18:00 – 18:14	0	0	0	0	1	0
18:15 – 18:29	0	5	0	0	1	1
18:30 – 18:44	0	2	1	2	2	0
18:45 – 18:59	0	1	0	0	1	1

Car / LGV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	0	88	9	51	65	19
07:15 – 07:29	0	114	18	59	112	14
07:30 – 07:44	0	125	38	104	148	36
07:45 – 07:59	2	140	52	83	179	54
08:00 – 08:14	2	189	37	56	213	41
08:15 – 08:29	0	157	63	76	178	39
08:30 – 08:44	5	162	52	53	198	29
08:45 – 08:59	0	135	56	45	223	43
09:00 – 09:14	2	150	41	58	207	36
09:15 – 09:29	1	145	39	44	207	33
09:30 – 09:44	3	127	37	68	178	29
09:45 – 09:59	0	110	28	61	169	45
10:00 – 10:14	2	117	36	58	147	47
10:15 – 10:29	0	109	23	52	164	40
10:30 – 10:44	1	131	19	52	152	49
10:45 – 10:59	2	124	21	57	159	42
11:00 – 11:14	0	123	18	49	172	41
11:15 – 11:29	0	158	20	45	160	56
11:30 – 11:44	0	152	30	48	159	43
11:45 – 11:59	2	135	27	62	158	45
12:00 – 12:14	1	132	38	62	170	42
12:15 – 12:29	1	176	31	66	160	49
12:30 – 12:44	2	169	27	55	126	46
12:45 – 12:59	1	156	26	52	128	35
13:00 – 13:14	1	168	16	58	153	47
13:15 – 13:29	1	155	27	45	159	60
13:30 – 13:44	2	140	45	48	158	42
13:45 – 13:59	1	148	25	49	152	40
14:00 – 14:14	3	177	34	38	160	46
14:15 – 14:29	0	141	42	60	147	38
14:30 – 14:44	5	158	19	51	192	69
14:45 – 14:59	1	169	23	52	154	55
15:00 – 15:14	2	157	35	53	150	50
15:15 – 15:29	0	156	28	47	179	50
15:30 – 15:44	0	168	32	51	171	39
15:45 – 15:59	2	186	26	42	149	42
16:00 – 16:14	2	178	31	64	163	65
16:15 – 16:29	2	178	32	45	170	72
16:30 – 16:44	4	180	30	50	159	56
16:45 – 16:59	3	196	27	50	161	52
17:00 – 17:14	8	192	31	42	169	64
17:15 – 17:29	9	183	30	46	171	65
17:30 – 17:44	5	181	32	60	165	64
17:45 – 17:59	4	185	30	37	121	66
18:00 – 18:14	3	196	21	43	169	51
18:15 – 18:29	2	167	20	41	173	64
18:30 – 18:44	0	160	26	67	148	59
18:45 – 18:59	0	143	28	49	142	55

HGV/PSV	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	1	3	4	3	4	5
07:15 – 07:29	0	4	2	0	8	3
07:30 – 07:44	0	4	0	2	5	1
07:45 – 07:59	0	7	2	2	8	5
08:00 – 08:14	2	5	2	2	5	1
08:15 – 08:29	0	3	4	2	8	0
08:30 – 08:44	3	2	1	1	2	0
08:45 – 08:59	0	7	2	2	5	4
09:00 – 09:14	0	5	0	1	8	1
09:15 – 09:29	1	2	0	5	7	3
09:30 – 09:44	0	5	0	2	5	0
09:45 – 09:59	0	5	2	5	5	3
10:00 – 10:14	0	3	4	3	5	2
10:15 – 10:29	0	9	1	3	5	0
10:30 – 10:44	0	4	0	1	2	3
10:45 – 10:59	0	3	1	4	6	2
11:00 – 11:14	0	7	2	3	8	5
11:15 – 11:29	0	4	1	2	7	4
11:30 – 11:44	0	5	2	3	7	2
11:45 – 11:59	2	7	1	3	2	5
12:00 – 12:14	3	3	3	4	4	1
12:15 – 12:29	0	3	1	3	4	3
12:30 – 12:44	2	5	1	2	6	3
12:45 – 12:59	0	5	1	4	3	2
13:00 – 13:14	0	4	1	0	7	4
13:15 – 13:29	0	4	1	4	8	0
13:30 – 13:44	0	8	2	1	1	1
13:45 – 13:59	1	4	0	0	3	4
14:00 – 14:14	0	1	1	5	3	3
14:15 – 14:29	1	3	1	1	7	3
14:30 – 14:44	1	7	0	2	5	2
14:45 – 14:59	0	3	0	3	6	2
15:00 – 15:14	0	4	0	4	3	3
15:15 – 15:29	0	4	0	6	6	2
15:30 – 15:44	2	5	0	0	3	1
15:45 – 15:59	0	6	0	2	6	2
16:00 – 16:14	0	2	1	1	2	4
16:15 – 16:29	1	5	0	1	3	4
16:30 – 16:44	0	2	1	2	2	2
16:45 – 16:59	0	3	0	1	2	2
17:00 – 17:14	0	1	1	3	4	0
17:15 – 17:29	0	3	0	0	2	2
17:30 – 17:44	0	6	1	0	4	0
17:45 – 17:59	0	3	0	0	1	1
18:00 – 18:14	0	3	1	1	1	1
18:15 – 18:29	0	3	0	0	4	0
18:30 – 18:44	0	1	0	0	3	3
18:45 – 18:59	0	4	0	0	1	0

Total Vehicles	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	2	93	13	54	70	24
07:15 – 07:29	0	120	20	59	120	18
07:30 – 07:44	0	129	38	107	153	37
07:45 – 07:59	2	150	54	85	188	59
08:00 – 08:14	5	196	39	58	222	42
08:15 – 08:29	0	160	68	78	187	39
08:30 – 08:44	8	167	55	54	202	29
08:45 – 08:59	0	143	60	48	231	47
09:00 – 09:14	2	156	42	59	219	37
09:15 – 09:29	2	147	40	49	215	36
09:30 – 09:44	3	133	37	70	186	29
09:45 – 09:59	0	115	31	66	176	48
10:00 – 10:14	2	120	40	61	153	49
10:15 – 10:29	0	118	24	55	169	41
10:30 – 10:44	1	135	19	54	154	52
10:45 – 10:59	2	127	22	61	167	44
11:00 – 11:14	0	131	20	52	180	46
11:15 – 11:29	0	163	21	47	172	60
11:30 – 11:44	0	157	32	53	167	45
11:45 – 11:59	4	144	28	65	161	50
12:00 – 12:14	4	135	41	66	175	43
12:15 – 12:29	1	181	33	69	164	52
12:30 – 12:44	4	174	28	58	132	50
12:45 – 12:59	1	161	28	56	131	37
13:00 – 13:14	1	173	17	58	162	51
13:15 – 13:29	1	162	28	50	168	60
13:30 – 13:44	2	149	47	49	159	44
13:45 – 13:59	2	153	25	49	160	44
14:00 – 14:14	3	179	35	43	164	49
14:15 – 14:29	1	145	43	61	154	41
14:30 – 14:44	6	168	19	53	199	71
14:45 – 14:59	1	174	23	55	164	58
15:00 – 15:14	2	162	35	58	154	55
15:15 – 15:29	0	161	28	53	188	52
15:30 – 15:44	2	174	32	51	175	40
15:45 – 15:59	2	192	26	44	157	44
16:00 – 16:14	2	182	33	65	167	69
16:15 – 16:29	3	183	32	47	176	76
16:30 – 16:44	4	184	31	52	163	59
16:45 – 16:59	3	202	27	51	165	54
17:00 – 17:14	8	197	33	45	176	64
17:15 – 17:29	9	187	30	46	176	67
17:30 – 17:44	5	187	34	60	172	64
17:45 – 17:59	4	194	30	37	125	68
18:00 – 18:14	3	199	22	44	172	52
18:15 – 18:29	2	175	20	41	179	65
18:30 – 18:44	0	163	27	69	155	62
18:45 – 18:59	0	148	29	49	145	56

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
07:00 – 07:14	3	95	18	58	74	31
07:15 – 07:29	0	124	23	59	130	21
07:30 – 07:44	0	134	38	109	160	38
07:45 – 07:59	2	157	57	88	198	66
08:00 – 08:14	7	201	42	61	225	43
08:15 – 08:29	0	164	72	81	197	39
08:30 – 08:44	12	167	55	55	203	29
08:45 – 08:59	0	152	61	50	235	52
09:00 – 09:14	2	162	41	60	226	38
09:15 – 09:29	3	150	39	56	223	40
09:30 – 09:44	3	139	37	73	190	29
09:45 – 09:59	0	122	33	73	181	52
10:00 – 10:14	2	124	45	65	159	52
10:15 – 10:29	0	130	25	59	176	40
10:30 – 10:44	1	140	19	55	157	56
10:45 – 10:59	2	131	23	66	173	47
11:00 – 11:14	0	139	23	56	190	53
11:15 – 11:29	0	167	22	50	177	65
11:30 – 11:44	0	164	35	56	175	48
11:45 – 11:59	7	152	29	69	163	57
12:00 – 12:14	8	139	45	71	180	44
12:15 – 12:29	1	184	34	73	169	56
12:30 – 12:44	7	181	29	60	140	53
12:45 – 12:59	1	168	29	61	135	40
13:00 – 13:14	1	178	18	58	170	56
13:15 – 13:29	1	165	29	55	178	60
13:30 – 13:44	2	159	50	50	160	45
13:45 – 13:59	3	158	25	49	160	49
14:00 – 14:14	3	180	36	50	167	53
14:15 – 14:29	2	148	44	62	163	45
14:30 – 14:44	7	175	19	56	204	74
14:45 – 14:59	1	177	23	59	169	60
15:00 – 15:14	2	167	35	62	157	58
15:15 – 15:29	0	165	28	61	193	55
15:30 – 15:44	5	180	32	51	178	41
15:45 – 15:59	2	200	26	47	163	47
16:00 – 16:14	2	183	34	66	168	74
16:15 – 16:29	4	190	32	48	178	81
16:30 – 16:44	4	185	32	55	164	61
16:45 – 16:59	3	204	27	52	166	57
17:00 – 17:14	8	195	34	49	179	64
17:15 – 17:29	9	190	30	46	176	70
17:30 – 17:44	5	195	35	60	175	64
17:45 – 17:59	4	193	30	37	124	69
18:00 – 18:14	3	203	23	45	172	53
18:15 – 18:29	2	176	20	41	183	64
18:30 – 18:44	0	163	26	68	156	66
18:45 – 18:59	0	153	28	49	145	55

PCUs are rounded to the nearest whole number

PCUS	A-B	A-C	B-A	B-C	C-A	C-B
08:00 – 08:59	19	684	230	247	860	164
17:30 – 18:29	14	767	108	183	654	250

Manual Classified (Video) Count Wednesday 10th April 2019 R445 Clare Street/Upper Clare Street/R445 Dublin Road/R858 Pennywell Road (4-arm signalised/freeflow)
Arm A = R445 Clare Street (to/from West)
Arm B = Upper Clare Street
Arm C = R445 Dublin Road (to/from East)
Arm D = R858 Pennywell Road

PCU Factors Cycle 0.2 Motorcycle 0.4 Car/LGV 1 HGV/PSV 2.3
Incidents: None
Weather: Dry

Cycle	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	0	1	0	0	0	0	1	0	1	0	0	2
07:15 – 07:29	0	0	0	0	0	0	0	0	0	0	0	0
07:30 – 07:44	0	0	0	0	0	0	0	0	0	0	1	0
07:45 – 07:59	0	3	0	0	0	0	0	0	1	0	0	0
08:00 – 08:14	2	2	0	0	0	0	1	0	2	0	1	0
08:15 – 08:29	1	0	0	0	0	0	1	0	0	0	0	0
08:30 – 08:44	0	0	0	0	0	0	2	0	2	0	0	1
08:45 – 08:59	0	0	0	0	0	0	1	0	2	0	0	0
09:00 – 09:14	0	0	0	0	0	0	1	0	1	0	0	1
09:15 – 09:29	0	0	0	0	0	0	0	0	0	0	0	0
09:30 – 09:44	0	0	0	0	0	0	1	0	2	1	0	0
09:45 – 09:59	0	0	0	0	0	0	0	0	3	0	0	0
10:00 – 10:14	0	0	0	0	0	0	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0	0	0	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0	2	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0	0	0	0	0	0	1
11:15 – 11:29	0	1	0	0	0	0	3	0	0	0	0	0
11:30 – 11:44	0	0	0	0	0	0	1	0	0	0	0	0
11:45 – 11:59	0	2	0	0	0	0	0	0	1	0	0	1
12:00 – 12:14	0	0	0	0	0	0	0	0	0	0	0	0
12:15 – 12:29	0	0	0	0	0	0	0	0	1	0	1	1
12:30 – 12:44	0	0	0	0	0	0	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0	0	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0	0	0	2	0	0	1
13:15 – 13:29	0	3	0	0	0	0	0	0	1	0	0	0
13:30 – 13:44	0	1	0	0	0	0	0	0	0	0	0	0
13:45 – 13:59	0	0	0	0	0	0	1	0	2	0	0	0
14:00 – 14:14	0	1	0	0	0	0	0	0	2	0	0	0
14:15 – 14:29	0	1	0	0	0	0	0	0	0	0	1	0
14:30 – 14:44	0	2	0	0	0	0	2	0	2	0	0	0
14:45 – 14:59	1	1	0	0	0	0	1	0	1	0	0	1
15:00 – 15:14	0	0	0	0	0	0	0	0	0	0	0	0
15:15 – 15:29	0	0	0	0	0	0	2	0	1	0	1	1
15:30 – 15:44	0	1	0	0	0	0	0	0	0	0	1	1
15:45 – 15:59	0	0	0	0	0	0	1	0	0	0	0	0
16:00 – 16:14	0	2	0	0	0	0	1	0	1	0	1	0
16:15 – 16:29	0	0	0	0	0	0	2	0	0	0	0	0
16:30 – 16:44	0	1	0	0	0	0	0	0	0	0	0	0
16:45 – 16:59	0	1	0	0	0	0	0	0	2	0	0	0
17:00 – 17:14	0	2	0	0	0	0	0	0	2	0	0	1
17:15 – 17:29	0	1	0	0	0	0	1	0	0	0	0	0
17:30 – 17:44	1	0	0	0	0	0	2	0	1	0	0	0
17:45 – 17:59	0	3	0	0	0	0	2	0	1	0	1	2
18:00 – 18:14	1	0	0	0	0	0	0	0	0	0	0	0
18:15 – 18:29	0	0	0	0	0	0	1	0	0	0	1	0
18:30 – 18:44	0	0	0	0	0	0	1	0	2	0	0	0
18:45 – 18:59	0	0	0	0	0	0	1	0	1	0	0	0

Motorcycle	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	0	0	0	0	0	0	0	0	0	0	0	0
07:15 – 07:29	0	1	0	0	0	0	0	0	0	0	0	0
07:30 – 07:44	0	0	0	0	0	0	0	0	0	0	0	0
07:45 – 07:59	0	0	0	0	0	0	0	0	0	0	0	0
08:00 – 08:14	0	1	0	0	0	0	0	0	0	0	0	0
08:15 – 08:29	0	0	0	0	0	0	0	0	0	0	0	0
08:30 – 08:44	0	1	0	0	0	0	0	0	0	1	0	0
08:45 – 08:59	0	1	0	0	0	0	0	0	0	0	0	0
09:00 – 09:14	0	0	0	0	0	0	0	0	1	0	0	0
09:15 – 09:29	0	0	0	0	0	0	1	0	0	0	0	0
09:30 – 09:44	0	0	0	0	0	0	0	0	0	0	0	0
09:45 – 09:59	0	0	0	0	0	0	0	0	0	0	0	0
10:00 – 10:14	0	0	0	0	0	0	0	0	0	0	0	0
10:15 – 10:29	0	0	0	0	0	0	0	0	0	0	0	0
10:30 – 10:44	0	0	0	0	0	0	0	0	0	0	0	0
10:45 – 10:59	0	0	0	0	0	0	0	0	0	0	0	0
11:00 – 11:14	0	0	0	0	0	0	0	0	0	0	0	0
11:15 – 11:29	0	0	0	0	0	0	0	0	1	0	0	0
11:30 – 11:44	0	0	0	0	0	0	0	0	0	0	0	0
11:45 – 11:59	0	0	0	0	0	0	0	0	0	0	0	0
12:00 – 12:14	0	0	0	0	0	0	0	0	1	0	1	0
12:15 – 12:29	0	0	0	0	0	0	0	0	0	0	0	0
12:30 – 12:44	0	0	0	0	0	0	0	0	0	0	0	0
12:45 – 12:59	0	0	0	0	0	0	1	0	0	0	0	0
13:00 – 13:14	0	0	0	0	0	0	0	0	0	0	0	1
13:15 – 13:29	0	0	0	0	0	0	0	0	0	0	0	0
13:30 – 13:44	0	0	0	0	0	0	0	0	0	0	0	0
13:45 – 13:59	0	1	0	0	0	0	1	0	2	0	0	0
14:00 – 14:14	0	0	0	0	0	0	0	0	0	0	0	0
14:15 – 14:29	0	0	0	0	0	0	0	0	0	0	0	0
14:30 – 14:44	0	0	0	0	0	0	0	0	0	0	1	1
14:45 – 14:59	0	0	0	0	0	0	1	0	0	0	0	0
15:00 – 15:14	0	1	0	0	0	0	0	0	0	0	0	0
15:15 – 15:29	1	0	0	0	0	0	0	0	0	0	0	0
15:30 – 15:44	0	0	0	0	0	0	1	0	0	0	0	0
15:45 – 15:59	0	0	0	0	0	0	1	0	0	0	0	0
16:00 – 16:14	0	1	0	0	0	0	0	0	0	0	0	0
16:15 – 16:29	0	0	0	0	0	0	1	0	0	0	0	0
16:30 – 16:44	0	1	0	0	0	0	2	0	0	1	0	0
16:45 – 16:59	1	1	0	0	0	0	0	0	0	0	1	1
17:00 – 17:14	0	0	0	0	0	0	2	0	0	0	0	1
17:15 – 17:29	0	0	0	0	0	0	0	0	1	0	0	0
17:30 – 17:44	1	0	0	0	0	0	1	0	0	0	0	0
17:45 – 17:59	0	0	0	0	0	0	0	0	0	0	0	1
18:00 – 18:14	0	0	0	0	0	0	0	0	1	0	1	0
18:15 – 18:29	0	3	0	0	0	0	1	0	0	0	0	2
18:30 – 18:44	0	1	0	0	0	0	0	1	2	0	0	1
18:45 – 18:59	0	0	0	0	0	0	1	0	0	0	1	1

Car / LGV	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	2	73	0	0	0	0	45	1	28	1	7	14
07:15 – 07:29	2	94	1	0	0	0	95	1	33	1	4	22
07:30 – 07:44	2	111	1	0	0	0	109	0	70	3	8	20
07:45 – 07:59	5	121	0	0	0	0	141	0	101	1	17	27
08:00 – 08:14	7	143	0	0	0	0	170	1	78	2	24	41
08:15 – 08:29	4	121	1	0	0	0	130	1	108	5	24	50
08:30 – 08:44	11	112	0	0	0	0	151	0	113	1	18	47
08:45 – 08:59	5	109	0	0	0	0	163	0	122	2	21	33
09:00 – 09:14	1	107	1	0	0	0	134	0	108	0	21	43
09:15 – 09:29	2	107	2	0	0	0	149	1	90	5	17	39
09:30 – 09:44	3	97	1	0	0	0	130	1	90	5	10	35
09:45 – 09:59	2	89	1	0	0	0	123	0	69	8	14	23
10:00 – 10:14	4	71	1	0	0	0	107	0	70	5	15	37
10:15 – 10:29	5	92	2	0	0	0	134	1	64	2	19	31
10:30 – 10:44	5	106	1	0	0	0	110	1	61	5	14	21
10:45 – 10:59	3	87	0	0	0	0	125	0	50	6	11	30
11:00 – 11:14	5	98	3	0	0	0	121	0	70	6	11	28
11:15 – 11:29	3	113	0	0	0	0	114	0	63	2	20	44
11:30 – 11:44	5	103	2	0	0	0	117	1	63	1	20	36
11:45 – 11:59	7	99	3	0	0	0	130	1	58	4	11	49
12:00 – 12:14	2	95	0	0	0	0	125	0	81	2	21	36
12:15 – 12:29	8	134	3	0	0	0	124	0	65	4	22	48
12:30 – 12:44	8	129	2	0	0	0	93	0	66	3	16	49
12:45 – 12:59	8	110	6	0	0	0	95	0	56	2	28	51
13:00 – 13:14	8	124	4	0	0	0	109	0	61	3	25	47
13:15 – 13:29	6	102	5	0	0	0	120	1	67	2	22	51
13:30 – 13:44	4	98	0	0	0	0	119	1	78	2	17	41
13:45 – 13:59	1	112	3	0	0	0	101	0	71	7	20	45
14:00 – 14:14	8	132	2	0	0	0	123	1	77	4	23	42
14:15 – 14:29	11	106	3	0	0	0	108	1	22	3	29	49
14:30 – 14:44	6	104	2	0	0	0	129	1	90	6	25	41
14:45 – 14:59	5	131	3	0	0	0	127	0	51	6	27	43
15:00 – 15:14	6	113	3	0	0	0	109	0	70	6	28	52
15:15 – 15:29	10	104	1	0	0	0	127	1	76	8	31	50
15:30 – 15:44	12	127	1	0	0	0	137	1	78	7	28	50
15:45 – 15:59	7	143	2	0	0	0	114	1	55	5	31	49
16:00 – 16:14	8	128	2	0	0	0	129	3	65	4	35	60
16:15 – 16:29	12	122	0	0	0	0	124	1	72	3	39	49
16:30 – 16:44	11	136	2	0	0	0	125	1	64	4	46	50
16:45 – 16:59	19	134	0	0	0	0	120	2	68	3	52	63
17:00 – 17:14	12	157	3	0	0	0	121	4	78	4	40	47
17:15 – 17:29	8	124	1	0	0	0	107	1	86	0	44	62
17:30 – 17:44	20	142	0	0	0	0	102	1	96	2	53	47
17:45 – 17:59	20	122	3	0	0	0	86	1	65	1	39	58
18:00 – 18:14	11	141	2	0	0	0	130	1	61	5	23	62
18:15 – 18:29	11	121	3	0	0	0	139	1	55	5	27	37
18:30 – 18:44	5	131	0	0	0	0	117	0	54	5	22	37
18:45 – 18:59	6	105	2	0	0	0	106	0	65	1	21	31

HGV/PSV	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	0	3	0	0	0	0	3	0	5	0	0	0
07:15 – 07:29	0	3	0	0	0	0	8	0	2	0	0	1
07:30 – 07:44	0	3	0	0	0	0	6	0	0	1	0	1
07:45 – 07:59	0	6	1	0	0	0	5	0	4	0	2	1
08:00 – 08:14	0	4	0	0	0	0	2	0	4	0	0	3
08:15 – 08:29	0	3	0	0	0	0	7	0	5	0	0	0
08:30 – 08:44	1	2	0	0	0	0	2	0	1	0	0	4
08:45 – 08:59	0	6	0	0	0	0	4	0	3	0	0	1
09:00 – 09:14	0	3	0	0	0	0	7	0	1	0	2	2
09:15 – 09:29	2	2	0	0	0	0	6	0	1	0	0	2
09:30 – 09:44	0	4	0	0	0	0	3	0	1	0	1	1
09:45 – 09:59	0	4	0	0	0	0	5	0	1	0	1	1
10:00 – 10:14	0	3	1	0	0	0	3	0	6	0	0	0
10:15 – 10:29	1	7	0	0	0	0	4	0	1	0	0	1
10:30 – 10:44	0	3	0	0	0	0	1	0	1	0	0	1
10:45 – 10:59	0	4	0	0	0	0	4	0	3	0	0	1
11:00 – 11:14	1	2	0	0	0	0	8	0	1	0	2	3
11:15 – 11:29	0	6	0	0	0	0	6	0	1	0	1	0
11:30 – 11:44	0	3	0	0	0	0	6	0	3	0	1	0
11:45 – 11:59	1	7	1	0	0	0	2	0	1	0	0	2
12:00 – 12:14	0	2	0	0	0	0	2	0	5	0	2	3
12:15 – 12:29	1	2	0	0	0	0	3	0	2	0	0	0
12:30 – 12:44	0	4	0	0	0	0	6	0	1	0	1	3
12:45 – 12:59	0	5	0	0	0	0	2	0	1	0	0	0
13:00 – 13:14	0	4	0	0	0	0	8	0	1	0	0	1
13:15 – 13:29	0	2	0	0	0	0	7	0	3	0	1	0
13:30 – 13:44	0	8	0	0	0	0	1	0	1	0	3	0
13:45 – 13:59	0	3	0	0	0	0	5	0	1	0	2	2
14:00 – 14:14	0	0	0	0	0	0	3	0	1	0	0	0
14:15 – 14:29	0	3	0	0	0	0	5	0	2	0	0	1
14:30 – 14:44	0	5	0	0	0	0	3	0	1	1	0	2
14:45 – 14:59	0	2	0	0	0	0	4	0	2	0	0	0
15:00 – 15:14	0	2	0	0	0	0	2	0	1	0	0	1
15:15 – 15:29	0	1	0	0	0	0	3	0	3	0	0	3
15:30 – 15:44	0	6	0	0	0	0	5	0	0	1	1	1
15:45 – 15:59	0	4	0	0	0	0	3	0	1	0	1	1
16:00 – 16:14	0	1	0	0	0	0	2	0	1	0	2	2
16:15 – 16:29	0	4	0	0	0	0	4	0	0	0	0	2
16:30 – 16:44	0	2	0	0	0	0	1	0	2	0	0	0
16:45 – 16:59	0	2	0	0	0	0	1	1	0	0	0	1
17:00 – 17:14	0	1	0	0	0	0	0	0	3	0	0	0
17:15 – 17:29	0	4	0	0	0	0	0	0	2	0	1	0
17:30 – 17:44	1	3	0	0	0	0	2	0	2	0	0	1
17:45 – 17:59	0	3	0	0	0	0	2	0	0	0	1	1
18:00 – 18:14	0	2	0	0	0	0	1	0	1	0	0	1
18:15 – 18:29	0	3	0	0	0	0	3	0	1	1	0	0
18:30 – 18:44	0	2	1	0	0	0	2	0	1	0	0	1
18:45 – 18:59	0	2	0	0	0	0	1	0	0	0	0	0

Total Vehicles	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	2	77	0	0	0	0	49	1	34	1	7	16
07:15 – 07:29	2	98	1	0	0	0	103	1	35	1	4	23
07:30 – 07:44	2	114	1	0	0	0	115	0	70	4	9	21
07:45 – 07:59	5	130	1	0	0	0	146	0	106	1	19	28
08:00 – 08:14	9	150	0	0	0	0	173	1	84	2	25	44
08:15 – 08:29	5	124	1	0	0	0	138	1	113	5	24	50
08:30 – 08:44	12	115	0	0	0	0	155	0	116	2	18	52
08:45 – 08:59	5	116	0	0	0	0	168	0	127	2	21	34
09:00 – 09:14	1	110	1	0	0	0	142	0	111	0	23	46
09:15 – 09:29	4	109	2	0	0	0	156	1	91	5	17	41
09:30 – 09:44	3	101	1	0	0	0	134	1	93	6	11	36
09:45 – 09:59	2	93	1	0	0	0	128	0	73	8	15	24
10:00 – 10:14	4	74	2	0	0	0	110	0	76	5	15	37
10:15 – 10:29	6	99	2	0	0	0	138	1	65	2	19	32
10:30 – 10:44	5	109	1	0	0	0	111	1	62	5	14	22
10:45 – 10:59	3	91	0	0	0	0	131	0	53	6	11	31
11:00 – 11:14	6	100	3	0	0	0	129	0	71	6	13	32
11:15 – 11:29	3	120	0	0	0	0	123	0	65	2	21	44
11:30 – 11:44	5	106	2	0	0	0	124	1	66	1	21	36
11:45 – 11:59	8	108	4	0	0	0	132	1	60	4	11	52
12:00 – 12:14	2	97	0	0	0	0	127	0	87	2	24	39
12:15 – 12:29	9	136	3	0	0	0	127	0	68	4	23	49
12:30 – 12:44	8	133	2	0	0	0	99	0	67	3	17	52
12:45 – 12:59	8	115	6	0	0	0	98	0	57	2	28	51
13:00 – 13:14	8	128	4	0	0	0	117	0	64	3	25	50
13:15 – 13:29	6	107	5	0	0	0	127	1	71	2	23	51
13:30 – 13:44	4	107	0	0	0	0	120	1	79	2	20	41
13:45 – 13:59	1	116	3	0	0	0	108	0	76	7	22	47
14:00 – 14:14	8	133	2	0	0	0	126	1	80	4	23	42
14:15 – 14:29	11	110	3	0	0	0	113	1	24	3	30	50
14:30 – 14:44	6	111	2	0	0	0	134	1	93	7	26	44
14:45 – 14:59	6	134	3	0	0	0	133	0	54	6	27	44
15:00 – 15:14	6	116	3	0	0	0	111	0	71	6	28	53
15:15 – 15:29	11	105	1	0	0	0	132	1	80	8	32	54
15:30 – 15:44	12	134	1	0	0	0	143	1	78	8	30	52
15:45 – 15:59	7	147	2	0	0	0	119	1	56	5	32	50
16:00 – 16:14	8	132	2	0	0	0	132	3	67	4	38	62
16:15 – 16:29	12	126	0	0	0	0	131	1	72	3	39	51
16:30 – 16:44	11	140	2	0	0	0	128	1	66	5	46	50
16:45 – 16:59	20	138	0	0	0	0	121	3	70	3	53	65
17:00 – 17:14	12	160	3	0	0	0	123	4	83	4	40	49
17:15 – 17:29	8	129	1	0	0	0	108	1	89	0	45	62
17:30 – 17:44	23	145	0	0	0	0	107	1	99	2	53	48
17:45 – 17:59	20	128	3	0	0	0	90	1	66	1	41	62
18:00 – 18:14	12	143	2	0	0	0	131	1	63	5	24	63
18:15 – 18:29	11	127	3	0	0	0	144	1	56	6	28	39
18:30 – 18:44	5	134	1	0	0	0	120	1	59	5	22	39
18:45 – 18:59	6	107	2	0	0	0	109	0	66	1	22	32

PCUS	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
07:00 – 07:14	2	80	0	0	0	0	52	1	40	1	7	14
07:15 – 07:29	2	101	1	0	0	0	113	1	38	1	4	24
07:30 – 07:44	2	118	1	0	0	0	123	0	70	5	8	22
07:45 – 07:59	5	135	2	0	0	0	153	0	110	1	22	29
08:00 – 08:14	7	153	0	0	0	0	175	1	88	2	24	48
08:15 – 08:29	4	128	1	0	0	0	146	1	120	5	24	50
08:30 – 08:44	13	117	0	0	0	0	156	0	116	1	18	56
08:45 – 08:59	5	123	0	0	0	0	172	0	129	2	21	35
09:00 – 09:14	1	114	1	0	0	0	150	0	111	0	26	48
09:15 – 09:29	7	112	2	0	0	0	163	1	92	5	17	44
09:30 – 09:44	3	106	1	0	0	0	137	1	93	5	12	37
09:45 – 09:59	2	98	1	0	0	0	135	0	72	8	16	25
10:00 – 10:14	4	78	3	0	0	0	114	0	84	5	15	37
10:15 – 10:29	7	108	2	0	0	0	143	1	66	2	19	33
10:30 – 10:44	5	113	1	0	0	0	112	1	63	5	14	23
10:45 – 10:59	3	96	0	0	0	0	135	0	57	6	11	32
11:00 – 11:14	7	103	3	0	0	0	139	0	72	6	16	35
11:15 – 11:29	3	127	0	0	0	0	128	0	66	2	22	44
11:30 – 11:44	5	110	2	0	0	0	131	1	70	1	22	36
11:45 – 11:59	9	116	5	0	0	0	135	1	61	4	11	54
12:00 – 12:14	2	100	0	0	0	0	130	0	93	2	26	43
12:15 – 12:29	10	139	3	0	0	0	131	0	70	4	22	48
12:30 – 12:44	8	138	2	0	0	0	107	0	68	3	18	56
12:45 – 12:59	8	122	6	0	0	0	100	0	58	2	28	51
13:00 – 13:14	8	133	4	0	0	0	127	0	64	3	25	50
13:15 – 13:29	6	107	5	0	0	0	136	1	74	2	24	51
13:30 – 13:44	4	117	0	0	0	0	121	1	80	2	24	41
13:45 – 13:59	1	119	3	0	0	0	113	0	75	7	25	50
14:00 – 14:14	8	132	2	0	0	0	130	1	80	4	23	42
14:15 – 14:29	11	113	3	0	0	0	120	1	27	3	29	51
14:30 – 14:44	6	116	2	0	0	0	136	1	93	8	25	46
14:45 – 14:59	5	136	3	0	0	0	137	0	56	6	27	43
15:00 – 15:14	6	118	3	0	0	0	114	0	72	6	28	54
15:15 – 15:29	10	106	1	0	0	0	134	1	83	8	31	57
15:30 – 15:44	12	141	1	0	0	0	149	1	78	9	31	53
15:45 – 15:59	7	152	2	0	0	0	122	1	57	5	33	51
16:00 – 16:14	8	131	2	0	0	0	134	3	68	4	40	65
16:15 – 16:29	12	131	0	0	0	0	134	1	72	3	39	54
16:30 – 16:44	11	141	2	0	0	0	128	1	69	4	46	50
16:45 – 16:59	19	139	0	0	0	0	122	4	68	3	52	66
17:00 – 17:14	12	160	3	0	0	0	122	4	85	4	40	48
17:15 – 17:29	8	133	1	0	0	0	107	1	91	0	46	62
17:30 – 17:44	23	149	0	0	0	0	107	1	101	2	53	49
17:45 – 17:59	20	130	3	0	0	0	91	1	65	1	42	61
18:00 – 18:14	11	146	2	0	0	0	132	1	64	5	23	64
18:15 – 18:29	11	129	3	0	0	0	147	1	57	7	27	38
18:30 – 18:44	5	136	2	0	0	0	122	0	58	5	22	40
18:45 – 18:59	6	110	2	0	0	0	109	0	65	1	21	31

PCUs are rounded to the nearest whole number

PCUS	A-B	A-C	A-D	B-A	B-C	B-D	C-A	C-B	C-D	D-A	D-B	D-C
08:00 – 08:59	30	521	1	0	0	0	650	2	452	10	87	190
17:30 – 18:29	65	553	8	0	0	0	477	4	287	15	145	213

APPENDIX 11.2 – Traffic Calculation Summary

Traffic Calculations – Summary
Existing R463 Corbally Roundabout (4-arm)

Arm A = Pa Healy Road (Corbally Link Road)
Arm B = Access
Arm C = R463 O'Dwyer's Bridge
Arm D = R463 Corbally Road

Scenario	**A-A**	**A-B**	**A-C**	**A-D**	**B-A**	**B-B**	**B-C**	**B-D**	**C-A**	**C-B**	**C-C**	**C-D**	**D-A**	**D-B**	**D-C**	**D-D**
2019 AM Peak Hour (08:00-08:59)	1	4	173	208	1	0	9	4	157	3	2	268	136	7	378	2
2023 AM Peak Hour (Factor = 1.073)	**1**	**4**	**185**	**223**	**1**	**0**	**10**	**5**	**168**	**3**	**2**	**288**	**146**	**7**	**406**	**2**
2028 AM Peak Hour (Factor = 1.173)	**1**	**5**	**203**	**244**	**1**	**0**	**11**	**5**	**184**	**4**	**2**	**315**	**160**	**8**	**444**	**2**
2038 AM Peak Hour (Factor = 1.273)	**1**	**5**	**220**	**265**	**1**	**0**	**12**	**5**	**199**	**4**	**3**	**342**	**174**	**8**	**481**	**3**
AM Committed Development Trips (19/1252)	0	1	37	45	0	0	0	0	38	0	0	0	33	0	0	0
2023 AM Peak Hour With Committed Development	**1**	**5**	**222**	**268**	**1**	**0**	**10**	**5**	**206**	**3**	**2**	**288**	**180**	**7**	**406**	**2**
2028 AM Peak Hour With Committed Development	**1**	**6**	**240**	**289**	**1**	**0**	**11**	**5**	**222**	**4**	**2**	**315**	**193**	**8**	**444**	**2**
2038 AM Peak Hour With Committed Development	**1**	**6**	**257**	**310**	**2**	**0**	**12**	**5**	**238**	**4**	**3**	**342**	**207**	**8**	**481**	**3**
Generated Trips AM	0	1	29	35	0	0	0	0	23	0	0	0	20	0	0	0
2023 AM Peak Hour With Committed and Proposed Development	**1**	**6**	**251**	**303**	**1**	**0**	**10**	**5**	**229**	**3**	**2**	**288**	**200**	**7**	**406**	**2**
2028 AM Peak Hour With Committed and Proposed Development	**1**	**6**	**269**	**324**	**2**	**0**	**11**	**5**	**245**	**4**	**2**	**315**	**213**	**8**	**444**	**2**
2038 AM Peak Hour With Committed and Proposed Development	**1**	**7**	**286**	**345**	**2**	**0**	**12**	**5**	**260**	**4**	**3**	**342**	**227**	**8**	**481**	**3**
2019 PM Peak Hour (17:30-18:29)	1	2	133	458	1	0	7	4	158	4	0	369	231	2	252	5
2023 PM Peak Hour (Factor = 1.073)	**1**	**2**	**143**	**492**	**1**	**0**	**8**	**4**	**169**	**4**	**0**	**396**	**248**	**2**	**271**	**5**
2028 PM Peak Hour (Factor = 1.173)	**1**	**2**	**156**	**537**	**1**	**0**	**8**	**5**	**185**	**5**	**0**	**433**	**271**	**2**	**296**	**6**
2038 PM Peak Hour (Factor = 1.273)	**1**	**3**	**170**	**583**	**1**	**0**	**9**	**5**	**201**	**5**	**0**	**470**	**294**	**3**	**321**	**6**
PM Committed Development Trips (19/1252)	0	0	1	4	0	0	0	0	4	0	0	0	6	0	0	0
2023 PM Peak Hour With Committed Development	**1**	**2**	**144**	**496**	**1**	**0**	**8**	**4**	**174**	**4**	**0**	**396**	**254**	**2**	**271**	**5**
2028 PM Peak Hour With Committed Development	**1**	**2**	**158**	**542**	**1**	**0**	**8**	**5**	**189**	**5**	**0**	**433**	**278**	**2**	**296**	**6**
2038 PM Peak Hour With Committed Development	**1**	**3**	**171**	**588**	**1**	**0**	**9**	**5**	**205**	**5**	**0**	**470**	**301**	**3**	**321**	**6**
Generated Trips PM	0	0	12	40	0	0	0	0	11	0	0	0	16	0	0	0
2023 PM Peak Hour With Committed and Proposed Development	**1**	**2**	**156**	**536**	**1**	**0**	**8**	**4**	**185**	**4**	**0**	**396**	**270**	**2**	**271**	**5**
2028 PM Peak Hour With Committed and Proposed Development	**1**	**3**	**169**	**582**	**1**	**0**	**8**	**5**	**200**	**5**	**0**	**433**	**294**	**2**	**296**	**6**
2038 PM Peak Hour With Committed and Proposed Development	**1**	**3**	**182**	**628**	**1**	**0**	**9**	**5**	**216**	**5**	**0**	**470**	**317**	**3**	**321**	**6**

Data in PCUs rounded to the nearest whole number

Traffic Calculations – Summary
Proposed Development Access (3-arm priority)

Arm A = Pa Healy Road (to/from West)
Arm B = Development Access
Arm C = Pa Healy Road (to/from East)

Scenario	A-B	A-C	B-A	B-C	C-A	C-B
2019 AM Peak Hour (08:00-08:59)	0	324	0	0	431	0
2023 AM Peak Hour (Factor = 1.073)	0	348	0	0	462	0
2028 AM Peak Hour (Factor = 1.173)	0	380	0	0	505	0
2038 AM Peak Hour (Factor = 1.273)	0	413	0	0	548	0
AM Committed Development Trips (19/1252)	0	72	0	0	83	0
2023 AM Peak Hour With Committed Development	0	420	0	0	545	0
2028 AM Peak Hour With Committed Development	0	452	0	0	588	0
2038 AM Peak Hour With Committed Development	0	485	0	0	631	0
Generated Trips AM	43	0	64	56	0	49
2023 AM Peak Hour With Committed and Proposed Development	**43**	**420**	**64**	**56**	**545**	**49**
2028 AM Peak Hour With Committed and Proposed Development	**43**	**452**	**64**	**56**	**588**	**49**
2038 AM Peak Hour With Committed and Proposed Development	**43**	**485**	**64**	**56**	**631**	**49**
2019 PM Peak Hour (17:30-18:29)	0	279	0	0	549	0
2023 PM Peak Hour (Factor = 1.073)	0	299	0	0	589	0
2028 PM Peak Hour (Factor = 1.173)	0	327	0	0	644	0
2038 PM Peak Hour (Factor = 1.273)	0	355	0	0	699	0
PM Committed Development Trips (19/1252)	0	11	0	0	6	0
2023 PM Peak Hour With Committed Development	0	310	0	0	595	0
2028 PM Peak Hour With Committed Development	0	338	0	0	650	0
2038 PM Peak Hour With Committed Development	0	365	0	0	705	0
Generated Trips PM	27	0	52	26	0	53
2023 PM Peak Hour With Committed and Proposed Development	**27**	**310**	**52**	**26**	**595**	**53**
2028 PM Peak Hour With Committed and Proposed Development	**27**	**338**	**52**	**26**	**650**	**53**
2038 PM Peak Hour With Committed and Proposed Development	**27**	**365**	**52**	**26**	**705**	**53**

Data in PCUs rounded to the nearest whole number

APPENDIX 11.3 – Traffic Modelling Output

Junctions 9

PICADY 9 - Priority Intersection Module

Version: 9.5.1.7462

For sales and distribution information, program advice and maintenance, contact TRL:
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Article I. **Filename:** western_access.j9
Path: T:\projects\T210602_Canal_Bank_Limerick_2021_Update\eiar_traffic_chapter\modelling\western_access
Report generation date: 25/03/2022 17:55:23

»2023 with committed and development, AM
»2028 with committed and development, AM
»2038 with committed and development, AM
»2023 with committed and development, PM
»2028 with committed and development, PM
»2038 with committed and development, PM

Summary of junction performance

	AM					PM				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2023 with committed and development									
Stream B-AC	D1	0.4	13.13	0.30	B	D4	0.3	11.61	0.20	B
Stream C-AB		0.1	6.91	0.08	A		0.1	6.57	0.09	A
	2028 with committed and development									
Stream B-AC	D2	0.5	13.74	0.31	B	D5	0.3	12.12	0.20	B
Stream C-AB		0.1	7.02	0.08	A		0.1	6.65	0.09	A
	2038 with committed and development									
Stream B-AC	D3	0.5	14.42	0.32	B	D6	0.3	11.73	0.20	B
Stream C-AB		0.1	7.13	0.09	A		0.1	6.44	0.08	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

– File Description

Title	Proposed western development access
Location	Pa Healy Road, Canal Bank, Limerick
Site number	
Date	30/09/2021
Version	Updated
Status	TTA
Identifier	
Client	Revington
Jobnumber	210602
Enumerator	TTRSA

Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D1	2023 with committed and development	AM	FLAT	07:45	09:15	90	15	✓
D2	2028 with committed and development	AM	FLAT	07:45	09:15	90	15	✓
D3	2038 with committed and development	AM	FLAT	07:45	09:15	90	15	✓
D4	2023 with committed and development	PM	FLAT	17:15	18:45	90	15	✓
D5	2028 with committed and development	PM	FLAT	17:15	18:45	90	15	✓
D6	2038 with committed and development	PM	FLAT	17:15	18:45	90	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2023 with committed and development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	T-Junction	Two-way		1.63	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description	Arm type
A	Pa Healy Road to/from West		Major
B	Western Development Access		Minor
C	Pa Healy Road to/from East		Major

Major Arm Geometry

Arm	Width of carriageway (m)	Has kerbed central reserve	Has right turn bay	Width for right turn (m)	Visibility for right turn (m)	Blocks?	Blocking queue (PCU)
C	7.60		✓	3.00	130.0	✓	8.00

Geometries for Arm C are measured opposite Arm B. Geometries for Arm A (if relevant) are measured opposite Arm D.

Minor Arm Geometry

Arm	Minor arm type	Lane width (m)	Visibility to left (m)	Visibility to right (m)
B	One lane	3.00	60	40

Slope / Intercept / Capacity

– Priority Intersection Slopes and Intercepts

Stream	Intercept (PCU/hr)	Slope for A-B	Slope for A-C	Slope for C-A	Slope for C-B
B-A	517	0.088	0.221	0.139	0.316
B-C	649	0.093	0.234	-	-
C-B	706	0.254	0.254	-	-

The slopes and intercepts shown above do NOT include any corrections or adjustments.
Streams may be combined, in which case capacity will be adjusted.
Values are shown for the first time segment only; they may differ for subsequent time segments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D1	2023 with committed and development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	463	100.000
B		FLAT	✓	120	100.000
C		FLAT	✓	594	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To		
		A	**B**	**C**
From	**A**	0	43	420
	B	64	0	56
	C	545	49	0

Vehicle Mix

– Heavy Vehicle Percentages

		To		
		A	B	C
From	A	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.30	13.13	0.4	B	120	180
C-AB	0.08	6.91	0.1	A	49	74
C-A					545	817
A-B					43	65
A-C					420	630

Main Results for each time segment

– 07:45 - 08:00

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	404	0.297	118	0.0	0.4	12.978	B
C-AB	49	12	588	0.083	49	0.0	0.1	6.904	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

– 08:00 - 08:15

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	404	0.297	120	0.4	0.4	13.127	B
C-AB	49	12	588	0.083	49	0.1	0.1	6.912	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

– 08:15 - 08:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	404	0.297	120	0.4	0.4	13.130	B
C-AB	49	12	588	0.083	49	0.1	0.1	6.912	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

– 08:30 - 08:45

Stream	Total	Junction	Capacity	RFC	Throughput	Start	End	Delay (s)	Unsignalised

	Demand (PCU/hr)	Arrivals (PCU)	(PCU/hr)		(PCU/hr)	queue (PCU)	queue (PCU)		level of service
B-AC	120	30	404	0.297	120	0.4	0.4	13.130	B
C-AB	49	12	588	0.083	49	0.1	0.1	6.912	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

– **08:45 - 09:00**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	404	0.297	120	0.4	0.4	13.130	B
C-AB	49	12	588	0.083	49	0.1	0.1	6.912	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

– **09:00 - 09:15**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	404	0.297	120	0.4	0.4	13.130	B
C-AB	49	12	588	0.083	49	0.1	0.1	6.912	A
C-A	545	136			545				
A-B	43	11			43				
A-C	420	105			420				

2028 with committed and development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	T-Junction	Two-way		1.59	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D2	2028 with committed and development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	495	100.000
B		FLAT	✓	120	100.000
C		FLAT	✓	637	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To		
		A	**B**	**C**
From	**A**	0	43	452
	B	64	0	56
	C	588	49	0

Vehicle Mix

– **Heavy Vehicle Percentages**

		To		
		A	**B**	**C**
From	**A**	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.31	13.74	0.5	B	120	180
C-AB	0.08	7.02	0.1	A	49	74
C-A					588	882
A-B					43	65
A-C					452	678

Main Results for each time segment

– **07:45 - 08:00**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	118	0.0	0.4	13.556	B
C-AB	49	12	580	0.085	49	0.0	0.1	7.010	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

– **08:00 - 08:15**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	120	0.4	0.5	13.732	B
C-AB	49	12	580	0.085	49	0.1	0.1	7.018	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

– **08:15 - 08:30**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	120	0.5	0.5	13.735	B
C-AB	49	12	580	0.085	49	0.1	0.1	7.018	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

– **08:30 - 08:45**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	120	0.5	0.5	13.735	B
C-AB	49	12	580	0.085	49	0.1	0.1	7.018	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

– **08:45 - 09:00**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	120	0.5	0.5	13.735	B
C-AB	49	12	580	0.085	49	0.1	0.1	7.018	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

– **09:00 - 09:15**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	391	0.307	120	0.5	0.5	13.735	B
C-AB	49	12	580	0.085	49	0.1	0.1	7.018	A
C-A	588	147			588				
A-B	43	11			43				
A-C	452	113			452				

2038 with committed and development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS

1	untitled	T-Junction	Two-way		1.57	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D3	2038 with committed and development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	528	100.000
B		FLAT	✓	120	100.000
C		FLAT	✓	680	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To		
From		**A**	**B**	**C**
	A	0	43	485
	B	64	0	56
	C	631	49	0

Vehicle Mix

– Heavy Vehicle Percentages

		To		
From		**A**	**B**	**C**
	A	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.32	14.42	0.5	B	120	180

C-AB	0.09	7.13	0.1	A	49	74
C-A					631	946
A-B					43	65
A-C					485	728

Main Results for each time segment

– 07:45 - 08:00

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	379	0.317	118	0.0	0.5	14.214	B
C-AB	49	12	571	0.086	49	0.0	0.1	7.123	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

– 08:00 - 08:15

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	378	0.317	120	0.5	0.5	14.416	B
C-AB	49	12	571	0.086	49	0.1	0.1	7.131	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

– 08:15 - 08:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	378	0.317	120	0.5	0.5	14.419	B
C-AB	49	12	571	0.086	49	0.1	0.1	7.131	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

– 08:30 - 08:45

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	378	0.317	120	0.5	0.5	14.419	B
C-AB	49	12	571	0.086	49	0.1	0.1	7.131	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

– 08:45 - 09:00

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	378	0.317	120	0.5	0.5	14.419	B
C-AB	49	12	571	0.086	49	0.1	0.1	7.131	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

– 09:00 - 09:15

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	120	30	378	0.317	120	0.5	0.5	14.419	B
C-AB	49	12	571	0.086	49	0.1	0.1	7.131	A
C-A	631	158			631				
A-B	43	11			43				
A-C	485	121			485				

2023 with committed and development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	T-Junction	Two-way		1.18	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D4	2023 with committed and development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	337	100.000
B		FLAT	✓	78	100.000
C		FLAT	✓	648	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To		
		A	**B**	**C**
From	**A**	0	27	310
	B	52	0	26
	C	595	53	0

Vehicle Mix

– Heavy Vehicle Percentages

	To			
From		**A**	**B**	**C**
	A	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.20	11.61	0.3	B	78	117
C-AB	0.09	6.57	0.1	A	53	80
C-A					595	892
A-B					27	41
A-C					310	465

Main Results for each time segment

– 17:15 - 17:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.195	77	0.0	0.2	11.540	B
C-AB	53	13	620	0.085	53	0.0	0.1	6.563	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

– 17:30 - 17:45

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.196	78	0.2	0.2	11.612	B
C-AB	53	13	620	0.085	53	0.1	0.1	6.570	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

– 17:45 - 18:00

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.196	78	0.2	0.3	11.612	B
C-AB	53	13	620	0.085	53	0.1	0.1	6.570	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

– 18:00 - 18:15

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.196	78	0.3	0.3	11.612	B
C-AB	53	13	620	0.085	53	0.1	0.1	6.570	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

– **18:15 - 18:30**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.196	78	0.3	0.3	11.612	B
C-AB	53	13	620	0.085	53	0.1	0.1	6.570	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

– **18:30 - 18:45**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	399	0.196	78	0.3	0.3	11.612	B
C-AB	53	13	620	0.085	53	0.1	0.1	6.570	A
C-A	595	149			595				
A-B	27	7			27				
A-C	310	78			310				

2028 with committed and development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	T-Junction	Two-way		1.13	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D5	2028 with committed and development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	365	100.000
B		FLAT	✓	78	100.000
C		FLAT	✓	703	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To		
		A	**B**	**C**
From	**A**	0	27	338
	B	52	0	26
	C	650	53	0

Vehicle Mix

– Heavy Vehicle Percentages

		To		
		A	**B**	**C**
From	**A**	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.20	12.12	0.3	B	78	117
C-AB	0.09	6.65	0.1	A	53	80
C-A					650	975
A-B					27	41
A-C					338	507

Main Results for each time segment

– 17:15 - 17:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	386	0.202	77	0.0	0.3	12.035	B
C-AB	53	13	613	0.086	53	0.0	0.1	6.646	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

– **17:30 - 17:45**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	385	0.202	78	0.3	0.3	12.117	B
C-AB	53	13	613	0.086	53	0.1	0.1	6.654	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

– **17:45 - 18:00**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	385	0.202	78	0.3	0.3	12.117	B
C-AB	53	13	613	0.086	53	0.1	0.1	6.654	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

– **18:00 - 18:15**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	385	0.202	78	0.3	0.3	12.117	B
C-AB	53	13	613	0.086	53	0.1	0.1	6.654	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

– **18:15 - 18:30**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	385	0.202	78	0.3	0.3	12.117	B
C-AB	53	13	613	0.086	53	0.1	0.1	6.654	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

– **18:30 - 18:45**

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	385	0.202	78	0.3	0.3	12.117	B
C-AB	53	13	613	0.086	53	0.1	0.1	6.654	A
C-A	650	163			650				
A-B	27	7			27				
A-C	338	85			338				

2038 with committed and development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Major road direction	Use circulating lanes	Junction Delay (s)	Junction LOS

1	untitled	T-Junction	Two-way		1.11	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D6	2038 with committed and development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	292	100.000
B		FLAT	✓	78	100.000
C		FLAT	✓	758	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To		
		A	**B**	**C**
From	**A**	0	27	265
	B	52	0	26
	C	705	53	0

Vehicle Mix

– Heavy Vehicle Percentages

		To		
		A	**B**	**C**
From	**A**	3	3	3
	B	3	3	3
	C	3	3	3

Results

Results Summary for whole modelled period

Stream	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
B-AC	0.20	11.73	0.3	B	78	117

C-AB	0.08	6.44	0.1	A	53	80
C-A					705	1057
A-B					27	41
A-C					265	398

Main Results for each time segment

– 17:15 - 17:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	77	0.0	0.2	11.651	B
C-AB	53	13	631	0.084	53	0.0	0.1	6.433	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

– 17:30 - 17:45

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	78	0.2	0.3	11.726	B
C-AB	53	13	631	0.084	53	0.1	0.1	6.440	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

– 17:45 - 18:00

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	78	0.3	0.3	11.726	B
C-AB	53	13	631	0.084	53	0.1	0.1	6.440	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

– 18:00 - 18:15

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	78	0.3	0.3	11.726	B
C-AB	53	13	631	0.084	53	0.1	0.1	6.440	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

– 18:15 - 18:30

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	78	0.3	0.3	11.726	B
C-AB	53	13	631	0.084	53	0.1	0.1	6.440	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

– 18:30 - 18:45

Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
B-AC	78	20	396	0.197	78	0.3	0.3	11.726	B
C-AB	53	13	631	0.084	53	0.1	0.1	6.440	A
C-A	705	176			705				
A-B	27	7			27				
A-C	265	66			265				

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462

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+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Article II. **Filename:** corbally.j9
Path: T:\projects\T210602_Canal_Bank_Limerick_2021_Update\eiar_traffic_chapter\modelling\corbally
Report generation date: 25/03/2022 17:57:46

- **»2023 No Development, AM**
- **»2028 No Development, AM**
- **»2038 No Development, AM**
- **»2023 No Development, PM**
- **»2028 No Development, PM**
- **»2038 No Development, PM**
- **»2023 With Committed Development, AM**
- **»2028 With Committed Development, AM**
- **»2038 With Committed Development, AM**
- **»2023 With Committed Development, PM**
- **»2028 With Committed Development, PM**
- **»2038 With Committed Development, PM**
- **»2023 With Committed and Proposed Development, AM**
- **»2028 With Committed and Proposed Development, AM**
- **»2038 With Committed and Proposed Development, AM**
- **»2023 With Committed and Proposed Development, PM**
- **»2028 With Committed and Proposed Development, PM**
- **»2038 With Committed and Proposed Development, PM**

Summary of junction performance

	AM					PM				
	Set ID	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**	**Set ID**	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**
	2023 No Development									
Arm A	D1	0.4	3.83	0.30	A	D4	0.8	4.47	0.43	A
Arm B		0.0	6.55	0.03	A		0.0	7.08	0.02	A
Arm C		0.4	3.19	0.28	A		0.7	4.27	0.39	A
Arm D		0.5	2.98	0.31	A		0.4	2.90	0.29	A
	2028 No Development									
Arm A	D2	0.5	4.11	0.33	A	D5	0.9	4.91	0.48	A
Arm B		0.0	7.04	0.03	A		0.0	7.72	0.03	A
Arm C		0.5	3.36	0.31	A		0.8	4.75	0.44	A
Arm D		0.5	3.14	0.34	A		0.5	3.04	0.32	A

	2038 No Development									
Arm A	D3	0.6	4.41	0.37	A	D6	1.1	5.46	0.53	A
Arm B		0.0	7.60	0.04	A		0.0	8.48	0.03	A
Arm C		0.5	3.54	0.34	A		1.0	5.32	0.49	A
Arm D		0.6	3.32	0.37	A		0.6	3.20	0.35	A
	2023 With Committed Development									
Arm A	D7	0.6	4.19	0.36	A	D10	0.8	4.50	0.44	A
Arm B		0.0	7.06	0.03	A		0.0	7.12	0.02	A
Arm C		0.5	3.39	0.31	A		0.7	4.31	0.40	A
Arm D		0.5	3.14	0.33	A		0.4	2.92	0.29	A
	2028 With Committed Development									
Arm A	D8	0.7	4.52	0.39	A	D11	1.0	4.96	0.48	A
Arm B		0.0	7.62	0.03	A		0.0	7.77	0.03	A
Arm C		0.5	3.58	0.34	A		0.8	4.79	0.45	A
Arm D		0.6	3.31	0.37	A		0.5	3.07	0.32	A
	2038 With Committed Development									
Arm A	D9	0.8	4.88	0.43	A	D12	1.2	5.52	0.53	A
Arm B		0.0	8.30	0.04	A		0.0	8.53	0.03	A
Arm C		0.6	3.80	0.37	A		1.0	5.38	0.50	A
Arm D		0.7	3.51	0.40	A		0.6	3.23	0.35	A
	2023 With Committed and Proposed Development									
Arm A	D13	0.7	4.52	0.41	A	D16	0.9	4.80	0.47	A
Arm B		0.0	7.51	0.03	A		0.0	7.49	0.03	A
Arm C		0.5	3.54	0.33	A		0.7	4.52	0.41	A
Arm D		0.6	3.23	0.35	A		0.5	2.98	0.30	A
	2028 With Committed and Proposed Development									
Arm A	D14	0.8	4.90	0.44	A	D17	1.1	5.33	0.52	A
Arm B		0.0	8.17	0.04	A		0.0	8.21	0.03	A
Arm C		0.6	3.75	0.36	A		0.9	5.04	0.46	A
Arm D		0.6	3.43	0.38	A		0.5	3.13	0.33	A
	2038 With Committed and Proposed Development									
Arm A	D15	0.9	5.34	0.48	A	D18	1.3	5.97	0.57	A
Arm B		0.0	8.92	0.04	A		0.0	9.06	0.04	A
Arm C		0.7	3.99	0.39	A		1.1	5.70	0.51	A
Arm D		0.7	3.64	0.41	A		0.7	3.46	0.39	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

– File Description

Title	Corbally Roundabout
Location	Limerick
Site number	
Date	30/09/2021
Version	
Status	TTA
Identifier	
Client	Revington
Jobnumber	T210602
Enumerator	TTRSA
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75				0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D1	2023 No Development	AM	FLAT	07:45	09:15	90	15	✓
D2	2028 No Development	AM	FLAT	07:45	09:15	90	15	✓
D3	2038 No Development	AM	FLAT	07:45	09:15	90	15	✓
D4	2023 No Development	PM	FLAT	17:15	18:45	90	15	✓
D5	2028 No Development	PM	FLAT	17:15	18:45	90	15	✓
D6	2038 No Development	PM	FLAT	17:15	18:45	90	15	✓
D7	2023 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓
D8	2028 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓
D9	2038 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓
D10	2023 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓
D11	2028 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓
D12	2038 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓
D13	2023 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓
D14	2028 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓
D15	2038 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓
D16	2023 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓
D17	2028 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓
D18	2038 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2023 No Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.33	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
A	Pa Healy Road	
B	Access	
C	R463 O'Dwyers Bridge	
D	R463 Corbally Road	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
A	5.53	6.64	1.5	9.6	33.3	35.4	
B	2.85	4.33	2.9	12.0	33.3	32.5	
C	4.24	7.02	7.0	59.3	33.4	15.5	
D	4.37	7.59	10.1	50.1	33.3	17.7	

Slope / Intercept / Capacity

– Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A	0.621	1646
B	0.497	992
C	0.698	1792
D	0.725	1938

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D1	2023 No Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	413	100.000
B		FLAT	✓	17	100.000
C		FLAT	✓	461	100.000
D		FLAT	✓	561	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	4	185	223
	B	1	0	10	5
	C	168	3	2	288
	D	146	7	406	2

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.30	3.83	0.4	A	413	620
B	0.03	6.55	0.0	A	17	25
C	0.28	3.19	0.4	A	461	692
D	0.31	2.98	0.5	A	561	842

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	413	103	419	1386	0.298	411	315	0.0	0.4	3.818	A
B	17	4	816	587	0.028	16	14	0.0	0.0	6.533	A
C	461	115	231	1631	0.283	460	601	0.0	0.4	3.178	A
D	561	140	175	1811	0.310	559	516	0.0	0.5	2.973	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	413	103	420	1385	0.298	413	316	0.4	0.4	3.833	A
B	17	4	819	585	0.028	17	14	0.0	0.0	6.553	A
C	461	115	232	1630	0.283	461	603	0.4	0.4	3.187	A
D	561	140	175	1811	0.310	561	518	0.5	0.5	2.981	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	413	103	420	1385	0.298	413	316	0.4	0.4	3.833	A
B	17	4	819	585	0.028	17	14	0.0	0.0	6.553	A
C	461	115	232	1630	0.283	461	603	0.4	0.4	3.187	A
D	561	140	175	1811	0.310	561	518	0.5	0.5	2.981	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	413	103	420	1385	0.298	413	316	0.4	0.4	3.833	A
B	17	4	819	585	0.028	17	14	0.0	0.0	6.553	A
C	461	115	232	1630	0.283	461	603	0.4	0.4	3.187	A
D	561	140	175	1811	0.310	561	518	0.5	0.5	2.981	A

– 08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	413	103	420	1385	0.298	413	316	0.4	0.4	3.833	A
B	17	4	819	585	0.028	17	14	0.0	0.0	6.553	A
C	461	115	232	1630	0.283	461	603	0.4	0.4	3.187	A
D	561	140	175	1811	0.310	561	518	0.5	0.5	2.981	A

– 09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	413	103	420	1385	0.298	413	316	0.4	0.4	3.833	A
B	17	4	819	585	0.028	17	14	0.0	0.0	6.553	A
C	461	115	232	1630	0.283	461	603	0.4	0.4	3.187	A
D	561	140	175	1811	0.310	561	518	0.5	0.5	2.981	A

2028 No Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS

1	untitled	Standard Roundabout		A, B, C, D	3.53	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D2	2028 No Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	453	100.000
B		FLAT	✓	17	100.000
C		FLAT	✓	505	100.000
D		FLAT	✓	614	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	5	203	244
	B	1	0	11	5
	C	184	4	2	315
	D	160	8	444	2

Vehicle Mix

– **Heavy Vehicle Percentages**

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue	Max LOS	Average Demand	Total Junction

			(PCU)		(PCU/hr)	Arrivals (PCU)
A	0.33	4.11	0.5	A	453	680
B	0.03	7.04	0.0	A	17	26
C	0.31	3.36	0.5	A	505	758
D	0.34	3.14	0.5	A	614	921

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	459	1361	0.333	451	345	0.0	0.5	4.084	A
B	17	4	893	549	0.031	17	17	0.0	0.0	7.009	A
C	505	126	252	1616	0.313	503	658	0.0	0.5	3.342	A
D	614	154	191	1799	0.341	612	564	0.0	0.5	3.133	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	460	1360	0.333	453	346	0.5	0.5	4.106	A
B	17	4	896	547	0.031	17	17	0.0	0.0	7.035	A
C	505	126	253	1615	0.313	505	660	0.5	0.5	3.355	A
D	614	154	192	1799	0.341	614	566	0.5	0.5	3.144	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	460	1360	0.333	453	346	0.5	0.5	4.106	A
B	17	4	896	547	0.031	17	17	0.0	0.0	7.035	A
C	505	126	253	1615	0.313	505	660	0.5	0.5	3.355	A
D	614	154	192	1799	0.341	614	566	0.5	0.5	3.144	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	460	1360	0.333	453	346	0.5	0.5	4.106	A
B	17	4	896	547	0.031	17	17	0.0	0.0	7.035	A
C	505	126	253	1615	0.313	505	660	0.5	0.5	3.355	A
D	614	154	192	1799	0.341	614	566	0.5	0.5	3.144	A

– 08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	460	1360	0.333	453	346	0.5	0.5	4.106	A
B	17	4	896	547	0.031	17	17	0.0	0.0	7.035	A
C	505	126	253	1615	0.313	505	660	0.5	0.5	3.355	A
D	614	154	192	1799	0.341	614	566	0.5	0.5	3.144	A

– 09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	453	113	460	1360	0.333	453	346	0.5	0.5	4.106	A
B	17	4	896	547	0.031	17	17	0.0	0.0	7.035	A

C	505	126	253	1615	0.313	505	660	0.5	0.5	3.355	A
D	614	154	192	1799	0.341	614	566	0.5	0.5	3.144	A

2038 No Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.75	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D3	2038 No Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	491	100.000
B		FLAT	✓	18	100.000
C		FLAT	✓	548	100.000
D		FLAT	✓	666	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	5	220	265
	B	1	0	12	5
	C	199	4	3	342
	D	174	8	481	3

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.37	4.41	0.6	A	491	737
B	0.04	7.60	0.0	A	18	27
C	0.34	3.54	0.5	A	548	822
D	0.37	3.32	0.6	A	666	999

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	497	1337	0.367	489	374	0.0	0.6	4.378	A
B	18	5	969	511	0.036	18	17	0.0	0.0	7.563	A
C	548	137	274	1601	0.342	546	713	0.0	0.5	3.524	A
D	666	167	207	1788	0.373	664	612	0.0	0.6	3.307	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	499	1336	0.367	491	375	0.6	0.6	4.408	A
B	18	5	973	509	0.036	18	17	0.0	0.0	7.598	A
C	548	137	275	1600	0.343	548	716	0.5	0.5	3.541	A
D	666	167	208	1787	0.373	666	615	0.6	0.6	3.322	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	499	1336	0.367	491	375	0.6	0.6	4.408	A
B	18	5	973	509	0.036	18	17	0.0	0.0	7.598	A
C	548	137	275	1600	0.343	548	716	0.5	0.5	3.541	A
D	666	167	208	1787	0.373	666	615	0.6	0.6	3.322	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	499	1336	0.367	491	375	0.6	0.6	4.408	A
B	18	5	973	509	0.036	18	17	0.0	0.0	7.598	A

C	548	137	275	1600	0.343	548	716	0.5	0.5	3.541	A
D	666	167	208	1787	0.373	666	615	0.6	0.6	3.322	A

– **08:45 - 09:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	499	1336	0.367	491	375	0.6	0.6	4.408	A
B	18	5	973	509	0.036	18	17	0.0	0.0	7.598	A
C	548	137	275	1600	0.343	548	716	0.5	0.5	3.541	A
D	666	167	208	1787	0.373	666	615	0.6	0.6	3.322	A

– **09:00 - 09:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	491	123	499	1336	0.367	491	375	0.6	0.6	4.408	A
B	18	5	973	509	0.036	18	17	0.0	0.0	7.598	A
C	548	137	275	1600	0.343	548	716	0.5	0.5	3.541	A
D	666	167	208	1787	0.373	666	615	0.6	0.6	3.322	A

2023 No Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.95	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D4	2023 No Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	638	100.000
B		FLAT	✓	13	100.000
C		FLAT	✓	569	100.000
D		FLAT	✓	526	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

	To				
		A	**B**	**C**	**D**
From	**A**	1	2	143	492
	B	1	0	8	4
	C	169	4	0	396
	D	248	2	271	5

Vehicle Mix

– **Heavy Vehicle Percentages**

	To				
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.43	4.47	0.8	A	638	957
B	0.02	7.08	0.0	A	13	20
C	0.39	4.27	0.7	A	569	854
D	0.29	2.90	0.4	A	526	789

Main Results for each time segment

– **17:15 - 17:30**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	281	1471	0.434	635	417	0.0	0.8	4.439	A
B	13	3	908	541	0.024	13	8	0.0	0.0	7.058	A
C	569	142	501	1443	0.394	566	420	0.0	0.7	4.240	A
D	526	132	174	1812	0.290	524	893	0.0	0.4	2.890	A

– **17:30 - 17:45**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	282	1471	0.434	638	419	0.8	0.8	4.473	A
B	13	3	912	539	0.024	13	8	0.0	0.0	7.085	A
C	569	142	503	1441	0.395	569	422	0.7	0.7	4.273	A
D	526	132	175	1811	0.290	526	897	0.4	0.4	2.898	A

– **17:45 - 18:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	282	1471	0.434	638	419	0.8	0.8	4.473	A
B	13	3	912	539	0.024	13	8	0.0	0.0	7.085	A
C	569	142	503	1441	0.395	569	422	0.7	0.7	4.273	A
D	526	132	175	1811	0.290	526	897	0.4	0.4	2.898	A

– **18:00 - 18:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	282	1471	0.434	638	419	0.8	0.8	4.473	A
B	13	3	912	539	0.024	13	8	0.0	0.0	7.085	A
C	569	142	503	1441	0.395	569	422	0.7	0.7	4.273	A
D	526	132	175	1811	0.290	526	897	0.4	0.4	2.898	A

– **18:15 - 18:30**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	282	1471	0.434	638	419	0.8	0.8	4.473	A
B	13	3	912	539	0.024	13	8	0.0	0.0	7.085	A
C	569	142	503	1441	0.395	569	422	0.7	0.7	4.273	A
D	526	132	175	1811	0.290	526	897	0.4	0.4	2.898	A

– **18:30 - 18:45**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	638	160	282	1471	0.434	638	419	0.8	0.8	4.473	A
B	13	3	912	539	0.024	13	8	0.0	0.0	7.085	A
C	569	142	503	1441	0.395	569	422	0.7	0.7	4.273	A
D	526	132	175	1811	0.290	526	897	0.4	0.4	2.898	A

2028 No Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.32	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length	Time segment length (min)	Run automatically

						(min)		
D5	2028 No Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	696	100.000
B		FLAT	✓	14	100.000
C		FLAT	✓	623	100.000
D		FLAT	✓	575	100.000

Origin-Destination Data

– Demand (PCU/hr)

	To				
		A	**B**	**C**	**D**
From	**A**	1	2	156	537
	B	1	0	8	5
	C	185	5	0	433
	D	271	2	296	6

Vehicle Mix

– Heavy Vehicle Percentages

	To				
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.48	4.91	0.9	A	696	1044
B	0.03	7.72	0.0	A	14	21
C	0.44	4.75	0.8	A	623	935
D	0.32	3.04	0.5	A	575	863

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	308	1455	0.478	692	456	0.0	0.9	4.864	A
B	14	4	991	499	0.028	14	9	0.0	0.0	7.674	A
C	623	156	547	1410	0.442	620	458	0.0	0.8	4.697	A
D	575	144	191	1800	0.320	573	976	0.0	0.5	3.029	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	309	1454	0.479	696	458	0.9	0.9	4.914	A
B	14	4	996	497	0.029	14	9	0.0	0.0	7.716	A
C	623	156	550	1408	0.443	623	460	0.8	0.8	4.747	A
D	575	144	192	1799	0.320	575	981	0.5	0.5	3.044	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	309	1454	0.479	696	458	0.9	0.9	4.914	A
B	14	4	996	497	0.029	14	9	0.0	0.0	7.716	A
C	623	156	550	1408	0.443	623	460	0.8	0.8	4.747	A
D	575	144	192	1799	0.320	575	981	0.5	0.5	3.044	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	309	1454	0.479	696	458	0.9	0.9	4.914	A
B	14	4	996	497	0.029	14	9	0.0	0.0	7.716	A
C	623	156	550	1408	0.443	623	460	0.8	0.8	4.747	A
D	575	144	192	1799	0.320	575	981	0.5	0.5	3.044	A

– 18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	309	1454	0.479	696	458	0.9	0.9	4.914	A
B	14	4	996	497	0.029	14	9	0.0	0.0	7.716	A
C	623	156	550	1408	0.443	623	460	0.8	0.8	4.747	A
D	575	144	192	1799	0.320	575	981	0.5	0.5	3.044	A

– 18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	696	174	309	1454	0.479	696	458	0.9	0.9	4.914	A
B	14	4	996	497	0.029	14	9	0.0	0.0	7.716	A
C	623	156	550	1408	0.443	623	460	0.8	0.8	4.747	A
D	575	144	192	1799	0.320	575	981	0.5	0.5	3.044	A

2038 No Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.76	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D6	2038 No Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	756	100.000
B		FLAT	✓	15	100.000
C		FLAT	✓	676	100.000
D		FLAT	✓	624	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	2	170	583
	B	1	0	9	5
	C	201	5	0	470
	D	294	3	321	6

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.53	5.46	1.1	A	756	1134
B	0.03	8.48	0.0	A	15	23
C	0.49	5.32	1.0	A	676	1014
D	0.35	3.20	0.6	A	624	936

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	756	189	334	1439	0.525	752	495	0.0	1.1	5.387	A
B	15	4	1075	458	0.033	15	10	0.0	0.0	8.416	A
C	676	169	593	1378	0.490	672	498	0.0	1.0	5.247	A
D	624	156	207	1788	0.349	622	1058	0.0	0.6	3.190	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	756	189	335	1438	0.526	756	497	1.1	1.1	5.463	A
B	15	4	1081	455	0.033	15	10	0.0	0.0	8.475	A
C	676	169	596	1376	0.491	676	500	1.0	1.0	5.324	A
D	624	156	208	1787	0.349	624	1064	0.6	0.6	3.202	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	756	189	335	1438	0.526	756	497	1.1	1.1	5.463	A
B	15	4	1081	455	0.033	15	10	0.0	0.0	8.475	A
C	676	169	596	1376	0.491	676	500	1.0	1.0	5.324	A
D	624	156	208	1787	0.349	624	1064	0.6	0.6	3.202	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	756	189	335	1438	0.526	756	497	1.1	1.1	5.463	A
B	15	4	1081	455	0.033	15	10	0.0	0.0	8.475	A
C	676	169	596	1376	0.491	676	500	1.0	1.0	5.324	A
D	624	156	208	1787	0.349	624	1064	0.6	0.6	3.202	A

– 18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	756	189	335	1438	0.526	756	497	1.1	1.1	5.463	A
B	15	4	1081	455	0.033	15	10	0.0	0.0	8.475	A
C	676	169	596	1376	0.491	676	500	1.0	1.0	5.324	A
D	624	156	208	1787	0.349	624	1064	0.6	0.6	3.202	A

– 18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	756	189	335	1438	0.526	756	497	1.1	1.1	5.463	A
B	15	4	1081	455	0.033	15	10	0.0	0.0	8.475	A
C	676	169	596	1376	0.491	676	500	1.0	1.0	5.324	A
D	624	156	208	1787	0.349	624	1064	0.6	0.6	3.202	A

2023 With Committed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.58	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D7	2023 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	496	100.000
B		FLAT	✓	17	100.000
C		FLAT	✓	499	100.000
D		FLAT	✓	595	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	5	222	268
	B	1	0	10	5
	C	206	3	2	288
	D	180	7	406	2

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	B	C	D
From	A	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.36	4.19	0.6	A	496	744
B	0.03	7.06	0.0	A	17	25
C	0.31	3.39	0.5	A	499	749
D	0.33	3.14	0.5	A	595	893

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	496	124	419	1386	0.358	494	387	0.0	0.6	4.166	A
B	17	4	897	546	0.030	16	15	0.0	0.0	7.033	A
C	499	125	276	1599	0.312	497	638	0.0	0.5	3.375	A
D	595	149	212	1784	0.334	593	561	0.0	0.5	3.124	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	496	124	420	1385	0.358	496	388	0.6	0.6	4.191	A
B	17	4	901	544	0.030	17	15	0.0	0.0	7.060	A
C	499	125	277	1598	0.312	499	640	0.5	0.5	3.389	A
D	595	149	213	1783	0.334	595	563	0.5	0.5	3.135	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	496	124	420	1385	0.358	496	388	0.6	0.6	4.191	A
B	17	4	901	544	0.030	17	15	0.0	0.0	7.060	A
C	499	125	277	1598	0.312	499	640	0.5	0.5	3.389	A
D	595	149	213	1783	0.334	595	563	0.5	0.5	3.135	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	496	124	420	1385	0.358	496	388	0.6	0.6	4.191	A
B	17	4	901	544	0.030	17	15	0.0	0.0	7.060	A
C	499	125	277	1598	0.312	499	640	0.5	0.5	3.389	A
D	595	149	213	1783	0.334	595	563	0.5	0.5	3.135	A

– 08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	496	124	420	1385	0.358	496	388	0.6	0.6	4.191	A
B	17	4	901	544	0.030	17	15	0.0	0.0	7.060	A
C	499	125	277	1598	0.312	499	640	0.5	0.5	3.389	A
D	595	149	213	1783	0.334	595	563	0.5	0.5	3.135	A

– 09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	496	124	420	1385	0.358	496	388	0.6	0.6	4.191	A
B	17	4	901	544	0.030	17	15	0.0	0.0	7.060	A
C	499	125	277	1598	0.312	499	640	0.5	0.5	3.389	A
D	595	149	213	1783	0.334	595	563	0.5	0.5	3.135	A

2028 With Committed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.81	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D8	2028 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	536	100.000
B		FLAT	✓	17	100.000
C		FLAT	✓	543	100.000

D		FLAT	✓	647	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	6	240	289
	B	1	0	11	5
	C	222	4	2	315
	D	193	8	444	2

Vehicle Mix

– **Heavy Vehicle Percentages**

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.39	4.52	0.7	A	536	804
B	0.03	7.62	0.0	A	17	26
C	0.34	3.58	0.5	A	543	815
D	0.37	3.31	0.6	A	647	971

Main Results for each time segment

– **07:45 - 08:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	458	1361	0.394	533	415	0.0	0.7	4.486	A
B	17	4	974	508	0.034	17	18	0.0	0.0	7.586	A
C	543	136	297	1585	0.343	541	694	0.0	0.5	3.562	A
D	647	162	229	1772	0.365	645	609	0.0	0.6	3.299	A

– **08:00 - 08:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	460	1360	0.394	536	417	0.7	0.7	4.520	A

B	17	4	978	506	0.034	17	18	0.0	0.0	7.622	A
C	543	136	298	1584	0.343	543	697	0.5	0.5	3.579	A
D	647	162	230	1771	0.365	647	611	0.6	0.6	3.313	A

– **08:15 - 08:30**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	460	1360	0.394	536	417	0.7	0.7	4.520	A
B	17	4	978	506	0.034	17	18	0.0	0.0	7.622	A
C	543	136	298	1584	0.343	543	697	0.5	0.5	3.579	A
D	647	162	230	1771	0.365	647	611	0.6	0.6	3.313	A

– **08:30 - 08:45**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	460	1360	0.394	536	417	0.7	0.7	4.520	A
B	17	4	978	506	0.034	17	18	0.0	0.0	7.622	A
C	543	136	298	1584	0.343	543	697	0.5	0.5	3.579	A
D	647	162	230	1771	0.365	647	611	0.6	0.6	3.313	A

– **08:45 - 09:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	460	1360	0.394	536	417	0.7	0.7	4.520	A
B	17	4	978	506	0.034	17	18	0.0	0.0	7.622	A
C	543	136	298	1584	0.343	543	697	0.5	0.5	3.579	A
D	647	162	230	1771	0.365	647	611	0.6	0.6	3.313	A

– **09:00 - 09:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	536	134	460	1360	0.394	536	417	0.7	0.7	4.520	A
B	17	4	978	506	0.034	17	18	0.0	0.0	7.622	A
C	543	136	298	1584	0.343	543	697	0.5	0.5	3.579	A
D	647	162	230	1771	0.365	647	611	0.6	0.6	3.313	A

2038 With Committed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.07	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D9	2038 With Committed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	574	100.000
B		FLAT	✓	19	100.000
C		FLAT	✓	587	100.000
D		FLAT	✓	698	100.000

Origin-Destination Data

– Demand (PCU/hr)

	To				
		A	**B**	**C**	**D**
From	**A**	1	6	257	310
	B	2	0	12	5
	C	238	4	3	342
	D	207	8	481	2

Vehicle Mix

– Heavy Vehicle Percentages

	To				
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.43	4.88	0.8	A	574	861
B	0.04	8.30	0.0	A	19	29
C	0.37	3.80	0.6	A	587	881
D	0.40	3.51	0.7	A	698	1047

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	496	1338	0.429	571	446	0.0	0.8	4.839	A
B	19	5	1049	471	0.041	19	18	0.0	0.0	8.250	A
C	587	147	319	1570	0.374	585	750	0.0	0.6	3.773	A
D	698	175	247	1759	0.397	695	656	0.0	0.7	3.494	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	498	1337	0.429	574	448	0.8	0.8	4.885	A
B	19	5	1054	468	0.041	19	18	0.0	0.0	8.297	A
C	587	147	320	1568	0.374	587	753	0.6	0.6	3.795	A
D	698	175	248	1758	0.397	698	659	0.7	0.7	3.513	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	498	1337	0.429	574	448	0.8	0.8	4.885	A
B	19	5	1054	468	0.041	19	18	0.0	0.0	8.297	A
C	587	147	320	1568	0.374	587	753	0.6	0.6	3.795	A
D	698	175	248	1758	0.397	698	659	0.7	0.7	3.513	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	498	1337	0.429	574	448	0.8	0.8	4.885	A
B	19	5	1054	468	0.041	19	18	0.0	0.0	8.297	A
C	587	147	320	1568	0.374	587	753	0.6	0.6	3.795	A
D	698	175	248	1758	0.397	698	659	0.7	0.7	3.513	A

– 08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	498	1337	0.429	574	448	0.8	0.8	4.885	A
B	19	5	1054	468	0.041	19	18	0.0	0.0	8.297	A
C	587	147	320	1568	0.374	587	753	0.6	0.6	3.795	A
D	698	175	248	1758	0.397	698	659	0.7	0.7	3.513	A

– 09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	574	144	498	1337	0.429	574	448	0.8	0.8	4.885	A
B	19	5	1054	468	0.041	19	18	0.0	0.0	8.297	A
C	587	147	320	1568	0.374	587	753	0.6	0.6	3.795	A
D	698	175	248	1758	0.397	698	659	0.7	0.7	3.513	A

2023 With Committed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.98	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D10	2023 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	643	100.000
B		FLAT	✓	13	100.000
C		FLAT	✓	574	100.000
D		FLAT	✓	532	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	2	144	496
	B	1	0	8	4
	C	174	4	0	396
	D	254	2	271	5

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.44	4.50	0.8	A	643	965
B	0.02	7.12	0.0	A	13	20
C	0.40	4.31	0.7	A	574	861
D	0.29	2.92	0.4	A	532	798

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	281	1472	0.437	640	428	0.0	0.8	4.464	A
B	13	3	913	538	0.024	13	8	0.0	0.0	7.091	A
C	574	144	505	1440	0.399	571	421	0.0	0.7	4.278	A
D	532	133	179	1808	0.294	530	897	0.0	0.4	2.912	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	282	1471	0.437	643	430	0.8	0.8	4.500	A
B	13	3	917	536	0.024	13	8	0.0	0.0	7.118	A
C	574	144	507	1438	0.399	574	423	0.7	0.7	4.312	A
D	532	133	180	1808	0.294	532	901	0.4	0.4	2.920	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	282	1471	0.437	643	430	0.8	0.8	4.500	A
B	13	3	917	536	0.024	13	8	0.0	0.0	7.119	A
C	574	144	507	1438	0.399	574	423	0.7	0.7	4.312	A
D	532	133	180	1808	0.294	532	901	0.4	0.4	2.920	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	282	1471	0.437	643	430	0.8	0.8	4.500	A
B	13	3	917	536	0.024	13	8	0.0	0.0	7.119	A
C	574	144	507	1438	0.399	574	423	0.7	0.7	4.312	A
D	532	133	180	1808	0.294	532	901	0.4	0.4	2.920	A

– 18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	282	1471	0.437	643	430	0.8	0.8	4.500	A
B	13	3	917	536	0.024	13	8	0.0	0.0	7.119	A
C	574	144	507	1438	0.399	574	423	0.7	0.7	4.312	A
D	532	133	180	1808	0.294	532	901	0.4	0.4	2.920	A

– 18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	643	161	282	1471	0.437	643	430	0.8	0.8	4.500	A
B	13	3	917	536	0.024	13	8	0.0	0.0	7.119	A
C	574	144	507	1438	0.399	574	423	0.7	0.7	4.312	A
D	532	133	180	1808	0.294	532	901	0.4	0.4	2.920	A

2028 With Committed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.35	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D11	2028 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	703	100.000
B		FLAT	✓	14	100.000
C		FLAT	✓	627	100.000
D		FLAT	✓	582	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	2	158	542
	B	1	0	8	5
	C	189	5	0	433
	D	278	2	296	6

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.48	4.96	1.0	A	703	1055
B	0.03	7.77	0.0	A	14	21
C	0.45	4.79	0.8	A	627	941
D	0.32	3.07	0.5	A	582	873

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	703	176	308	1455	0.483	699	467	0.0	1.0	4.907	A
B	14	4	998	496	0.029	14	9	0.0	0.0	7.730	A
C	627	157	552	1407	0.446	624	460	0.0	0.8	4.740	A
D	582	146	195	1797	0.324	580	981	0.0	0.5	3.057	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	703	176	309	1454	0.483	703	469	1.0	1.0	4.960	A
B	14	4	1003	494	0.029	14	9	0.0	0.0	7.772	A
C	627	157	555	1404	0.446	627	462	0.8	0.8	4.792	A
D	582	146	196	1796	0.324	582	986	0.5	0.5	3.068	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	703	176	309	1454	0.483	703	469	1.0	1.0	4.960	A
B	14	4	1003	494	0.029	14	9	0.0	0.0	7.772	A
C	627	157	555	1404	0.446	627	462	0.8	0.8	4.792	A
D	582	146	196	1796	0.324	582	986	0.5	0.5	3.068	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	703	176	309	1454	0.483	703	469	1.0	1.0	4.960	A
B	14	4	1003	494	0.029	14	9	0.0	0.0	7.772	A
C	627	157	555	1404	0.446	627	462	0.8	0.8	4.792	A
D	582	146	196	1796	0.324	582	986	0.5	0.5	3.068	A

– 18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	703	176	309	1454	0.483	703	469	1.0	1.0	4.960	A
B	14	4	1003	494	0.029	14	9	0.0	0.0	7.772	A
C	627	157	555	1404	0.446	627	462	0.8	0.8	4.792	A
D	582	146	196	1796	0.324	582	986	0.5	0.5	3.068	A

– 18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	703	176	309	1454	0.483	703	469	1.0	1.0	4.960	A
B	14	4	1003	494	0.029	14	9	0.0	0.0	7.772	A
C	627	157	555	1404	0.446	627	462	0.8	0.8	4.792	A
D	582	146	196	1796	0.324	582	986	0.5	0.5	3.068	A

2038 With Committed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.80	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D12	2038 With Committed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	763	100.000
B		FLAT	✓	15	100.000
C		FLAT	✓	680	100.000

D		FLAT	✓	631	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	3	171	588
	B	1	0	9	5
	C	205	5	0	470
	D	301	3	321	6

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.53	5.52	1.2	A	763	1145
B	0.03	8.53	0.0	A	15	23
C	0.50	5.38	1.0	A	680	1020
D	0.35	3.23	0.6	A	631	947

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	334	1439	0.530	758	506	0.0	1.2	5.440	A
B	15	4	1081	455	0.033	15	11	0.0	0.0	8.473	A
C	680	170	598	1375	0.495	676	499	0.0	1.0	5.303	A
D	631	158	211	1785	0.353	629	1063	0.0	0.6	3.217	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	335	1438	0.531	763	508	1.2	1.2	5.520	A

B	15	4	1087	452	0.034	15	11	0.0	0.0	8.533	A
C	680	170	601	1372	0.496	680	501	1.0	1.0	5.381	A
D	631	158	212	1784	0.354	631	1069	0.6	0.6	3.230	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	335	1438	0.531	763	508	1.2	1.2	5.520	A
B	15	4	1087	452	0.034	15	11	0.0	0.0	8.533	A
C	680	170	601	1372	0.496	680	501	1.0	1.0	5.382	A
D	631	158	212	1784	0.354	631	1069	0.6	0.6	3.230	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	335	1438	0.531	763	508	1.2	1.2	5.520	A
B	15	4	1087	452	0.034	15	11	0.0	0.0	8.533	A
C	680	170	601	1372	0.496	680	501	1.0	1.0	5.382	A
D	631	158	212	1784	0.354	631	1069	0.6	0.6	3.230	A

– 18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	335	1438	0.531	763	508	1.2	1.2	5.520	A
B	15	4	1087	452	0.034	15	11	0.0	0.0	8.533	A
C	680	170	601	1372	0.496	680	501	1.0	1.0	5.382	A
D	631	158	212	1784	0.354	631	1069	0.6	0.6	3.230	A

– 18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	763	191	335	1438	0.531	763	508	1.2	1.2	5.520	A
B	15	4	1087	452	0.034	15	11	0.0	0.0	8.533	A
C	680	170	601	1372	0.496	680	501	1.0	1.0	5.382	A
D	631	158	212	1784	0.354	631	1069	0.6	0.6	3.230	A

2023 With Committed and Proposed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	3.79	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D13	2023 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	561	100.000
B		FLAT	✓	17	100.000
C		FLAT	✓	522	100.000
D		FLAT	✓	615	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	6	251	303
	B	1	0	10	5
	C	229	3	2	288
	D	200	7	406	2

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.41	4.52	0.7	A	561	842
B	0.03	7.51	0.0	A	17	25
C	0.33	3.54	0.5	A	522	783
D	0.35	3.23	0.6	A	615	923

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	419	1386	0.405	558	429	0.0	0.7	4.487	A
B	17	4	961	515	0.032	16	16	0.0	0.0	7.478	A
C	522	131	311	1575	0.332	520	667	0.0	0.5	3.527	A
D	615	154	235	1767	0.348	613	596	0.0	0.5	3.223	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	420	1385	0.405	561	431	0.7	0.7	4.522	A
B	17	4	965	512	0.032	17	16	0.0	0.0	7.513	A
C	522	131	312	1574	0.332	522	669	0.5	0.5	3.541	A
D	615	154	236	1767	0.348	615	598	0.5	0.6	3.235	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	420	1385	0.405	561	431	0.7	0.7	4.522	A
B	17	4	965	512	0.032	17	16	0.0	0.0	7.513	A
C	522	131	312	1574	0.332	522	669	0.5	0.5	3.541	A
D	615	154	236	1767	0.348	615	598	0.6	0.6	3.235	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	420	1385	0.405	561	431	0.7	0.7	4.522	A
B	17	4	965	512	0.032	17	16	0.0	0.0	7.513	A
C	522	131	312	1574	0.332	522	669	0.5	0.5	3.541	A
D	615	154	236	1767	0.348	615	598	0.6	0.6	3.235	A

– 08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	420	1385	0.405	561	431	0.7	0.7	4.522	A
B	17	4	965	512	0.032	17	16	0.0	0.0	7.513	A
C	522	131	312	1574	0.332	522	669	0.5	0.5	3.541	A
D	615	154	236	1767	0.348	615	598	0.6	0.6	3.235	A

– 09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	561	140	420	1385	0.405	561	431	0.7	0.7	4.522	A
B	17	4	965	512	0.032	17	16	0.0	0.0	7.513	A
C	522	131	312	1574	0.332	522	669	0.5	0.5	3.541	A
D	615	154	236	1767	0.348	615	598	0.6	0.6	3.235	A

2028 With Committed and Proposed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.05	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D14	2028 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	600	100.000
B		FLAT	✓	18	100.000
C		FLAT	✓	566	100.000
D		FLAT	✓	667	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	6	269	324
	B	2	0	11	5
	C	245	4	2	315
	D	213	8	444	2

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	B	C	D
From	A	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.44	4.90	0.8	A	600	900
B	0.04	8.17	0.0	A	18	27
C	0.36	3.75	0.6	A	566	849
D	0.38	3.43	0.6	A	667	1001

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	458	1361	0.441	597	459	0.0	0.8	4.853	A
B	18	5	1037	477	0.038	18	18	0.0	0.0	8.123	A
C	566	142	332	1560	0.363	564	723	0.0	0.6	3.733	A
D	667	167	253	1755	0.380	665	643	0.0	0.6	3.412	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	460	1360	0.441	600	461	0.8	0.8	4.900	A
B	18	5	1042	474	0.038	18	18	0.0	0.0	8.171	A
C	566	142	334	1559	0.363	566	726	0.6	0.6	3.753	A
D	667	167	254	1754	0.380	667	646	0.6	0.6	3.427	A

– 08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	460	1360	0.441	600	461	0.8	0.8	4.900	A
B	18	5	1042	474	0.038	18	18	0.0	0.0	8.171	A
C	566	142	334	1559	0.363	566	726	0.6	0.6	3.753	A
D	667	167	254	1754	0.380	667	646	0.6	0.6	3.427	A

– 08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	460	1360	0.441	600	461	0.8	0.8	4.900	A
B	18	5	1042	474	0.038	18	18	0.0	0.0	8.171	A

C	566	142	334	1559	0.363	566	726	0.6	0.6	3.753	A
D	667	167	254	1754	0.380	667	646	0.6	0.6	3.427	A

– **08:45 - 09:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	460	1360	0.441	600	461	0.8	0.8	4.900	A
B	18	5	1042	474	0.038	18	18	0.0	0.0	8.171	A
C	566	142	334	1559	0.363	566	726	0.6	0.6	3.753	A
D	667	167	254	1754	0.380	667	646	0.6	0.6	3.427	A

– **09:00 - 09:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	600	150	460	1360	0.441	600	461	0.8	0.8	4.900	A
B	18	5	1042	474	0.038	18	18	0.0	0.0	8.171	A
C	566	142	334	1559	0.363	566	726	0.6	0.6	3.753	A
D	667	167	254	1754	0.380	667	646	0.6	0.6	3.427	A

2038 With Committed and Proposed Development, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.34	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D15	2038 With Committed and Proposed Development	AM	FLAT	07:45	09:15	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	639	100.000
B		FLAT	✓	18	100.000

C		FLAT	✓	609	100.000
D		FLAT	✓	719	100.000

Origin-Destination Data

– Demand (PCU/hr)

	To				
From		**A**	**B**	**C**	**D**
	A	1	7	286	345
	B	2	0	11	5
	C	260	4	3	342
	D	227	8	481	3

Vehicle Mix

– Heavy Vehicle Percentages

	To				
From		**A**	**B**	**C**	**D**
	A	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.48	5.34	0.9	A	639	959
B	0.04	8.92	0.0	A	18	27
C	0.39	3.99	0.7	A	609	914
D	0.41	3.64	0.7	A	719	1079

Main Results for each time segment

– 07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	639	160	497	1337	0.478	635	488	0.0	0.9	5.280	A
B	18	5	1113	439	0.041	18	19	0.0	0.0	8.852	A
C	609	152	354	1545	0.394	606	777	0.0	0.7	3.959	A
D	719	180	269	1743	0.412	716	692	0.0	0.7	3.617	A

– 08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	639	160	499	1336	0.478	639	490	0.9	0.9	5.344	A
B	18	5	1119	436	0.042	18	19	0.0	0.0	8.919	A
C	609	152	356	1543	0.395	609	781	0.7	0.7	3.987	A
D	719	180	270	1742	0.413	719	695	0.7	0.7	3.640	A

– **08:15 - 08:30**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	639	160	499	1336	0.478	639	490	0.9	0.9	5.344	A
B	18	5	1119	436	0.042	18	19	0.0	0.0	8.919	A
C	609	152	356	1543	0.395	609	781	0.7	0.7	3.987	A
D	719	180	270	1742	0.413	719	695	0.7	0.7	3.640	A

– **08:30 - 08:45**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	639	160	499	1336	0.478	639	490	0.9	0.9	5.344	A
B	18	5	1119	436	0.042	18	19	0.0	0.0	8.919	A
C	609	152	356	1543	0.395	609	781	0.7	0.7	3.987	A
D	719	180	270	1742	0.413	719	695	0.7	0.7	3.640	A

– **08:45 - 09:00**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	639	160	499	1336	0.478	639	490	0.9	0.9	5.344	A
B	18	5	1119	436	0.042	18	19	0.0	0.0	8.919	A
C	609	152	356	1543	0.395	609	781	0.7	0.7	3.987	A
D	719	180	270	1742	0.413	719	695	0.7	0.7	3.640	A

– **09:00 - 09:15**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	639	160	499	1336	0.478	639	490	0.9	0.9	5.344	A
B	18	5	1119	436	0.042	18	19	0.0	0.0	8.919	A
C	609	152	356	1543	0.395	609	781	0.7	0.7	3.987	A
D	719	180	270	1742	0.413	719	695	0.7	0.7	3.640	A

2023 With Committed and Proposed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.19	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D16	2023 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	695	100.000
B		FLAT	✓	13	100.000
C		FLAT	✓	585	100.000
D		FLAT	✓	548	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	**B**	**C**	**D**
From	**A**	1	2	156	536
	B	1	0	8	4
	C	185	4	0	396
	D	270	2	271	5

Vehicle Mix

– **Heavy Vehicle Percentages**

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.47	4.80	0.9	A	695	1043
B	0.03	7.49	0.0	A	13	20
C	0.41	4.52	0.7	A	585	878
D	0.30	2.98	0.5	A	548	822

Main Results for each time segment

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	281	1472	0.472	691	455	0.0	0.9	4.755	A
B	13	3	964	513	0.025	13	8	0.0	0.0	7.452	A
C	585	146	544	1412	0.414	582	433	0.0	0.7	4.474	A
D	548	137	190	1800	0.304	546	936	0.0	0.5	2.968	A

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	282	1471	0.473	695	457	0.9	0.9	4.802	A
B	13	3	969	511	0.026	13	8	0.0	0.0	7.488	A
C	585	146	547	1410	0.415	585	435	0.7	0.7	4.515	A
D	548	137	191	1800	0.305	548	941	0.5	0.5	2.976	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	282	1471	0.473	695	457	0.9	0.9	4.802	A
B	13	3	969	511	0.026	13	8	0.0	0.0	7.489	A
C	585	146	547	1410	0.415	585	435	0.7	0.7	4.515	A
D	548	137	191	1800	0.305	548	941	0.5	0.5	2.976	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	282	1471	0.473	695	457	0.9	0.9	4.802	A
B	13	3	969	511	0.026	13	8	0.0	0.0	7.489	A
C	585	146	547	1410	0.415	585	435	0.7	0.7	4.515	A
D	548	137	191	1800	0.305	548	941	0.5	0.5	2.976	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	282	1471	0.473	695	457	0.9	0.9	4.802	A
B	13	3	969	511	0.026	13	8	0.0	0.0	7.489	A
C	585	146	547	1410	0.415	585	435	0.7	0.7	4.515	A
D	548	137	191	1800	0.305	548	941	0.5	0.5	2.976	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	695	174	282	1471	0.473	695	457	0.9	0.9	4.802	A
B	13	3	969	511	0.026	13	8	0.0	0.0	7.489	A
C	585	146	547	1410	0.415	585	435	0.7	0.7	4.515	A
D	548	137	191	1800	0.305	548	941	0.5	0.5	2.976	A

2028 With Committed and Proposed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	4.60	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D17	2028 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	755	100.000
B		FLAT	✓	14	100.000
C		FLAT	✓	638	100.000
D		FLAT	✓	598	100.000

Origin-Destination Data

– **Demand (PCU/hr)**

		To			
		A	B	C	D
From	A	1	3	169	582
	B	1	0	8	5
	C	200	5	0	433
	D	294	2	296	6

Vehicle Mix

– Heavy Vehicle Percentages

	To				
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.52	5.33	1.1	A	755	1133
B	0.03	8.21	0.0	A	14	21
C	0.46	5.04	0.9	A	638	957
D	0.33	3.13	0.5	A	598	897

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	308	1455	0.519	751	494	0.0	1.1	5.259	A
B	14	4	1049	471	0.030	14	10	0.0	0.0	8.154	A
C	638	160	592	1379	0.463	634	471	0.0	0.9	4.983	A
D	598	150	206	1789	0.334	596	1020	0.0	0.5	3.118	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	309	1454	0.519	755	496	1.1	1.1	5.329	A
B	14	4	1054	468	0.030	14	10	0.0	0.0	8.206	A
C	638	160	595	1377	0.463	638	473	0.9	0.9	5.045	A
D	598	150	207	1788	0.334	598	1026	0.5	0.5	3.130	A

– 17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	309	1454	0.519	755	496	1.1	1.1	5.329	A
B	14	4	1054	468	0.030	14	10	0.0	0.0	8.206	A
C	638	160	595	1376	0.464	638	473	0.9	0.9	5.045	A
D	598	150	207	1788	0.334	598	1026	0.5	0.5	3.130	A

– 18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	309	1454	0.519	755	496	1.1	1.1	5.329	A
B	14	4	1054	468	0.030	14	10	0.0	0.0	8.206	A

C	638	160	595	1376	0.464	638	473	0.9	0.9	5.045	A
D	598	150	207	1788	0.334	598	1026	0.5	0.5	3.130	A

– **18:15 - 18:30**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	309	1454	0.519	755	496	1.1	1.1	5.329	A
B	14	4	1054	468	0.030	14	10	0.0	0.0	8.206	A
C	638	160	595	1376	0.464	638	473	0.9	0.9	5.045	A
D	598	150	207	1788	0.334	598	1026	0.5	0.5	3.130	A

– **18:30 - 18:45**

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	755	189	309	1454	0.519	755	496	1.1	1.1	5.329	A
B	14	4	1054	468	0.030	14	10	0.0	0.0	8.206	A
C	638	160	595	1376	0.464	638	473	0.9	0.9	5.045	A
D	598	150	207	1788	0.334	598	1026	0.5	0.5	3.130	A

2038 With Committed and Proposed Development, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		A, B, C, D	5.12	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time period length (min)	Time segment length (min)	Run automatically
D18	2038 With Committed and Proposed Development	PM	FLAT	17:15	18:45	90	15	✓

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.30

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		FLAT	✓	814	100.000
B		FLAT	✓	15	100.000

C		FLAT	✓	691	100.000
D		FLAT	✓	701	100.000

Origin-Destination Data

– Demand (PCU/hr)

		To			
		A	**B**	**C**	**D**
From	**A**	1	3	182	628
	B	1	0	9	5
	C	216	5	0	470
	D	371	3	321	6

Vehicle Mix

– Heavy Vehicle Percentages

		To			
		A	**B**	**C**	**D**
From	**A**	3	3	3	3
	B	3	3	3	3
	C	3	3	3	3
	D	3	3	3	3

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.57	5.97	1.3	A	814	1221
B	0.04	9.06	0.0	A	15	23
C	0.51	5.70	1.1	A	691	1037
D	0.39	3.46	0.7	A	701	1052

Main Results for each time segment

– 17:15 - 17:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	814	204	334	1439	0.566	809	586	0.0	1.3	5.865	A
B	15	4	1131	430	0.035	15	11	0.0	0.0	8.983	A
C	691	173	637	1347	0.513	687	509	0.0	1.1	5.606	A
D	701	175	222	1777	0.394	698	1102	0.0	0.7	3.444	A

– 17:30 - 17:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service

A	814	204	335	1438	0.566	814	589	1.3	1.3	5.971	A
B	15	4	1138	427	0.036	15	11	0.0	0.0	9.059	A
C	691	173	641	1344	0.514	691	512	1.1	1.1	5.702	A
D	701	175	223	1776	0.395	701	1109	0.7	0.7	3.464	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	814	204	335	1438	0.566	814	589	1.3	1.3	5.971	A
B	15	4	1138	426	0.036	15	11	0.0	0.0	9.059	A
C	691	173	641	1344	0.514	691	512	1.1	1.1	5.702	A
D	701	175	223	1776	0.395	701	1109	0.7	0.7	3.464	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	814	204	335	1438	0.566	814	589	1.3	1.3	5.971	A
B	15	4	1138	426	0.036	15	11	0.0	0.0	9.059	A
C	691	173	641	1344	0.514	691	512	1.1	1.1	5.702	A
D	701	175	223	1776	0.395	701	1109	0.7	0.7	3.464	A

18:15 - 18:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	814	204	335	1438	0.566	814	589	1.3	1.3	5.971	A
B	15	4	1138	426	0.036	15	11	0.0	0.0	9.059	A
C	691	173	641	1344	0.514	691	512	1.1	1.1	5.702	A
D	701	175	223	1776	0.395	701	1109	0.7	0.7	3.464	A

18:30 - 18:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	814	204	335	1438	0.566	814	589	1.3	1.3	5.971	A
B	15	4	1138	426	0.036	15	11	0.0	0.0	9.059	A
C	691	173	641	1344	0.514	691	512	1.1	1.1	5.702	A
D	701	175	223	1776	0.395	701	1109	0.7	0.7	3.464	A

FG13: '2038 AM with committed'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	102	28	0	236	366
	B	0	0	49	22	0	645	716
	C	84	121	0	113	0	220	538
	D	32	46	12	0	0	84	174
	E	22	32	182	43	0	59	338
	F	448	644	180	43	0	0	1315
	Tot.	586	843	525	249	0	1244	3447

FG14: '2023 PM with committed'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	129	36	0	224	389
	B	0	0	65	24	0	583	672
	C	34	59	0	50	0	159	302
	D	4	8	11	0	0	19	42
	E	4	8	199	50	0	21	282
	F	262	436	230	58	0	0	986
	Tot.	304	511	634	218	0	1006	2673

FG15: '2028 PM with committed'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	140	40	0	245	425
	B	0	0	71	26	0	637	734
	C	38	64	0	55	0	173	330
	D	5	8	12	0	0	21	46
	E	5	8	217	55	0	23	308
	F	286	476	251	63	0	0	1076
	Tot.	334	556	691	239	0	1099	2919

FG16: '2038 PM with committed'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	152	43	0	266	461

	B	0	0	77	28	0	691	796
	C	41	70	0	60	0	188	359
	D	5	9	13	0	0	23	50
	E	5	9	235	60	0	25	334
	F	311	517	272	69	0	0	1169
	Tot.	362	605	749	260	0	1193	3169

FG17: 'AM Peak Development Trips'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	11	0	0	0	11
	B	0	0	5	0	0	0	5
	C	8	11	0	10	0	20	49
	D	0	0	1	0	0	0	1
	E	0	0	19	0	0	0	19
	F	0	0	19	0	0	0	19
	Tot.	8	11	55	10	0	20	104

FG18: 'PM Peak Development Trips'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	5	0	0	0	5
	B	0	0	3	0	0	0	3
	C	6	10	0	9	0	28	53
	D	0	0	0	0	0	0	0
	E	0	0	8	0	0	0	8
	F	0	0	10	0	0	0	10
	Tot.	6	10	26	9	0	28	79

FG19: '2023 AM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	98	24	0	199	321

	B	0	0	47	18	0	544	609
	C	82	117	0	109	0	214	522
	D	27	39	12	0	0	71	149
	E	18	27	175	36	0	49	305
	F	378	543	173	36	0	0	1130
	Tot.	505	726	505	223	0	1077	3036

FG20: '2028 AM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	106	26	0	217	349
	B	0	0	50	20	0	595	665
	C	87	125	0	116	0	227	555
	D	29	42	13	0	0	77	161
	E	20	29	188	40	0	54	331
	F	413	594	186	40	0	0	1233
	Tot.	549	790	543	242	0	1170	3294

FG21: '2038 AM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	113	28	0	236	377
	B	0	0	54	22	0	645	721
	C	92	132	0	123	0	240	587
	D	32	46	13	0	0	84	175
	E	22	32	201	43	0	59	357
	F	448	644	199	43	0	0	1334
	Tot.	594	854	580	259	0	1264	3551

FG22: '2023 PM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	134	36	0	224	394

	B	0	0	68	24	0	583	675
	C	40	69	0	59	0	187	355
	D	4	8	11	0	0	19	42
	E	4	8	207	50	0	21	290
	F	262	436	240	58	0	0	996
	Tot.	310	521	660	227	0	1034	2752

FG23: '2028 PM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	145	40	0	245	430
	B	0	0	74	26	0	637	737
	C	44	74	0	64	0	201	383
	D	5	8	12	0	0	21	46
	E	5	8	225	55	0	23	316
	F	286	476	261	63	0	0	1086
	Tot.	340	566	717	248	0	1127	2998

FG24: '2038 PM with committed + development'
Desired Flow :

	Destination							
Origin		A	B	C	D	E	F	Tot.
	A	0	0	157	43	0	266	466
	B	0	0	80	28	0	691	799
	C	47	80	0	69	0	216	412
	D	5	9	13	0	0	23	50
	E	5	9	243	60	0	25	342
	F	311	517	282	69	0	0	1179
	Tot.	368	615	775	269	0	1221	3248

Stage Timings

Scenario 1: '2023 AM without development' (FG2: '2023 AM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	61	7	21	7
Change Point	52	118	10	37

C2 - Rhebogue

Stage	1	2
Duration	23	81
Change Point	113	24

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	34	7	33	8	6
Change Point	8	50	65	106	2

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**71.7%**	**26.8**	**37.0**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**57.5%**	**5.8**	**8.8**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	88	56	1795	1331	4.2%	0.1	0.1	5.5	0.5	0.5
1/2	Clare Street EB Ahead	U	C1:E	88	544	2025	1502	36.2%	0.8	1.1	7.4	6.3	6.6
2/1	Pennywell Road EB Ahead	U	C1:G	21	102	1840	337	30.2%	1.2	1.4	50.0	2.9	3.1
2/2	Pennywell Road EB Ahead	U	C1:G	21	199	1948	357	55.7%	2.5	3.1	55.9	6.0	6.6
3/1	Dublin Road WB Ahead	U	C1:J	120	478	1865	1865	25.6%	0.0	0.2	1.3	0.0	0.2
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	88	822	1926	1428	57.5%	1.1	1.8	7.9	9.2	9.9
4/1	Clare Street WB	U	-	-	687	1935	1935	35.5%	0.0	0.3	1.4	0.0	0.3
6/1	Dublin Road EB	U	-	-	1006	1985	1985	50.7%	0.0	0.5	1.8	0.0	0.5
7/1	Pennywell Adv Ahead	U	C1:K	103	478	1940	1681	28.4%	0.1	0.3	2.5	2.0	2.2
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	22	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**71.7%**	**10.9**	**14.8**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	61	0	1865	964	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	61	743	2005	1036	71.7%	5.3	6.5	31.6	21.0	22.2

2/1	Park Road SB Left	U	C1:M	34	263	1730	505	52.1%	0.6	1.2	16.2	7.0	7.5
2/2	Park Road SB Right	U	C1:D	21	244	1856	340	71.7%	1.3	2.6	37.7	7.7	9.0
3/1	Dublin Road WB Ahead	U	C1:A	73	513	1915	1181	43.4%	1.7	2.1	14.7	8.8	9.2
3/2	Dublin Road WB Ahead Right	U	C1:A	73	582	2055	1267	45.9%	2.0	2.4	14.9	10.3	10.8
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17.8%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	293	1646	1646	17.8%	0.0	0.1	1.3	0.0	0.1
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**55.5%**	**4.7**	**6.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	23	185	1915	383	48.3%	1.7	2.2	42.9	5.6	6.0
1/2	Park Road SB Ahead	U	C2:B	23	228	2055	411	55.5%	2.1	2.7	43.3	5.6	6.2
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	81	269	1683:1587	781+419	22.4 : 22.4%	0.5	0.6	8.5	2.0	2.2
3/1	Park Road NB Ahead	U	C2:A	23	39	1915	383	10.2%	0.4	0.4	40.7	1.2	1.2
Ped Link: P1	Rhebogue	-	C2:D	23	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**64.6%**	**5.3**	**7.3**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	40:96	507	1965:2014	176+608	64.6 : 64.6%	0.8	1.7	12.2	4.5	5.4
2/1	Pa Healy Road WB	U	-	-	403	1995	1995	20.2%	0.0	0.1	1.1	0.0	0.1
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	55:7	147	1980:1717	863+63	15.9 : 15.9%	0.8	0.9	23.0	2.6	2.7

4/1	Pa Healy Road EB Right Left	U	C3:A	33	349	1948	552	63.2%	3.6	4.5	46.3	10.1	10.9
5/1	Park Road NB	U	-	-	187	1915	1915	9.8%	0.0	0.1	1.0	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 25.5 Total Delay for Signalled Lanes (pcuHr): 22.78 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 62.2 Total Delay for Signalled Lanes (pcuHr): 6.03 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 39.2 Total Delay for Signalled Lanes (pcuHr): 7.14 Cycle Time (s): 120
PRC Over All Lanes (%): 25.5 Total Delay Over All Lanes(pcuHr): 37.03

Stage Timings

Scenario 2: '2028 AM without development' (FG3: '2028 AM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	**1**	**2**	**3**	**4**
Duration	61	7	21	7
Change Point	0	66	78	105

C2 - Rhebogue

Stage	**1**	**2**
Duration	59	45
Change Point	0	67

C3 - Park Road Corbally Road

Stage	**1**	**2**	**3**	**4**	**5**
Duration	36	7	31	8	6
Change Point	0	44	59	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**78.4%**	**39.6**	**51.6**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**60.8%**	**6.2**	**9.4**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	88	61	1795	1331	4.6%	0.1	0.1	5.6	0.5	0.6
1/2	Clare Street EB Ahead	U	C1:E	88	595	2025	1502	39.6%	0.9	1.3	7.7	7.1	7.4
2/1	Pennywell Road EB Ahead	U	C1:G	21	112	1840	337	33.2%	1.3	1.6	50.6	3.2	3.5
2/2	Pennywell Road EB Ahead	U	C1:G	21	217	1948	357	60.8%	2.7	3.5	57.7	6.6	7.4
3/1	Dublin Road WB Ahead	U	C1:J	120	522	1865	1865	28.0%	0.0	0.2	1.3	2.1	2.3
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	88	751	2005	1487	50.5%	1.0	1.5	7.0	6.3	6.9
4/1	Clare Street WB	U	-	-	751	1935	1935	38.8%	0.0	0.3	1.5	2.2	2.5
6/1	Dublin Road EB	U	-	-	1099	1985	1985	55.4%	0.0	0.6	2.0	2.8	3.4
7/1	Pennywell Adv Ahead	U	C1:K	103	522	1940	1681	31.0%	0.2	0.4	2.6	2.3	2.5
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	22	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**78.4%**	**19.2**	**24.4**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	61	0	1865	964	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	61	812	2005	1036	78.4%	6.0	7.8	34.6	23.8	25.5

2/1	Park Road SB Left	U	C1:M	34	287	1730	505	56.9%	4.1	4.7	59.5	9.3	10.0
2/2	Park Road SB Right	U	C1:D	21	266	1856	340	78.2%	4.6	6.4	86.0	8.8	10.5
3/1	Dublin Road WB Ahead	U	C1:A	73	413	1915	1181	35.0%	1.3	1.6	13.6	6.7	6.9
3/2	Dublin Road WB Ahead Right	U	C1:A	73	785	2055	1267	61.9%	3.1	3.9	18.0	16.1	16.9
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10.5%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	173	1646	1646	10.5%	0.0	0.1	1.2	0.5	0.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**41.8%**	**6.5**	**7.3**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	59	202	1915	957	21.1%	1.7	1.8	32.2	5.7	5.8
1/2	Park Road SB Ahead	U	C2:B	59	248	2055	1027	24.1%	2.4	2.5	36.7	7.3	7.5
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	45	295	1683:1587	459+246	41.8 : 41.8%	2.1	2.4	29.8	4.9	5.3
3/1	Park Road NB Ahead	U	C2:A	59	191	1915	957	19.9%	0.4	0.5	9.0	0.9	1.0
Ped Link: P1	Rhebogue	-	C2:D	59	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**73.5%**	**7.7**	**10.5**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	42:96	556	1965:2014	185+632	68.1 : 68.1%	2.6	3.7	23.8	11.7	12.8
2/1	Pa Healy Road WB	U	-	-	441	1995	1995	22.1%	0.0	0.1	1.2	0.0	0.1
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	57:7	159	1980:1717	893+66	16.6 : 16.6%	0.9	1.0	22.0	2.8	2.9

4/1	Pa Healy Road EB Right Left	U	C3:A	31	382	1948	519	73.5%	4.3	5.6	53.0	11.6	12.9
5/1	Park Road NB	U	-	-	206	1915	1915	10.8%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 14.8 Total Delay for Signalled Lanes (pcuHr): 32.85 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 115.2 Total Delay for Signalled Lanes (pcuHr): 7.26 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 22.4 Total Delay for Signalled Lanes (pcuHr): 10.26 Cycle Time (s): 120
PRC Over All Lanes (%): 14.8 Total Delay Over All Lanes(pcuHr): 51.57

Stage Timings

Scenario 3: '2038 AM without development' (FG4: '2038 AM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	**1**	**2**	**3**	**4**
Duration	61	7	21	7
Change Point	0	66	78	105

C2 - Rhebogue

Stage	**1**	**2**
Duration	59	45
Change Point	0	67

C3 - Park Road Corbally Road

Stage	**1**	**2**	**3**	**4**	**5**
Duration	35	7	32	8	6
Change Point	0	43	58	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**85.2%**	**44.2**	**60.0**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**66.1%**	**6.8**	**10.6**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	88	67	1795	1331	5.0%	0.1	0.1	5.6	0.6	0.6
1/2	Clare Street EB Ahead	U	C1:E	88	645	2025	1502	42.9%	1.1	1.4	8.0	8.1	8.4
2/1	Pennywell Road EB Ahead	U	C1:G	21	121	1840	337	35.9%	1.4	1.7	51.1	3.5	3.8
2/2	Pennywell Road EB Ahead	U	C1:G	21	236	1948	357	66.1%	3.0	3.9	60.2	7.3	8.2
3/1	Dublin Road WB Ahead	U	C1:J	120	567	1865	1865	30.4%	0.0	0.2	1.4	3.2	3.4
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	88	815	2005	1487	54.8%	1.0	1.6	7.2	6.9	7.5
4/1	Clare Street WB	U	-	-	815	1935	1935	42.1%	0.0	0.4	1.6	2.7	3.1
6/1	Dublin Road EB	U	-	-	1193	1985	1985	60.1%	0.0	0.8	2.3	6.6	7.4
7/1	Pennywell Adv Ahead	U	C1:K	103	567	1940	1681	33.7%	0.2	0.4	2.7	2.5	2.7
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	22	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**85.2%**	**21.4**	**28.9**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	61	0	1865	964	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	61	881	2005	1036	85.0%	6.9	9.6	39.4	26.9	29.6

2/1	Park Road SB Left	U	C1:M	34	312	1730	505	61.8%	4.5	5.3	60.9	10.1	11.0
2/2	Park Road SB Right	U	C1:D	21	290	1856	340	85.2%	5.1	7.7	95.6	9.6	12.2
3/1	Dublin Road WB Ahead	U	C1:A	73	448	1915	1181	37.9%	1.4	1.7	14.0	7.5	7.8
3/2	Dublin Road WB Ahead Right	U	C1:A	73	851	2055	1267	67.2%	3.6	4.6	19.4	18.4	19.5
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11.4%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	188	1646	1646	11.4%	0.0	0.1	1.2	0.9	1.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**45.5%**	**7.1**	**8.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	59	221	1915	957	23.1%	1.9	2.0	32.8	6.3	6.4
1/2	Park Road SB Ahead	U	C2:B	59	268	2055	1027	26.1%	2.6	2.7	36.9	7.9	8.1
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	45	321	1683:1587	457+249	45.5 : 45.5%	2.3	2.7	30.5	5.7	6.1
3/1	Park Road NB Ahead	U	C2:A	59	207	1915	957	21.6%	0.4	0.5	9.1	0.9	1.1
Ped Link: P1	Rhebogue	-	C2:D	59	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**77.3%**	**8.9**	**12.4**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	41:96	603	1965:2014	181+620	75.3 : 75.3%	3.3	4.8	28.7	14.0	15.5
2/1	Pa Healy Road WB	U	-	-	478	1995	1995	24.0%	0.0	0.2	1.2	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	56:7	173	1980:1717	883+60	18.3 : 18.3%	1.0	1.1	22.6	3.1	3.2

4/1	Pa Healy Road EB Right Left	U	C3:A	32	414	1948	536	77.3%	4.6	6.3	54.5	12.7	14.3
5/1	Park Road NB	U	-	-	223	1915	1915	11.6%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	5.6	Total Delay for Signalled Lanes (pcuHr):	38.40	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	97.9	Total Delay for Signalled Lanes (pcuHr):	8.00	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	16.5	Total Delay for Signalled Lanes (pcuHr):	12.15	Cycle Time (s):	120
	PRC Over All Lanes (%):	5.6	Total Delay Over All Lanes(pcuHr):	59.96		

Stage Timings

Scenario 4: '2023 PM without development' (FG6: '2023 PM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	64	7	18	7
Change Point	0	69	81	105

C2 - Rhebogue

Stage	1	2
Duration	22	82
Change Point	0	30

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**79.6%**	**30.9**	**42.5**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**72.6%**	**6.8**	**10.4**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	91	87	1795	1376	6.3%	0.1	0.1	4.8	0.7	0.7
1/2	Clare Street EB Ahead	U	C1:E	91	583	2025	1553	37.6%	0.7	1.0	6.4	6.3	6.6
2/1	Pennywell Road EB Ahead	U	C1:G	18	162	1840	291	55.6%	2.1	2.7	60.4	5.0	5.6
2/2	Pennywell Road EB Ahead	U	C1:G	18	224	1948	308	72.6%	3.0	4.3	68.7	7.1	8.4
3/1	Dublin Road WB Ahead	U	C1:J	120	304	1865	1865	16.3%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	91	730	1865	1430	51.1%	0.8	1.3	6.4	8.9	9.4
4/1	Clare Street WB	U	-	-	510	1935	1935	26.4%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1004	1985	1985	50.6%	0.0	0.5	1.8	0.6	1.1
7/1	Pennywell Adv Ahead	U	C1:K	103	304	1940	1681	18.1%	0.1	0.2	2.4	1.3	1.4
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	19	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**	**14.1**	**16.9**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	64	0	1865	1010	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	64	807	2005	1086	74.3%	5.6	7.1	31.5	23.0	24.4

2/1	Park Road SB Left	U	C1:M	31	197	1730	461	42.7%	3.4	3.8	68.8	6.5	6.8
2/2	Park Road SB Right	U	C1:D	18	116	1856	294	39.5%	2.3	2.6	82.0	3.8	4.2
3/1	Dublin Road WB Ahead	U	C1:A	76	482	1915	1229	39.2%	1.4	1.7	12.7	7.6	8.0
3/2	Dublin Road WB Ahead Right	U	C1:A	76	498	2055	1319	37.8%	1.4	1.7	12.4	7.7	8.0
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**28.5%**	**0.0**	**0.2**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	469	1646	1646	28.5%	0.0	0.2	1.6	2.8	3.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**39.1%**	**4.1**	**4.9**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	22	126	1915	367	34.3%	1.3	1.6	45.0	4.1	4.4
1/2	Park Road SB Ahead	U	C2:B	22	154	2055	394	39.1%	1.7	2.0	47.0	5.1	5.4
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	82	277	1683:1587	1044+141	23.4 : 23.4%	0.5	0.7	8.6	2.9	3.1
3/1	Park Road NB Ahead	U	C2:A	22	62	1915	367	16.9%	0.6	0.7	38.2	1.0	1.1
Ped Link: P1	Rhebogue	-	C2:D	22	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**79.6%**	**5.9**	**10.0**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	775	1965:2014	211+762	79.6 : 79.6%	1.8	3.7	17.4	11.3	13.2
2/1	Pa Healy Road WB	U	-	-	618	1995	1995	31.0%	0.0	0.2	1.3	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	42	1980:1717	277+98	11.2 : 11.2%	0.3	0.3	28.0	0.5	0.5

4/1	Pa Healy Road EB Right Left	U	C3:A	22	298	1958	375	79.4%	3.8	5.7	68.5	9.4	11.3
5/1	Park Road NB	U	-	-	217	1915	1915	11.3%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	21.1	Total Delay for Signalled Lanes (pcuHr):	26.64	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	130.2	Total Delay for Signalled Lanes (pcuHr):	4.90	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	13.0	Total Delay for Signalled Lanes (pcuHr):	9.74	Cycle Time (s):	120
	PRC Over All Lanes (%):	13.0	Total Delay Over All Lanes(pcuHr):	42.46		

Stage Timings

Scenario 5: '2028 PM without development' (FG7: '2028 PM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	**1**	**2**	**3**	**4**
Duration	64	7	18	7
Change Point	0	69	81	105

C2 - Rhebogue

Stage	**1**	**2**
Duration	20	84
Change Point	0	28

C3 - Park Road Corbally Road

Stage	**1**	**2**	**3**	**4**	**5**
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**87.1%**	**34.6**	**50.8**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**79.4%**	**7.6**	**12.2**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	91	95	1795	1376	6.9%	0.1	0.1	4.9	0.8	0.8
1/2	Clare Street EB Ahead	U	C1:E	91	637	2025	1553	41.0%	0.8	1.2	6.7	7.1	7.4
2/1	Pennywell Road EB Ahead	U	C1:G	18	177	1840	291	60.8%	2.3	3.1	62.6	5.5	6.2
2/2	Pennywell Road EB Ahead	U	C1:G	18	245	1948	308	79.4%	3.3	5.1	75.5	7.8	9.7
3/1	Dublin Road WB Ahead	U	C1:J	120	334	1865	1865	17.9%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	91	798	1863	1428	55.9%	0.9	1.5	7.0	10.6	11.3
4/1	Clare Street WB	U	-	-	555	1935	1935	28.7%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1097	1985	1985	55.3%	0.0	0.6	2.0	4.4	5.0
7/1	Pennywell Adv Ahead	U	C1:K	103	334	1940	1681	19.9%	0.1	0.2	2.4	1.4	1.6
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	19	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.2%**	**15.9**	**19.6**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	64	0	1865	1010	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	64	882	2005	1086	81.2%	6.5	8.6	35.2	26.2	28.3

2/1	Park Road SB Left	U	C1:M	31	215	1730	461	46.6%	3.7	4.2	69.6	7.1	7.5
2/2	Park Road SB Right	U	C1:D	18	127	1856	294	43.2%	2.5	2.9	82.8	4.2	4.6
3/1	Dublin Road WB Ahead	U	C1:A	76	529	1915	1229	43.1%	1.6	1.9	13.2	8.7	9.0
3/2	Dublin Road WB Ahead Right	U	C1:A	76	541	2055	1319	41.0%	1.6	1.9	12.8	8.7	9.1
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**31.3%**	**0.0**	**0.2**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	515	1646	1646	31.3%	0.0	0.2	1.6	3.7	4.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**45.9%**	**4.4**	**5.5**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	20	141	1915	335	42.1%	1.5	1.8	46.7	4.6	5.0
1/2	Park Road SB Ahead	U	C2:B	20	165	2055	360	45.9%	1.8	2.2	48.6	5.5	5.9
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	84	303	1683:1587	1069+144	25.0 : 25.0%	0.5	0.7	8.0	3.0	3.2
3/1	Park Road NB Ahead	U	C2:A	20	65	1915	335	19.4%	0.6	0.7	40.7	1.1	1.2
Ped Link: P1	Rhebogue	-	C2:D	20	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**87.1%**	**6.7**	**13.3**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	847	1965:2014	211+761	87.1 : 87.1%	2.2	5.4	22.9	13.0	16.2
2/1	Pa Healy Road WB	U	-	-	675	1995	1995	33.8%	0.0	0.3	1.4	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	46	1980:1717	279+98	12.2 : 12.2%	0.3	0.4	28.0	0.5	0.6

4/1	Pa Healy Road EB Right Left	U	C3:A	22	326	1958	375	86.9%	4.3	7.2	79.7	10.5	13.5
5/1	Park Road NB	U	-	-	238	1915	1915	12.4%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	10.8	Total Delay for Signalled Lanes (pcuHr):	30.98	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	96.2	Total Delay for Signalled Lanes (pcuHr):	5.46	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	3.4	Total Delay for Signalled Lanes (pcuHr):	12.95	Cycle Time (s):	120
	PRC Over All Lanes (%):	3.4	Total Delay Over All Lanes(pcuHr):	50.77		

Stage Timings

Scenario 6: '2038 PM without development' (FG8: '2038 PM without development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	63	7	19	7
Change Point	0	68	80	105

C2 - Rhebogue

Stage	1	2
Duration	52	52
Change Point	0	60

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**94.6%**	**43.1**	**68.1**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.9%**	**7.9**	**12.8**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	90	103	1795	1361	7.6%	0.1	0.1	5.2	0.9	0.9
1/2	Clare Street EB Ahead	U	C1:E	90	691	2025	1536	45.0%	1.0	1.4	7.4	8.4	8.9
2/1	Pennywell Road EB Ahead	U	C1:G	19	192	1840	307	62.6%	2.5	3.3	62.0	5.9	6.7
2/2	Pennywell Road EB Ahead	U	C1:G	19	266	1948	325	81.9%	3.6	5.7	76.9	8.5	10.6
3/1	Dublin Road WB Ahead	U	C1:J	120	362	1865	1865	19.4%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	90	604	2005	1520	39.7%	0.6	0.9	5.5	3.9	4.2
4/1	Clare Street WB	U	-	-	604	1935	1935	31.2%	0.0	0.2	1.4	0.0	0.2
6/1	Dublin Road EB	U	-	-	1191	1985	1985	60.0%	0.0	0.8	2.3	8.3	9.1
7/1	Pennywell Adv Ahead	U	C1:K	103	362	1940	1681	21.5%	0.1	0.2	2.5	1.6	1.8
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	20	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.5%**	**18.2**	**24.2**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	63	0	1865	995	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	63	957	2005	1069	89.5%	7.7	11.6	43.7	29.8	33.8

2/1	Park Road SB Left	U	C1:M	32	234	1730	476	49.2%	3.9	4.3	66.7	7.7	8.1
2/2	Park Road SB Right	U	C1:D	19	138	1856	309	44.6%	2.6	3.0	78.9	4.6	5.0
3/1	Dublin Road WB Ahead	U	C1:A	75	311	1915	1213	25.6%	0.8	1.0	11.6	4.5	4.7
3/2	Dublin Road WB Ahead Right	U	C1:A	75	852	2055	1302	65.5%	3.3	4.2	17.8	17.8	18.7
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17.9%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	295	1646	1646	17.9%	0.0	0.1	1.4	3.7	3.8
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**42.9%**	**6.4**	**7.4**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	52	138	1915	846	16.3%	1.3	1.4	37.3	4.4	4.5
1/2	Park Road SB Ahead	U	C2:B	52	195	2055	908	21.5%	1.9	2.1	38.5	6.2	6.3
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	52	329	1683:1587	676+91	42.9 : 42.9%	2.1	2.4	26.6	6.8	7.2
3/1	Park Road NB Ahead	U	C2:A	52	335	1915	846	39.6%	1.1	1.4	15.1	3.4	3.7
Ped Link: P1	Rhebogue	-	C2:D	52	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**94.6%**	**10.6**	**23.6**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	920	1965:2014	211+761	94.6 : 94.6%	5.6	12.5	48.9	26.3	33.2
2/1	Pa Healy Road WB	U	-	-	733	1995	1995	36.7%	0.0	0.3	1.4	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	50	1980:1717	280+98	13.2 : 13.2%	0.3	0.4	28.0	0.6	0.6

4/1	Pa Healy Road EB Right Left	U	C3:A	22	355	1957	375	94.6%	4.7	10.4	105.2	11.6	17.3
5/1	Park Road NB	U	-	-	259	1915	1915	13.5%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	0.6	Total Delay for Signalled Lanes (pcuHr):	36.05	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	109.8	Total Delay for Signalled Lanes (pcuHr):	7.35	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	-5.2	Total Delay for Signalled Lanes (pcuHr):	23.25	Cycle Time (s):	120
	PRC Over All Lanes (%):	-5.2	Total Delay Over All Lanes(pcuHr):	68.12		

Stage Timings

Scenario 7: '2023 AM with committed' (FG11: '2023 AM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	58	7	24	7
Change Point	0	63	75	105

C2 - Rhebogue

Stage	1	2
Duration	82	22
Change Point	0	90

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	30	7	37	8	6
Change Point	0	38	53	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**76.7%**	**33.4**	**46.1**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**53.2%**	**5.9**	**8.7**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	85	60	1795	1286	4.7%	0.1	0.1	6.5	0.6	0.6
1/2	Clare Street EB Ahead	U	C1:E	85	544	2025	1451	37.5%	1.0	1.3	8.6	7.0	7.3
2/1	Pennywell Road EB Ahead	U	C1:G	24	111	1840	383	29.0%	1.2	1.4	46.6	3.1	3.3
2/2	Pennywell Road EB Ahead	U	C1:G	24	199	1948	406	49.0%	2.3	2.8	50.6	5.8	6.3
3/1	Dublin Road WB Ahead	U	C1:J	120	497	1865	1865	26.6%	0.0	0.2	1.3	2.1	2.3
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	85	715	2005	1437	49.8%	1.1	1.6	8.2	6.7	7.2
4/1	Clare Street WB	U	-	-	715	1935	1935	37.0%	0.0	0.3	1.5	2.7	3.0
6/1	Dublin Road EB	U	-	-	1057	1985	1985	53.2%	0.0	0.6	1.9	1.7	2.2
7/1	Pennywell Adv Ahead	U	C1:K	103	497	1940	1681	29.6%	0.1	0.3	2.5	2.0	2.2
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	25	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**75.4%**	**15.2**	**19.8**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	58	0	1865	917	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	58	743	2005	986	75.4%	5.6	7.1	34.5	21.7	23.3

2/1	Park Road SB Left	U	C1:M	37	314	1730	548	57.3%	2.2	2.9	33.0	7.3	8.0
2/2	Park Road SB Right	U	C1:D	24	291	1856	387	75.3%	2.9	4.3	53.7	9.0	10.4
3/1	Dublin Road WB Ahead	U	C1:A	70	378	1915	1133	33.4%	1.3	1.6	14.8	6.4	6.7
3/2	Dublin Road WB Ahead Right	U	C1:A	70	733	2055	1216	60.3%	3.2	3.9	19.3	15.5	16.2
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10.4%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	171	1646	1646	10.4%	0.0	0.1	1.2	0.5	0.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**	**4.3**	**6.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	82	29	1915	1325	2.2%	0.0	0.0	1.4	0.0	0.0
1/2	Park Road SB Ahead	U	C2:B	82	482	2055	1421	33.9%	0.8	1.0	7.6	4.7	4.9
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	22	286	1683:1587	258+126	74.3 : 74.3%	3.5	4.9	61.9	7.1	8.5
3/1	Park Road NB Ahead	U	C2:A	82	190	1915	1325	14.3%	0.0	0.1	1.6	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	82	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**76.7%**	**8.1**	**11.6**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	36:96	553	1965:2014	150+579	75.8 : 75.8%	2.3	3.8	25.0	12.3	13.8
2/1	Pa Healy Road WB	U	-	-	450	1995	1995	22.6%	0.0	0.1	1.2	0.0	0.1
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	51:7	148	1980:1717	797+64	17.2 : 17.2%	0.9	1.1	25.6	2.8	2.9

4/1	Pa Healy Road EB Right Left	U	C3:A	37	473	1948	617	76.7%	4.9	6.5	49.2	14.2	15.8
5/1	Park Road NB	U	-	-	213	1915	1915	11.1%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 19.4 Total Delay for Signalled Lanes (pcuHr): 27.62 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 21.1 Total Delay for Signalled Lanes (pcuHr): 6.04 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 17.4 Total Delay for Signalled Lanes (pcuHr): 11.36 Cycle Time (s): 120
PRC Over All Lanes (%): 17.4 Total Delay Over All Lanes(pcuHr): 46.14

Stage Timings

Scenario 8: '2028 AM with committed' (FG11: '2023 AM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	58	7	24	7
Change Point	0	63	75	105

C2 - Rhebogue

Stage	1	2
Duration	82	22
Change Point	0	90

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	30	7	37	8	6
Change Point	0	38	53	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**76.7%**	**33.4**	**46.1**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**53.2%**	**5.9**	**8.7**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	85	60	1795	1286	4.7%	0.1	0.1	6.5	0.6	0.6
1/2	Clare Street EB Ahead	U	C1:E	85	544	2025	1451	37.5%	1.0	1.3	8.6	7.0	7.3
2/1	Pennywell Road EB Ahead	U	C1:G	24	111	1840	383	29.0%	1.2	1.4	46.6	3.1	3.3
2/2	Pennywell Road EB Ahead	U	C1:G	24	199	1948	406	49.0%	2.3	2.8	50.6	5.8	6.3
3/1	Dublin Road WB Ahead	U	C1:J	120	497	1865	1865	26.6%	0.0	0.2	1.3	2.1	2.3
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	85	715	2005	1437	49.8%	1.1	1.6	8.2	6.7	7.2
4/1	Clare Street WB	U	-	-	715	1935	1935	37.0%	0.0	0.3	1.5	2.7	3.0
6/1	Dublin Road EB	U	-	-	1057	1985	1985	53.2%	0.0	0.6	1.9	1.7	2.2
7/1	Pennywell Adv Ahead	U	C1:K	103	497	1940	1681	29.6%	0.1	0.3	2.5	2.0	2.2
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	25	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**75.4%**	**15.2**	**19.8**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	58	0	1865	917	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	58	743	2005	986	75.4%	5.6	7.1	34.5	21.7	23.3

2/1	Park Road SB Left	U	C1:M	37	314	1730	548	57.3%	2.2	2.9	33.0	7.3	8.0
2/2	Park Road SB Right	U	C1:D	24	291	1856	387	75.3%	2.9	4.3	53.7	9.0	10.4
3/1	Dublin Road WB Ahead	U	C1:A	70	378	1915	1133	33.4%	1.3	1.6	14.8	6.4	6.7
3/2	Dublin Road WB Ahead Right	U	C1:A	70	733	2055	1216	60.3%	3.2	3.9	19.3	15.5	16.2
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10.4%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	171	1646	1646	10.4%	0.0	0.1	1.2	0.5	0.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**	**4.3**	**6.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	82	29	1915	1325	2.2%	0.0	0.0	1.4	0.0	0.0
1/2	Park Road SB Ahead	U	C2:B	82	482	2055	1421	33.9%	0.8	1.0	7.6	4.7	4.9
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	22	286	1683:1587	258+126	74.3 : 74.3%	3.5	4.9	61.9	7.1	8.5
3/1	Park Road NB Ahead	U	C2:A	82	190	1915	1325	14.3%	0.0	0.1	1.6	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	82	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**76.7%**	**8.1**	**11.6**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	36:96	553	1965:2014	150+579	75.8 : 75.8%	2.3	3.8	25.0	12.3	13.8
2/1	Pa Healy Road WB	U	-	-	450	1995	1995	22.6%	0.0	0.1	1.2	0.0	0.1
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	51:7	148	1980:1717	797+64	17.2 : 17.2%	0.9	1.1	25.6	2.8	2.9

4/1	Pa Healy Road EB Right Left	U	C3:A	37	473	1948	617	76.7%	4.9	6.5	49.2	14.2	15.8
5/1	Park Road NB	U	-	-	213	1915	1915	11.1%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	19.4	Total Delay for Signalled Lanes (pcuHr):	27.62	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	21.1	Total Delay for Signalled Lanes (pcuHr):	6.04	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	17.4	Total Delay for Signalled Lanes (pcuHr):	11.36	Cycle Time (s):	120
	PRC Over All Lanes (%):	17.4	Total Delay Over All Lanes(pcuHr):	46.14		

Stage Timings

Scenario 9: '2038 AM with committed' (FG13: '2038 AM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	58	7	24	7
Change Point	0	63	75	105

C2 - Rhebogue

Stage	1	2
Duration	81	23
Change Point	0	89

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	30	7	37	8	6
Change Point	0	38	53	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.4%**	**43.6**	**67.2**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**62.7%**	**7.1**	**10.9**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	85	71	1795	1286	5.5%	0.1	0.1	6.5	0.7	0.7
1/2	Clare Street EB Ahead	U	C1:E	85	645	2025	1451	44.4%	1.3	1.7	9.3	8.8	9.2
2/1	Pennywell Road EB Ahead	U	C1:G	24	130	1840	383	33.9%	1.5	1.7	47.6	3.7	3.9
2/2	Pennywell Road EB Ahead	U	C1:G	24	236	1948	406	58.2%	2.8	3.5	53.3	7.1	7.8
3/1	Dublin Road WB Ahead	U	C1:J	120	586	1865	1865	31.4%	0.0	0.2	1.4	3.7	3.9
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	85	843	2005	1437	58.7%	1.3	2.0	8.6	7.8	8.5
4/1	Clare Street WB	U	-	-	843	1935	1935	43.6%	0.0	0.4	1.7	3.9	4.2
6/1	Dublin Road EB	U	-	-	1244	1985	1985	62.7%	0.0	0.8	2.4	8.8	9.7
7/1	Pennywell Adv Ahead	U	C1:K	103	586	1940	1681	34.9%	0.2	0.4	2.7	2.5	2.7
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	25	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.4%**	**20.4**	**29.8**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	58	0	1865	917	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	58	881	2005	986	89.4%	7.3	11.3	46.0	27.6	31.5

2/1	Park Road SB Left	U	C1:M	37	363	1730	548	66.3%	3.3	4.2	41.9	10.6	11.6
2/2	Park Road SB Right	U	C1:D	24	337	1856	387	87.2%	4.0	7.0	75.0	10.5	13.6
3/1	Dublin Road WB Ahead	U	C1:A	70	448	1915	1133	39.5%	1.6	2.0	15.7	7.8	8.2
3/2	Dublin Road WB Ahead Right	U	C1:A	70	867	2055	1216	71.3%	4.2	5.4	22.4	20.2	21.5
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.2%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	201	1646	1646	12.2%	0.0	0.1	1.3	0.9	1.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**84.6%**	**5.7**	**8.6**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	81	88	1915	1309	6.7%	0.0	0.0	1.7	0.0	0.1
1/2	Park Road SB Ahead	U	C2:B	81	499	2055	1404	35.5%	1.5	1.7	12.6	6.2	6.5
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	23	338	1683:1587	266+134	84.6 : 84.6%	4.2	6.7	71.6	8.9	11.5
3/1	Park Road NB Ahead	U	C2:A	81	223	1915	1309	17.0%	0.0	0.1	1.7	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	81	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.2%**	**10.4**	**17.7**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	36:96	649	1965:2014	152+575	89.2 : 89.2%	3.5	7.3	40.4	16.8	20.6
2/1	Pa Healy Road WB	U	-	-	525	1995	1995	26.3%	0.0	0.2	1.2	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	51:7	174	1980:1717	802+59	20.2 : 20.2%	1.1	1.2	25.8	3.3	3.5

4/1	Pa Healy Road EB Right Left	U	C3:A	37	538	1948	617	87.2%	5.8	8.9	59.8	16.9	20.0
5/1	Park Road NB	U	-	-	249	1915	1915	13.0%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	0.7	Total Delay for Signalled Lanes (pcuHr):	39.54	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	6.4	Total Delay for Signalled Lanes (pcuHr):	8.61	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	0.9	Total Delay for Signalled Lanes (pcuHr):	17.48	Cycle Time (s):	120
	PRC Over All Lanes (%):	0.7	Total Delay Over All Lanes(pcuHr):	67.18		

Stage Timings

Scenario 10: '2023 PM with committed' (FG14: '2023 PM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	64	7	18	7
Change Point	0	69	81	105

C2 - Rhebogue

Stage	1	2
Duration	21	83
Change Point	0	29

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.0%**	**31.1**	**43.1**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**72.6%**	**6.9**	**10.6**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	91	89	1795	1376	6.5%	0.1	0.1	4.9	0.7	0.8
1/2	Clare Street EB Ahead	U	C1:E	91	583	2025	1553	37.6%	0.7	1.0	6.4	6.3	6.6
2/1	Pennywell Road EB Ahead	U	C1:G	18	165	1840	291	56.6%	2.1	2.8	60.8	5.0	5.7
2/2	Pennywell Road EB Ahead	U	C1:G	18	224	1948	308	72.6%	3.0	4.3	68.7	7.1	8.4
3/1	Dublin Road WB Ahead	U	C1:J	120	304	1865	1865	16.3%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	91	738	1862	1428	51.7%	0.8	1.3	6.5	9.0	9.6
4/1	Clare Street WB	U	-	-	511	1935	1935	26.4%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1006	1985	1985	50.7%	0.0	0.5	1.8	0.6	1.1
7/1	Pennywell Adv Ahead	U	C1:K	103	304	1940	1681	18.1%	0.1	0.2	2.4	1.3	1.4
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	19	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**74.3%**	**14.2**	**17.0**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	64	0	1865	1010	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	64	807	2005	1086	74.3%	5.6	7.1	31.5	23.0	24.4

2/1	Park Road SB Left	U	C1:M	31	199	1730	461	43.1%	3.4	3.8	69.0	6.5	6.9
2/2	Park Road SB Right	U	C1:D	18	117	1856	294	39.8%	2.3	2.7	82.1	3.9	4.2
3/1	Dublin Road WB Ahead	U	C1:A	76	489	1915	1229	39.8%	1.4	1.7	12.8	7.7	8.1
3/2	Dublin Road WB Ahead Right	U	C1:A	76	497	2055	1319	37.7%	1.4	1.7	12.4	7.7	8.0
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**29.2%**	**0.0**	**0.2**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	481	1646	1646	29.2%	0.0	0.2	1.6	3.3	3.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**41.4%**	**4.1**	**5.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	21	127	1915	351	36.2%	1.3	1.6	45.6	4.2	4.4
1/2	Park Road SB Ahead	U	C2:B	21	156	2055	377	41.4%	1.7	2.1	47.7	5.1	5.5
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	83	282	1683:1587	1058+140	23.5 : 23.5%	0.5	0.6	8.2	2.9	3.1
3/1	Park Road NB Ahead	U	C2:A	21	61	1915	351	17.4%	0.6	0.7	39.3	1.0	1.1
Ped Link: P1	Rhebogue	-	C2:D	21	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.0%**	**6.0**	**10.4**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	791	1965:2014	207+769	81.0 : 81.0%	1.8	3.9	17.9	11.3	13.4
2/1	Pa Healy Road WB	U	-	-	634	1995	1995	31.8%	0.0	0.2	1.3	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	42	1980:1717	277+98	11.2 : 11.2%	0.3	0.3	28.0	0.5	0.5

4/1	Pa Healy Road EB Right Left	U	C3:A	22	302	1958	375	80.5%	3.9	5.8	69.7	9.6	11.5
5/1	Park Road NB	U	-	-	218	1915	1915	11.4%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	21.1	Total Delay for Signalled Lanes (pcuHr):	26.85	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	117.4	Total Delay for Signalled Lanes (pcuHr):	4.99	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	11.0	Total Delay for Signalled Lanes (pcuHr):	10.09	Cycle Time (s):	120
	PRC Over All Lanes (%):	11.0	Total Delay Over All Lanes(pcuHr):	43.13		

Stage Timings

Scenario 11: '2028 PM with committed' (FG15: '2028 PM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	64	7	18	7
Change Point	0	69	81	105

C2 - Rhebogue

Stage	1	2
Duration	20	84
Change Point	0	28

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**88.5%**	**34.9**	**51.8**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**79.4%**	**7.6**	**12.3**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	91	97	1795	1376	7.0%	0.1	0.1	4.9	0.8	0.8
1/2	Clare Street EB Ahead	U	C1:E	91	637	2025	1553	41.0%	0.8	1.2	6.7	7.1	7.4
2/1	Pennywell Road EB Ahead	U	C1:G	18	180	1840	291	61.8%	2.4	3.2	63.1	5.6	6.3
2/2	Pennywell Road EB Ahead	U	C1:G	18	245	1948	308	79.4%	3.3	5.1	75.5	7.8	9.7
3/1	Dublin Road WB Ahead	U	C1:J	120	334	1865	1865	17.9%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	91	806	1861	1427	56.5%	0.9	1.6	7.1	11.0	11.6
4/1	Clare Street WB	U	-	-	556	1935	1935	28.7%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1099	1985	1985	55.4%	0.0	0.6	2.0	4.4	5.0
7/1	Pennywell Adv Ahead	U	C1:K	103	334	1940	1681	19.9%	0.1	0.2	2.4	1.4	1.6
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	19	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.2%**	**16.0**	**19.7**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	64	0	1865	1010	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	64	882	2005	1086	81.2%	6.5	8.6	35.2	26.2	28.3

2/1	Park Road SB Left	U	C1:M	31	217	1730	461	47.0%	3.8	4.2	69.8	7.1	7.6
2/2	Park Road SB Right	U	C1:D	18	128	1856	294	43.6%	2.6	2.9	82.9	4.2	4.6
3/1	Dublin Road WB Ahead	U	C1:A	76	536	1915	1229	43.6%	1.6	2.0	13.3	8.8	9.2
3/2	Dublin Road WB Ahead Right	U	C1:A	76	540	2055	1319	41.0%	1.6	1.9	12.8	8.7	9.0
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**32.0%**	**0.0**	**0.2**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	527	1646	1646	32.0%	0.0	0.2	1.7	3.8	4.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**46.4%**	**4.4**	**5.5**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	20	142	1915	335	42.4%	1.5	1.8	46.6	4.6	5.0
1/2	Park Road SB Ahead	U	C2:B	20	167	2055	360	46.4%	1.8	2.3	48.7	5.5	5.9
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	84	308	1683:1587	1071+142	25.4 : 25.4%	0.5	0.7	8.0	3.1	3.3
3/1	Park Road NB Ahead	U	C2:A	20	64	1915	335	19.1%	0.6	0.7	40.7	1.1	1.2
Ped Link: P1	Rhebogue	-	C2:D	20	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**88.5%**	**6.8**	**14.1**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	863	1965:2014	208+767	88.5 : 88.5%	2.2	5.8	24.3	13.3	16.9
2/1	Pa Healy Road WB	U	-	-	691	1995	1995	34.6%	0.0	0.3	1.4	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	46	1980:1717	279+98	12.2 : 12.2%	0.3	0.4	28.0	0.5	0.6

4/1	Pa Healy Road EB Right Left	U	C3:A	22	330	1957	375	88.0%	4.3	7.5	82.1	10.6	13.8
5/1	Park Road NB	U	-	-	239	1915	1915	12.5%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 10.8 Total Delay for Signalled Lanes (pcuHr): 31.20 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 93.8 Total Delay for Signalled Lanes (pcuHr): 5.50 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 1.7 Total Delay for Signalled Lanes (pcuHr): 13.72 Cycle Time (s): 120
PRC Over All Lanes (%): 1.7 Total Delay Over All Lanes(pcuHr): 51.82

Stage Timings

Scenario 12: '2038 PM with committed' (FG16: '2038 PM with committed', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	63	7	19	7
Change Point	0	68	80	105

C2 - Rhebogue

Stage	1	2
Duration	20	84
Change Point	0	28

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	45	7	22	8	6
Change Point	0	53	68	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**96.0%**	**39.4**	**67.2**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.9%**	**8.5**	**14.0**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	90	105	1795	1361	7.7%	0.1	0.2	5.2	0.9	0.9
1/2	Clare Street EB Ahead	U	C1:E	90	691	2025	1536	45.0%	1.0	1.4	7.4	8.4	8.9
2/1	Pennywell Road EB Ahead	U	C1:G	19	195	1840	307	63.6%	2.5	3.4	62.5	6.0	6.9
2/2	Pennywell Road EB Ahead	U	C1:G	19	266	1948	325	81.9%	3.6	5.7	76.9	8.5	10.6
3/1	Dublin Road WB Ahead	U	C1:J	120	362	1865	1865	19.4%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	90	875	1861	1411	62.0%	1.2	2.0	8.1	13.4	14.3
4/1	Clare Street WB	U	-	-	605	1935	1935	31.3%	0.0	0.2	1.4	0.0	0.2
6/1	Dublin Road EB	U	-	-	1193	1985	1985	60.1%	0.0	0.8	2.3	8.3	9.1
7/1	Pennywell Adv Ahead	U	C1:K	103	362	1940	1681	21.5%	0.1	0.2	2.5	1.6	1.8
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	20	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.5%**	**18.2**	**23.9**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	63	0	1865	995	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	63	957	2005	1069	89.5%	7.7	11.6	43.7	29.8	33.8

2/1	Park Road SB Left	U	C1:M	32	236	1730	476	49.6%	4.0	4.5	69.2	7.7	8.2
2/2	Park Road SB Right	U	C1:D	19	139	1856	309	44.9%	2.7	3.2	81.6	4.6	5.0
3/1	Dublin Road WB Ahead	U	C1:A	75	581	1915	1213	47.9%	1.9	2.3	14.4	10.2	10.6
3/2	Dublin Road WB Ahead Right	U	C1:A	75	588	2055	1302	45.2%	1.8	2.3	13.8	10.0	10.4
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**34.6%**	**0.0**	**0.3**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	570	1646	1646	34.6%	0.0	0.3	1.7	4.3	4.6
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50.6%**	**4.8**	**6.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	20	154	1915	335	46.0%	1.6	2.0	46.8	5.0	5.5
1/2	Park Road SB Ahead	U	C2:B	20	182	2055	360	50.6%	2.0	2.5	49.2	6.0	6.5
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	84	334	1683:1587	1071+142	27.5 : 27.5%	0.6	0.8	8.1	3.4	3.6
3/1	Park Road NB Ahead	U	C2:A	20	71	1915	335	21.2%	0.7	0.8	40.7	1.2	1.3
Ped Link: P1	Rhebogue	-	C2:D	20	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**96.0%**	**7.9**	**23.0**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	51:96	936	1965:2014	208+767	96.0 : 96.0%	2.8	11.2	43.0	15.3	23.7
2/1	Pa Healy Road WB	U	-	-	749	1995	1995	37.5%	0.0	0.3	1.4	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	66:7	50	1980:1717	280+98	13.2 : 13.2%	0.3	0.4	28.0	0.6	0.6

4/1	Pa Healy Road EB Right Left	U	C3:A	22	359	1957	375	95.7%	4.8	11.1	110.9	11.8	18.0
5/1	Park Road NB	U	-	-	260	1915	1915	13.6%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	0.6	Total Delay for Signalled Lanes (pcuHr):	36.89	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	77.8	Total Delay for Signalled Lanes (pcuHr):	6.04	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	-6.7	Total Delay for Signalled Lanes (pcuHr):	22.63	Cycle Time (s):	120
	PRC Over All Lanes (%):	-6.7	Total Delay Over All Lanes(pcuHr):	67.20		

Stage Timings

Scenario 13: '2023 AM with committed + development' (FG19: '2023 AM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	57	7	25	7
Change Point	0	62	74	105

C2 - Rhebogue

Stage	1	2
Duration	82	22
Change Point	0	90

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	29	7	38	8	6
Change Point	0	37	52	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**83.4%**	**36.2**	**51.5**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**54.3%**	**6.1**	**8.9**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	84	65	1795	1271	5.1%	0.1	0.1	6.8	0.7	0.7
1/2	Clare Street EB Ahead	U	C1:E	84	544	2025	1434	37.9%	1.1	1.4	9.0	7.1	7.4
2/1	Pennywell Road EB Ahead	U	C1:G	25	122	1840	399	30.6%	1.3	1.6	45.9	3.4	3.6
2/2	Pennywell Road EB Ahead	U	C1:G	25	199	1948	422	47.1%	2.3	2.7	49.1	5.7	6.2
3/1	Dublin Road WB Ahead	U	C1:J	120	505	1865	1865	27.1%	0.0	0.2	1.3	2.1	2.3
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	84	726	2005	1420	51.1%	1.2	1.8	8.7	7.1	7.6
4/1	Clare Street WB	U	-	-	726	1935	1935	37.5%	0.0	0.3	1.5	3.3	3.6
6/1	Dublin Road EB	U	-	-	1077	1985	1985	54.3%	0.0	0.6	2.0	1.7	2.2
7/1	Pennywell Adv Ahead	U	C1:K	103	505	1940	1681	30.0%	0.1	0.4	2.5	2.0	2.2
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	26	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**77.1%**	**16.2**	**21.2**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	57	0	1865	901	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	57	743	2005	969	76.7%	5.7	7.3	35.6	21.9	23.5

2/1	Park Road SB Left	U	C1:M	38	334	1730	562	59.4%	2.5	3.2	34.4	8.2	9.0
2/2	Park Road SB Right	U	C1:D	25	310	1856	402	77.1%	3.2	4.8	55.7	9.7	11.3
3/1	Dublin Road WB Ahead	U	C1:A	69	378	1915	1117	33.8%	1.4	1.6	15.4	6.5	6.8
3/2	Dublin Road WB Ahead Right	U	C1:A	69	752	2055	1199	62.7%	3.4	4.3	20.4	16.3	17.1
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11.4%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	187	1646	1646	11.4%	0.0	0.1	1.2	0.5	0.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**80.2%**	**4.8**	**7.2**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	82	50	1915	1325	3.8%	0.0	0.0	1.4	0.0	0.0
1/2	Park Road SB Ahead	U	C2:B	82	500	2055	1421	35.2%	1.0	1.3	9.5	5.2	5.5
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	22	305	1683:1587	263+117	80.2 : 80.2%	3.8	5.7	67.6	8.0	9.9
3/1	Park Road NB Ahead	U	C2:A	82	209	1915	1325	15.8%	0.0	0.1	1.6	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	82	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**83.4%**	**9.1**	**14.1**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	35:96	607	1965:2014	137+591	83.4 : 83.4%	2.7	5.1	30.2	14.1	16.6
2/1	Pa Healy Road WB	U	-	-	505	1995	1995	25.3%	0.0	0.2	1.2	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	50:7	149	1980:1717	777+68	17.6 : 17.6%	1.0	1.1	26.4	2.8	2.9

4/1	Pa Healy Road EB Right Left	U	C3:A	38	522	1948	633	82.5%	5.4	7.7	52.9	16.0	18.2
5/1	Park Road NB	U	-	-	223	1915	1915	11.6%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 16.7 Total Delay for Signalled Lanes (pcuHr): 29.27 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 12.2 Total Delay for Signalled Lanes (pcuHr): 7.16 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 7.9 Total Delay for Signalled Lanes (pcuHr): 13.86 Cycle Time (s): 120
PRC Over All Lanes (%): 7.9 Total Delay Over All Lanes(pcuHr): 51.48

Stage Timings

Scenario 14: '2028 AM with committed + development' (FG20: '2028 AM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	57	7	25	7
Change Point	0	62	74	105

C2 - Rhebogue

Stage	1	2
Duration	80	24
Change Point	0	88

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	30	7	37	8	6
Change Point	0	38	53	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**90.0%**	**42.2**	**62.9**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**58.9%**	**6.7**	**10.0**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	84	70	1795	1271	5.5%	0.1	0.1	6.8	0.7	0.7
1/2	Clare Street EB Ahead	U	C1:E	84	595	2025	1434	41.5%	1.2	1.5	9.4	8.1	8.5
2/1	Pennywell Road EB Ahead	U	C1:G	25	132	1840	399	33.1%	1.5	1.7	46.4	3.7	4.0
2/2	Pennywell Road EB Ahead	U	C1:G	25	217	1948	422	51.4%	2.5	3.0	50.2	6.3	6.9
3/1	Dublin Road WB Ahead	U	C1:J	120	549	1865	1865	29.4%	0.0	0.2	1.4	3.1	3.3
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	84	790	2005	1420	55.6%	1.3	2.0	8.9	7.6	8.3
4/1	Clare Street WB	U	-	-	790	1935	1935	40.8%	0.0	0.3	1.6	3.8	4.1
6/1	Dublin Road EB	U	-	-	1170	1985	1985	58.9%	0.0	0.7	2.2	5.0	5.7
7/1	Pennywell Adv Ahead	U	C1:K	103	549	1940	1681	32.7%	0.2	0.4	2.6	2.3	2.5
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	26	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**83.8%**	**19.2**	**26.2**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	57	0	1865	901	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	57	812	2005	969	83.8%	6.6	9.1	40.2	24.8	27.3

2/1	Park Road SB Left	U	C1:M	38	358	1730	562	63.7%	3.2	4.1	41.1	10.3	11.2
2/2	Park Road SB Right	U	C1:D	25	332	1856	402	82.6%	3.9	6.2	66.9	10.4	12.7
3/1	Dublin Road WB Ahead	U	C1:A	69	413	1915	1117	37.0%	1.5	1.8	15.8	7.2	7.5
3/2	Dublin Road WB Ahead Right	U	C1:A	69	820	2055	1199	68.4%	3.9	5.0	22.1	18.9	20.0
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.3%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	202	1646	1646	12.3%	0.0	0.1	1.3	0.9	1.0
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.0%**	**5.8**	**8.2**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	80	94	1915	1293	7.3%	0.0	0.0	1.8	0.0	0.1
1/2	Park Road SB Ahead	U	C2:B	80	493	2055	1387	35.5%	1.8	2.0	14.9	6.7	7.0
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	24	331	1683:1587	281+127	81.0 : 81.0%	4.0	6.1	65.8	8.7	10.7
3/1	Park Road NB Ahead	U	C2:A	80	226	1915	1293	17.5%	0.0	0.1	1.7	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	80	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**90.0%**	**10.4**	**18.3**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	36:96	656	1965:2014	142+599	88.6 : 88.6%	3.3	6.9	37.9	16.4	19.9
2/1	Pa Healy Road WB	U	-	-	543	1995	1995	27.2%	0.0	0.2	1.2	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	51:7	161	1980:1717	791+70	18.7 : 18.7%	1.0	1.2	26.0	3.0	3.1

4/1	Pa Healy Road EB Right Left	U	C3:A	37	555	1948	617	90.0%	6.0	10.0	65.0	17.6	21.5
5/1	Park Road NB	U	-	-	242	1915	1915	12.6%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 7.4 Total Delay for Signalled Lanes (pcuHr): 35.14 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 11.1 Total Delay for Signalled Lanes (pcuHr): 8.25 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 0.0 Total Delay for Signalled Lanes (pcuHr): 18.09 Cycle Time (s): 120
PRC Over All Lanes (%): 0.0 Total Delay Over All Lanes(pcuHr): 62.87

Stage Timings

Scenario 15: '2038 AM with committed + development' (FG21: '2038 AM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	57	7	25	7
Change Point	0	62	74	105

C2 - Rhebogue

Stage	1	2
Duration	78	26
Change Point	0	86

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	30	7	37	8	6
Change Point	0	38	53	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**95.2%**	**48.0**	**79.4**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**63.7%**	**7.4**	**11.2**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	84	76	1795	1271	6.0%	0.1	0.1	6.9	0.8	0.8
1/2	Clare Street EB Ahead	U	C1:E	84	645	2025	1434	45.0%	1.3	1.8	9.8	9.1	9.5
2/1	Pennywell Road EB Ahead	U	C1:G	25	141	1840	399	35.4%	1.6	1.8	46.9	4.0	4.2
2/2	Pennywell Road EB Ahead	U	C1:G	25	236	1948	422	55.9%	2.7	3.4	51.5	6.9	7.6
3/1	Dublin Road WB Ahead	U	C1:J	120	594	1865	1865	31.8%	0.0	0.2	1.4	3.7	3.9
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	84	854	2005	1420	60.1%	1.4	2.2	9.2	8.2	9.0
4/1	Clare Street WB	U	-	-	854	1935	1935	44.1%	0.0	0.4	1.7	4.4	4.8
6/1	Dublin Road EB	U	-	-	1264	1985	1985	63.7%	0.0	0.9	2.5	8.9	9.7
7/1	Pennywell Adv Ahead	U	C1:K	103	594	1940	1681	35.3%	0.2	0.4	2.7	2.5	2.7
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	26	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**90.9%**	**22.2**	**32.9**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	57	0	1865	901	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	57	881	2005	969	90.9%	7.5	12.0	49.1	27.9	32.5

2/1	Park Road SB Left	U	C1:M	38	383	1730	562	68.1%	3.9	5.0	46.5	11.8	12.9
2/2	Park Road SB Right	U	C1:D	25	356	1856	402	88.5%	4.6	8.0	81.1	11.7	15.1
3/1	Dublin Road WB Ahead	U	C1:A	69	448	1915	1117	40.1%	1.7	2.0	16.3	8.1	8.4
3/2	Dublin Road WB Ahead Right	U	C1:A	69	886	2055	1199	73.9%	4.5	5.9	24.0	21.4	22.8
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13.2%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	217	1646	1646	13.2%	0.0	0.1	1.3	1.4	1.5
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.7%**	**6.6**	**9.2**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	78	116	1915	1261	9.2%	0.0	0.1	2.0	0.1	0.1
1/2	Park Road SB Ahead	U	C2:B	78	510	2055	1353	37.7%	2.4	2.7	19.1	8.3	8.6
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	26	357	1683:1587	299+138	81.7 : 81.7%	4.2	6.3	63.9	9.5	11.6
3/1	Park Road NB Ahead	U	C2:A	78	242	1915	1261	19.2%	0.0	0.1	1.8	0.0	0.1
Ped Link: P1	Rhebogue	-	C2:D	78	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**95.2%**	**11.8**	**25.9**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	36:96	703	1965:2014	143+597	95.0 : 95.0%	4.1	11.1	56.8	18.6	25.6
2/1	Pa Healy Road WB	U	-	-	580	1995	1995	29.1%	0.0	0.2	1.3	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	51:7	175	1980:1717	797+64	20.3 : 20.3%	1.1	1.3	26.0	3.3	3.5

4/1	Pa Healy Road EB Right Left	U	C3:A	37	587	1948	617	95.2%	6.5	13.3	81.6	19.1	25.8
5/1	Park Road NB	U	-	-	259	1915	1915	13.5%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	-1.0	Total Delay for Signalled Lanes (pcuHr):	42.89	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	10.2	Total Delay for Signalled Lanes (pcuHr):	9.22	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	-5.7	Total Delay for Signalled Lanes (pcuHr):	25.66	Cycle Time (s):	120
	PRC Over All Lanes (%):	-5.7	Total Delay Over All Lanes(pcuHr):	79.40		

Stage Timings

Scenario 16: '2023 PM with committed + development' (FG22: '2023 PM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	63	7	19	7
Change Point	0	68	80	105

C2 - Rhebogue

Stage	1	2
Duration	46	58
Change Point	0	54

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	43	7	24	8	6
Change Point	0	51	66	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**87.1%**	**37.1**	**50.9**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**69.0%**	**6.6**	**9.9**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	90	92	1795	1361	6.8%	0.1	0.1	5.1	0.8	0.8
1/2	Clare Street EB Ahead	U	C1:E	90	583	2025	1536	38.0%	0.8	1.1	6.8	6.5	6.8
2/1	Pennywell Road EB Ahead	U	C1:G	19	170	1840	307	55.4%	2.2	2.8	59.0	5.2	5.8
2/2	Pennywell Road EB Ahead	U	C1:G	19	224	1948	325	69.0%	2.9	4.0	64.6	7.0	8.1
3/1	Dublin Road WB Ahead	U	C1:J	120	310	1865	1865	16.6%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	90	521	2005	1520	34.3%	0.5	0.8	5.6	3.6	3.9
4/1	Clare Street WB	U	-	-	521	1935	1935	26.9%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1034	1985	1985	52.1%	0.0	0.5	1.9	1.1	1.6
7/1	Pennywell Adv Ahead	U	C1:K	103	310	1940	1681	18.4%	0.1	0.2	2.4	1.3	1.4
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	20	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**75.5%**	**15.4**	**18.5**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	63	0	1865	995	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	63	807	2005	1069	75.5%	5.8	7.3	32.5	23.2	24.7

2/1	Park Road SB Left	U	C1:M	32	227	1730	476	47.7%	3.8	4.3	67.8	7.5	7.9
2/2	Park Road SB Right	U	C1:D	19	133	1856	309	43.0%	2.6	2.9	79.8	4.4	4.8
3/1	Dublin Road WB Ahead	U	C1:A	75	262	1915	1213	21.6%	0.7	0.8	11.2	3.6	3.8
3/2	Dublin Road WB Ahead Right	U	C1:A	75	734	2055	1302	56.4%	2.6	3.2	15.7	13.9	14.5
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15.9%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	262	1646	1646	15.9%	0.0	0.1	1.4	2.8	2.9
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**39.7%**	**6.2**	**7.0**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	46	137	1915	750	18.3%	1.4	1.5	40.1	4.5	4.6
1/2	Park Road SB Ahead	U	C2:B	46	190	2055	805	23.6%	2.0	2.2	41.4	6.1	6.3
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	58	290	1683:1587	753+97	34.1 : 34.1%	1.5	1.7	21.4	5.3	5.5
3/1	Park Road NB Ahead	U	C2:A	46	298	1915	750	39.7%	1.3	1.6	19.4	3.9	4.2
Ped Link: P1	Rhebogue	-	C2:D	46	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**87.1%**	**8.9**	**15.3**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	49:96	817	1965:2014	195+753	86.2 : 86.2%	4.1	7.1	31.4	21.8	24.8
2/1	Pa Healy Road WB	U	-	-	660	1995	1995	33.1%	0.0	0.2	1.3	0.0	0.2
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	64:7	42	1980:1717	277+98	11.2 : 11.2%	0.3	0.3	28.7	0.5	0.5

4/1	Pa Healy Road EB Right Left	U	C3:A	24	355	1957	408	87.1%	4.5	7.6	76.6	11.4	14.5
5/1	Park Road NB	U	-	-	227	1915	1915	11.9%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 19.3 Total Delay for Signalled Lanes (pcuHr): 27.68 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 126.5 Total Delay for Signalled Lanes (pcuHr): 7.04 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): 3.4 Total Delay for Signalled Lanes (pcuHr): 15.01 Cycle Time (s): 120
PRC Over All Lanes (%): 3.4 Total Delay Over All Lanes(pcuHr): 50.86

Stage Timings

Scenario 17: '2028 PM with committed + development' (FG23: '2028 PM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	63	7	19	7
Change Point	0	68	80	105

C2 - Rhebogue

Stage	1	2
Duration	49	55
Change Point	0	57

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	43	7	24	8	6
Change Point	0	51	66	98	114

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**93.9%**	**41.6**	**63.0**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**75.5%**	**7.3**	**11.3**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	90	100	1795	1361	7.3%	0.1	0.1	5.2	0.8	0.9
1/2	Clare Street EB Ahead	U	C1:E	90	637	2025	1536	41.5%	0.9	1.3	7.1	7.4	7.8
2/1	Pennywell Road EB Ahead	U	C1:G	19	185	1840	307	60.3%	2.4	3.1	60.9	5.7	6.5
2/2	Pennywell Road EB Ahead	U	C1:G	19	245	1948	325	75.5%	3.2	4.7	69.5	7.8	9.2
3/1	Dublin Road WB Ahead	U	C1:J	120	340	1865	1865	18.2%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	90	566	2005	1520	37.2%	0.6	0.9	5.6	3.9	4.2
4/1	Clare Street WB	U	-	-	566	1935	1935	29.3%	0.0	0.2	1.3	0.0	0.2
6/1	Dublin Road EB	U	-	-	1127	1985	1985	56.8%	0.0	0.7	2.1	5.0	5.6
7/1	Pennywell Adv Ahead	U	C1:K	103	340	1940	1681	20.2%	0.1	0.2	2.4	1.4	1.6
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	20	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**82.5%**	**17.2**	**21.4**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	63	0	1865	995	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	63	882	2005	1069	82.5%	6.7	9.0	36.6	26.4	28.7

2/1	Park Road SB Left	U	C1:M	32	245	1730	476	51.5%	4.1	4.6	68.2	8.1	8.6
2/2	Park Road SB Right	U	C1:D	19	144	1856	309	46.6%	2.8	3.2	80.2	4.8	5.2
3/1	Dublin Road WB Ahead	U	C1:A	75	286	1915	1213	23.6%	0.8	0.9	11.4	4.1	4.2
3/2	Dublin Road WB Ahead Right	U	C1:A	75	800	2055	1302	61.5%	2.9	3.7	16.8	16.0	16.8
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17.3%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	285	1646	1646	17.3%	0.0	0.1	1.4	3.3	3.4
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**40.6%**	**6.7**	**7.6**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	49	149	1915	798	18.7%	1.5	1.6	39.2	4.8	4.9
1/2	Park Road SB Ahead	U	C2:B	49	204	2055	856	23.8%	2.2	2.3	40.7	6.6	6.7
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	55	316	1683:1587	716+92	39.1 : 39.1%	1.8	2.1	24.0	6.2	6.5
3/1	Park Road NB Ahead	U	C2:A	49	324	1915	798	40.6%	1.2	1.6	17.3	3.8	4.2
Ped Link: P1	Rhebogue	-	C2:D	49	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**93.9%**	**10.4**	**22.6**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	49:96	889	1965:2014	196+751	93.9 : 93.9%	5.1	11.5	46.4	25.1	31.4
2/1	Pa Healy Road WB	U	-	-	717	1995	1995	35.9%	0.0	0.3	1.4	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	64:7	46	1980:1717	279+98	12.2 : 12.2%	0.3	0.4	28.7	0.5	0.6

4/1	Pa Healy Road EB Right Left	U	C3:A	24	383	1957	408	93.9%	5.0	10.4	97.5	12.6	17.9
5/1	Park Road NB	U	-	-	248	1915	1915	13.0%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell	PRC for Signalled Lanes (%):	9.1	Total Delay for Signalled Lanes (pcuHr):	31.92	Cycle Time (s):	120
C2 - Rhebogue	PRC for Signalled Lanes (%):	121.6	Total Delay for Signalled Lanes (pcuHr):	7.59	Cycle Time (s):	120
C3 - Park Road Corbally Road	PRC for Signalled Lanes (%):	-4.4	Total Delay for Signalled Lanes (pcuHr):	22.21	Cycle Time (s):	120
	PRC Over All Lanes (%):	-4.4	Total Delay Over All Lanes(pcuHr):	63.05		

Stage Timings

Scenario 18: '2038 PM with committed + development' (FG24: '2038 PM with committed + development', Plan 1: 'Network Control Plan 1')

C1 - Pennywell

Stage	1	2	3	4
Duration	63	7	19	7
Change Point	62	10	22	47

C2 - Rhebogue

Stage	1	2
Duration	59	45
Change Point	62	9

C3 - Park Road Corbally Road

Stage	1	2	3	4	5
Duration	43	7	24	8	6
Change Point	62	113	8	40	56

Network Results

Item	Lane Description	Lane Type	Full Phase	Total Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Mean Max Queue (pcu)
Network: Pa Healy Road, Canal Bank, Limerick	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**101.7%**	**47.1**	**91.5**	**-**	**-**	**-**
J1: Clare Street/Upper Clare Street/Dublin Road/Pennywell Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81.9%**	**8.0**	**13.2**	**-**	**-**	**-**
1/1	Clare Street EB Ahead	U	C1:E	90	108	1795	1361	7.9%	0.1	0.2	5.2	0.9	0.9
1/2	Clare Street EB Ahead	U	C1:E	90	691	2025	1536	45.0%	1.0	1.4	7.4	8.4	8.9
2/1	Pennywell Road EB Ahead	U	C1:G	19	200	1840	307	65.2%	2.6	3.5	63.3	6.2	7.1
2/2	Pennywell Road EB Ahead	U	C1:G	19	266	1948	325	81.9%	3.6	5.7	76.9	8.5	10.6
3/1	Dublin Road WB Ahead	U	C1:J	120	368	1865	1865	19.7%	0.0	0.1	1.2	0.0	0.1
3/2	Dublin Road WB Ahead U-Turn	U	C1:H	90	615	2005	1520	40.4%	0.6	1.0	5.7	4.2	4.5
4/1	Clare Street WB	U	-	-	615	1935	1935	31.7%	0.0	0.2	1.4	0.0	0.2
6/1	Dublin Road EB	U	-	-	1221	1985	1985	61.4%	0.0	0.8	2.4	9.4	10.2
7/1	Pennywell Adv Ahead	U	C1:K	103	368	1940	1681	21.9%	0.1	0.2	2.4	1.6	1.8
Ped Link: P1	Pennywell	-	C1:I	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Clare Street	-	C1:F	20	0	-	0	0.0%	-	-	-	-	-
J2: Dublin Road/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**89.5%**	**18.7**	**24.9**	**-**	**-**	**-**
1/1	Dublin Road EB Left	U	C1:C	63	0	1865	995	0.0%	0.0	0.0	0.0	0.0	0.0
1/2	Dublin Road EB Ahead	U	C1:C	63	957	2005	1069	89.5%	7.7	11.6	43.7	29.8	33.8

2/1	Park Road SB Left	U	C1:M	32	264	1730	476	55.0%	4.1	4.7	64.3	8.4	9.0
2/2	Park Road SB Right	U	C1:D	19	155	1856	309	49.7%	2.8	3.2	76.0	5.1	5.5
3/1	Dublin Road WB Ahead	U	C1:A	75	311	1915	1213	25.6%	0.8	1.0	11.6	4.5	4.7
3/2	Dublin Road WB Ahead Right	U	C1:A	75	868	2055	1302	66.7%	3.4	4.4	18.1	18.3	19.3
Ped Link: P1	Dublin Road	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Road S	-	C1:B	7	0	-	0	0.0%	-	-	-	-	-
J3: Upper Clare Street/Park Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**18.7%**	**0.0**	**0.1**	**-**	**-**	**-**
1/1	Upper Clare Street Left	U	-	-	308	1646	1646	18.7%	0.0	0.1	1.4	4.1	4.2
J4: Park Road/Rhebogue Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**51.1%**	**7.7**	**8.7**	**-**	**-**	**-**
1/1	Park Road SB Ahead	U	C2:B	59	24	1915	957	2.5%	0.0	0.0	5.3	0.0	0.1
1/2	Park Road SB Ahead	U	C2:B	59	356	2055	1027	34.3%	4.3	4.5	46.2	11.6	11.9
2/2+2/1	Rhebogue Road WB Left Right	U	C2:C	45	342	1683:1587	593+76	51.1 : 51.1%	2.6	3.2	33.2	8.1	8.6
3/1	Park Road NB Ahead	U	C2:A	59	351	1915	957	36.7%	0.7	1.0	10.6	2.4	2.6
Ped Link: P1	Rhebogue	-	C2:D	59	0	-	0	0.0%	-	-	-	-	-
J5: Park Road/Pa Healy Road	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**101.7%**	**12.8**	**44.6**	**-**	**-**	**-**
1/2+1/1	Park Road NB Left Ahead	U	C3:C	49:96	962	1965:2014	197+749	101.7 : 101.7%	6.8	26.9	100.5	29.2	49.3
2/1	Pa Healy Road WB	U	-	-	775	1995	1995	38.8%	0.0	0.3	1.5	0.0	0.3
3/1+3/2	Park Road SB Ahead Right	U	C3:D C3:E	64:7	50	1980:1717	280+98	13.2 : 13.2%	0.3	0.4	28.7	0.6	0.7

4/1	Pa Healy Road EB Right Left	U	C3:A	24	412	1957	408	101.1%	5.7	17.0	148.2	13.9	25.2
5/1	Park Road NB	U	-	-	269	1915	1915	13.8%	0.0	0.1	1.1	0.0	0.1
Ped Link: P1	Pa Healy	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P2	Park Pa Healy	-	C3:G	14	0	-	0	0.0%	-	-	-	-	-
Ped Link: P3	Park Road	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-
Ped Link: P4	Park Road N	-	C3:F	8	0	-	0	0.0%	-	-	-	-	-

C1 - Pennywell PRC for Signalled Lanes (%): 0.6 Total Delay for Signalled Lanes (pcuHr): 37.04 Cycle Time (s): 120
C2 - Rhebogue PRC for Signalled Lanes (%): 76.1 Total Delay for Signalled Lanes (pcuHr): 8.74 Cycle Time (s): 120
C3 - Park Road Corbally Road PRC for Signalled Lanes (%): -13.0 Total Delay for Signalled Lanes (pcuHr): 44.21 Cycle Time (s): 120
PRC Over All Lanes (%): -13.0 Total Delay Over All Lanes(pcuHr): 91.55

APPENDIX 11.4 – Road Safety Audit Stage 1

Proposed Mixed-Use Development
Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit
with Appended Re-audit

Final Report

23rd March 2022

Prepared for

Revington Developments Limited

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Proposed Mixed-Use Development – Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit with Appended Re-audit

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Proposed Mixed-Use Development – Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit with Appended Re-audit

Contents

1.0 Introduction

This report presents the findings of a Stage 1 Road Safety Audit (RSA) of the design of the site layout of a proposed mixed-use development at Pa Healy Road, Canal Bank, Limerick.

This RSA was commissioned by Revington Developments Limited. The design team for this proposed development was led by OCA Architects Limited, whilst the highway engineering drawings for the development were prepared by PHM Consulting.

This RSA has been undertaken by Traffic Transport and Road Safety Associates Limited (TTRSA) in accordance with the requirements of Transport Infrastructure Ireland (TII) GE-STY-01024 Road Safety Audit standard, and with full cognisance of the principles, approaches and standards contained within DMURS. The Audit Team members comprised: Matthew Steele (TII Auditor Ref. No. MS88315) and Pamela Townley (TII Auditor Ref. No. PT90300). The composition on the Audit Team was made known to Limerick City and County Council prior to the audit being undertaken. A brief for this audit, in accordance with the requirements of TII GE-STY-01024, is included as Appendix A of this report.

A site visit for this RSA was undertaken by both Audit Team members during the PM traffic peak period on Thursday 12th December 2019. During the audit site visit the weather was intermittent rain showers and the road surface was wet. The RSA was undertaken in the office premises of TTRSA between 13th and 19th December 2019.

This RSA examines the documents relating to the proposed scheme and on-site observations at the time of the audit site visit, and identifies issues which may have an adverse impact on road safety. The RSA does not examine or verify the proposed scheme for compliance with any other standards or criteria.

Issues which impact on road safety are listed as problems within this report, and relate to the documentation provided upon commencement of the RSA and associated clarification. The problems identified are considered to require action in order to improve the safety of the scheme and minimise collision occurrence.

The scheme employer and designer are required to respond to this RSA by completing a Road Safety Audit Feedback Form, included as Appendix B of this report. If any of the recommendations within this RSA are not accepted, a written response is required within the feedback form, stating the reasons for non-acceptance.

A limited re-audit covering minor changes to the preliminary design of highway related aspects of the proposed development is appended to this report as Appendix C with the associated Re-audit Feedback Form being included as Appendix D.

2.0 Scheme Background

2.1 The proposed scheme

The scheme is a mixed-use development of: 363 build-to-rent apartments; 61 student apartments; a café; three retail units; a community and management facilities building which contains a crèche; and 18 dwelling houses. The development covers approximately four hectares bounded by Limerick's Park Canal to the north, Pa Healy Road to the south and Park Road to the west. Two priority stop controlled access junctions are proposed off the northern side of Pa Healy Road. The western site access junction has been designed to cater for all movements, whilst the eastern site access junction has been designed to facilitate only left-turn in and left- turn out movements. The scheme also includes the construction of: a) a 6m wide internal two-way spine road (road 1) which continues to the north of the western site access for a distance of approximately 50m before transitioning to the east on an east-west alignment and then transitioning to the north for a short section length; b) a north south road bounded to the west by perpendicular parking linking the eastern site access to the spine road; and, c) five further access junctions off the spine road, three serving parking areas and one a delivery bay for the community and management facilities building. Pedestrian routes are provided throughout the development with additional pedestrian accesses linking to existing pedestrian facilities on Pa Healy Road, Park Road and the Canal Bank route. Cycle routes are proposed within a landscaped area on the northern and western sectors of the site, linking to existing off-road cycle routes. A copy of the site layout plan is included in Appendix A.

No details have been provided in relation to either public lighting. This design element has therefore not been included within this RSA.

2.2 The existing situation

The characteristics of Pa Healy Road in the vicinity of the proposed site access junction, as observed at the time of the audit site visit, included the following:

- Pa Healy Road is an urban single carriageway with a sealed width of approximately 10.6m. The carriageway is demarcated with one eastbound lane and one westbound lane, both approximately 3.8m in width, and a centrally located 3m wide ghost island providing right-turning lanes into accesses.
- The northern kerb of the carriageway is bounded by a cycle track of approximately 1.9m width, which is backed by a footpath of approximately 2.2m width. This footpath is bounded by a wooden post and rail fence and grass bank in the vicinity of the proposed western site access, and by a wall in the vicinity of the proposed eastern site access.
- The horizontal alignment of the carriageway is straight and the vertical profile of the carriageway is flat in long-section and crowned in cross-section. To the western extremity of the development, the carriageway enters a gentle westbound right-hand horizontal curve, also rising vertically, to a canal overbridge;
- A zebra type controlled pedestrian crossing is located to the south-eastern side of the Pa Healy Road canal overbridge, consistent with the access to the Canal Bank route;
- An eastbound bus stop is located in the immediate vicinity of the proposed westernmost site access junction;
- Public lighting and surface water drainage gullies are present on both sides of Pa Healy Road carriageway; and,

- 50km/h speed limit repeater signing is present consistent with the posted speed limit.

2.3 Design Standards and Departures from Standards

The design standard applicable for this development is the Design Manual for Urban Roads and Streets (DMURS). No departures from standards were reported to the audit team.

2.4 Traffic Collision Information

Consultation of the Road Safety Authority online collision data (for the period 2005 to 2016 inclusive) available to the date of this report indicates that one collision resulting in injury has been reported on Pa Healy Road in the vicinity of the proposed development. This collision occurred on a Saturday evening (19:00-23:00) in 2012 and involved a car and resulted in minor injuries to three casualties.

2.5 Information provided for the audit

Documents and information provided for this audit are detailed with the RSA brief contained in Appendix A.

3.0 Stage 1 Road Safety Audit Findings

3.1 Problem: Lack of inter-visibility splay at western site access junction

The indented pedestrian and cyclist crossing point located across the proposed western site access junction of the development will not provide adequate inter-visibility splays between these road-users and those turning into the junction, increasing the risk of collision involving these road-users. The indented crossing point does not coincide with the desire line of west-east cycle access, increasing the risk of cyclists dismounting the kerb and continuing on the carriageway, veering into the path of vehicles.

Recommendation:
Relocate this crossing point to the mouth of the western site access junction, providing a raised crossing as necessary and taking full account of the cycle access desire line and surface water drainage.

3.2 Problem: Inadequate left-turn access for large vehicle into eastern site access junction

The proposed geometry of the eastern site access junction will not provide safe left-turn access for large vehicles, forcing these vehicles to mount the adjacent proposed footpath and central island, with potential for collision into road-side infrastructure and pedestrians/cyclists traversing the adjacent pedestrian and cycle routes.

Recommendation:
Provide adequate geometry of this site access junction to ensure that the swept-path of left-turning large vehicles is fully and safely accommodated.

3.3 Problem: Hazardous proposed central median on Pa Healy Road

The proposed carriageway central median on Pa Healy Road opposite the eastern site access junction will create a hazardous narrowing of the westbound traffic lane, increasing the risk of collisions with this proposed infrastructure. As the eastern site access junction does not provide right-turn egress, there is also the potential for road-users exiting the eastern site access of the proposed development to then use this turning lane and the access junction located eastern-opposite to undertake westbound u-turn manoeuvres, increasing the risk of a range of collision types in this locality.

Recommendation:
Either: (a) provide a left-turn in access only restriction for the eastern site access junction (taking Section 3.2 of this report into full account), revising the southern extent of internal road numbered 4 to ensure one-way north-bound access only with associated signing and road markings, or **(b)** relocate the eastern site access to a safe location providing both right-turn and left-turn egress.

3.4 Problem: Potential for collisions involving cyclists at cycle route on off-side of bus lay-by

There is potential for vehicles to utilise the proposed bus lay-by located at the frontage of the retail units of the site for parking, loading or set-down/pick-up, and as the access manoeuvres of these vehicles differs from bus vehicle access this increases the risk of conflict and collision between these vehicles and cyclists traversing the cycle route positioned on the off-side of this bus lay-by.

Recommendation:
Remove the cycle lane aligned off-side to the bus lay-by, and provide a safe off-road cycle route for this locality, incorporating a section length of joint-use pedestrian/cycle route in the vicinity of bus stop infrastructure or area used for passengers boarding/disembarking bus vehicles. Provide measures to distinguish and segregate the frontage of the retail units of building block 1 and the pedestrian and cycle route and footpath aligning the northern side of the carriageway of Pa Healy Road. Provide parking restrictions for this proposed bus lay-by. Undertake a Stage 2 RSA of the proposed design of this cycle route and infrastructure prior to construction.

3.5 Problem: Landscape vegetation located within and immediately adjacent to bus lay-by

The proposed landscape design information provided for this audit indicates landscape vegetation is positioned within and immediately adjacent to the proposed bus lay-by, creating a hazardous environment for bus vehicles, pedestrians and cyclists at this locality.

Recommendation:
Ensure that landscape vegetation is not located within and immediately adjacent to the proposed bus lay-by, taking section 3.4 of this report into full account.

3.6 Problem: Inappropriate road markings on Pa Healy Road for western site access junction

The proposed road markings relating to the proposed western site access junction conflict with the existing road markings on Pa Healy Road carriageway, and create the potential for hazardous turning lane/access to the western junction of the development and associated potential for collisions.

Recommendation:
Revise the proposed road markings on Pa Healy Road taking full account of the position of the proposed western site access junction and existing road markings.

3.7 Problem: Potential for kerb-side pick-up/set-down on Pa Healy Road at building block 2

The distance between building block 2 and the proposed set-down area located internally within the development site will increase the likelihood for kerb-side pick-up/set-down on Pa Healy Road at the road-side frontage of building block 2. This situation increases the risk of a range of collision types including rear-end and side-impact type collisions, and collisions between cyclists on the cycle route adjacent to the kerb-side and those traversing across this cycle route to access pick-up/set-down vehicles.

Recommendation:
Provide a set-down facility for this building block at a safe location, taking full account of adjacent pedestrian and cycle routes and visibility splays. Provide measures to ensure that this set-down facility is not used as a parking area.

3.8 Problem: Obstruction of visibility splays by proposed vegetation

Visibility splays including inter-visibility between vehicles, and between pedestrians/cyclists and vehicles, will be obstructed by the proposed landscape vegetation positioned adjacent to access junctions, parking bays, crossing points, and set-down area, increasing the potential for collision involving these road-users. Tree vegetation will also restrict forward visibility of road signs on both the horizontal and vertical planes, reducing road-users awareness of this signing and increasing the potential for non-adherence of priority right-of-way, with increased risk of a range of collisions.

Recommendation:
Remove the proposed landscape vegetation from the vicinity of access junctions, parking bays, crossing points, and set-down area to ensure that clear visibility splays are provided at these locations all times on both the horizontal and vertical planes. Ensure that tree vegetation does not mask forward visibility of road signs.

3.9 Problem: Obstruction of pedestrian, cyclist and vehicles routes by proposed vegetation

Tree/shrub vegetation located adjacent to the carriageway, access gates, and pedestrian/cycle routes will potentially over-hang these routes, increasing the risk of direct injury to pedestrians or cyclists and increasing vehicle collision relating to manoeuvres to avoid collision with tree vegetation. There are several locations where the indicative position of tree vegetation is located immediately adjacent to the tactile paving of pedestrian crossing points, increasing the risk of those pedestrians with visual impairments to collide with the tree structure, particularly as the girth of the tree trunk will increase as the tree grows.

Recommendation:
Relocate proposed tree/shrub vegetation away from the edge of all pedestrian, cyclist and vehicle routes and access gates, to provide adequate lateral clearance, and ensure that the canopy height of shrub/tree vegetation is greater than 2.2m above the surface of adjacent pedestrian/cycle routes and is greater than 4.65m above adjacent vehicle routes. Remove tree vegetation located immediately adjacent to pedestrian crossing points.

3.10 Problem: Potential for inappropriate vehicle speeds on internal road numbered 4

The straight alignment and section length of the internal site road numbered 4 will increase the potential for inappropriate vehicle speeds on this section of the internal access road and associated potential for a range of collision types.

Recommendation:
Provide traffic calming measures for internal road numbered 4, ensuring that appropriate signing and surface water drainage is provided for these traffic calming measures.

3.11 Problem: Inadequate visibility splays for egressing internal junctions

The proposed yield priority control of internal roads numbered 2, 3, 4, 6, 7 and the internal route located on the eastern side of the community facilities building will not provide adequate visibility splays from a 9m approach setback, increasing the risk of those road-users egressing from these internal junctions colliding with internal through-traffic or crossing pedestrians.

Recommendation:
Provide stop priority control for these internal junctions, ensuring that adequate visibility splays are provided at all times and that full clear visibility of associated road signing is provided without being masked by vehicle occupation of parking bays or vegetation located within the vicinity of these junctions.

3.12 Problem: Lack of defined right-of-way for the junction of internal road numbered 5

The lack defined right-of-way for the junction of the internal road numbered 5 will increase the potential for vehicles egressing this road to directly collide with road-users traversing road numbered 1 to or cause sharp breaking/collision between road-users on the carriageway of road numbered 1 in this locality.

Recommendation:

Provide stop priority control for the junction of internal road numbered 5, ensuring that adequate visibility splays and visibility of signing and road markings are provided.

3.13 Problem: Inadequate internal turning head facilities

The proposed turning heads located at the northern extents of internal roads numbered 2, 3 and 7, and eastern extent of internal road numbered 6, do not provide adequate access for the safe u-turn movements of vehicles, increasing the potential for collision with other manoeuvring vehicles/pedestrians accessing the car parking, or forcing turning vehicles to either utilise the ramp area of the building frontages to u-turn or to reverse back towards the junction, increasing the risk of collision to all types of road-users.

Recommendation:

Provide turning head facilities of adequate dimension for safe u-turn access for vehicles for each of these internal roads.

3.14 Problem: Hazardous manoeuvres for access to waste collection points by refuse vehicles

As the waste collection points of the proposed development are positioned in the vicinity of the access points to each of the buildings blocks and dwellings of the development, the lack of turning heads of adequate dimensions for refuse vehicles will result in refuse vehicles undertaking long section lengths of reverse manoeuvres at internal junctions and also stopping kerb-side on Pa Healy Road at building block 2. This situation increases the risk of a range of collision types involving all types of road-users.

Recommendation:

Either: a) Provide adequate turning head facilities for each refuse collection point (excluding building block 2) or **b)** Provide refuse collection points which are accessed by the refuse vehicle kerb-side to the internal roads of the development only.

3.15 Problem: Potential for collision with site infrastructure whilst manoeuvring into parking bays

There is potential for vehicle overhang to directly collide with site infrastructure such as kerbing, landscape vegetation/trees at the following locations: the northern parking bays of internal roads numbered 1 and 2, and the north-western parking bays of internal roads numbered 3 and 7, the eastern parking bay of internal road numbered 6, and the northern and southern parking bays of internal road numbered 4, and parking bays located immediately adjacent to the vegetation surrounds of cycle parking. Vehicle collision with this site infrastructure can lead to injury to vehicle occupants or vehicle damage.

Recommendation:

Provide buffer strips for these parking bays, ensuring that the height and profile of the area adjacent to these parking bays is adequate for vehicle manoeuvring overhang and repositioning landscape vegetation outside of these buffer strips.

3.16 Problem: Inadequate access at delivery bay at community facilities building

The proposed delivery bay located on the eastern side of the community facilities building will not provide safe access for turning movements of delivery vehicles or for turning movements within the carriageway of the route without completion of a series of vehicle point turns, increasing the risk of collision between road-users at this locality. The proposed landscape tree vegetation adjacent to this delivery bay will create hazardous access for the manual transfer of goods/services to and from this delivery bay.

Recommendation:

Provide a delivery bay of adequate dimensions to ensure safe access for vehicles including large vehicles. A safe route of adequate gradient profile and width should be provided for the manual transfer of goods/services to and from this delivery bay and the associated destination buildings.

3.17 Problem: Potential obstruction of set-down bay by parked vehicles

There is potential for the proposed set-down bay located on the northern perimeter of building block 1 to be obstructed by parked vehicles, forcing delivery vehicles to utilise the traffic lane of the internal road carriageway for servicing/loading and creating road-safety hazard for all types of road-users.

Recommendation:

Provide a designated safe loading bay for the proposed retail units, ensuring that non-servicing/loading vehicle access/parking cannot occur within this loading bay.

3.18 Problem: Restricted inter-visibility splays at the proposed set-down bay

Vehicle occupation of the set-down bay located on the northern side of building block 1 will restrict the inter-visibility splays between through-traffic on the internal road numbered 1 and pedestrians preparing to cross south to north at the crossing points located adjacent to the set-down bay, increasing the risk of pedestrian-vehicle collisions. It is also unclear how the section of set-down bay adjacent to the raised junction table will function.

Recommendation:

Revise the proposed set-down bay and adjacent pedestrian crossing points to ensure that adequate inter-visibility splays are provided between through-traffic on the internal road numbered 1 and those pedestrians preparing to cross south to north at these crossing points. Remove the proposed pedestrian crossing point located within the mid-eastern area of the set-down bay.

3.19 Problem: Lack of pedestrian route connectivity at northern extents of internal roads

There is a lack of pedestrian route connectivity at the northern extents of internal roads numbered 1, 2, 4 and the road between the community facilities building and building block 4. This situation increases the risk of conflict and collision involving pedestrians crossing between manoeuvring vehicles of the delivery/parking bays.

Recommendation:
Provide defined connected pedestrian routes for these internal roads for safe pedestrian access between these buildings.

3.20 Problem: Potential non-adherence of segregated pedestrian/cycle routes of landscaped area
The proposed segregated pedestrian/cycle routes located within the north-western landscaped area of the site result in discontinuous routes for cyclists and any yield at intersections with pedestrian routes will not be adhered to, creating conflict and potential collision between cyclists and pedestrians within this area. The lack of connectivity between the cycle routes within this landscaped area and the buildings/road network of the proposed development will result in cyclists utilising pedestrian routes and forced access between buildings, infrastructure and car parking to merge to/from the internal roads of the proposed development, increasing the potential for a range of cyclist collisions with all types of road-users.

Recommendation:
Revise the segregated pedestrian/cycle routes to joint-use pedestrian/cycle routes within this landscaped area. Provide route connectivity for cyclists to safely access between this landscaped area and the internal buildings and roads of the proposed site.

3.21 Problem: Hazardous access at proposed bicycle parking area
Whilst the proposed vegetation surrounds of the cycle parking areas located in the vicinity of access points of building blocks numbered 3, 5, 6 and 7, provide an element of protection of this cycle parking, this proposed vegetation may cause physical obstruction and restrict inter-visibility for safe access to this cycle parking. It is also unclear of whether adequate gradient profile will be provided for cyclists to access these cycle parking areas via the proposed ramp located immediately adjacent to this cycle parking and also how these ramps will be kept clear of parking to ensure that the cycle parking areas can be safely accessed without potential conflict and collision between accessing cyclists and vehicles manoeuvring at these ramps.

Recommendation:
Ensure that the proposed vegetation surrounds of the cycle parking do not obstruct safe physical access to and within these cycle parking areas and do not obstruct inter-visibility splays for safe access point to and from these cycle parking areas. Provide adequate gradient and profile surface access to these cycle parking areas. Provide measures to ensure that the ramp areas located to these cycle parking bays do not become obstructed by parked or manoeuvring vehicles.

3.22 Problem: Displacement of proposed gravel surfacing of cycle parking onto pedestrian route
Access to the cycle parking bays located within building block 1 will displace the proposed gravel surfacing of this cycle parking onto the adjacent pedestrian route, increasing the risk of pedestrian slip/fall type injuries and potential forced dismount of cyclists riding within this locality.

Recommendation:
Provide a solid surfacing of adequate profile and surface water drainage for these proposed cycle parking areas.

3.23 Problem: Potential for non detection of tactile paving of pedestrian crossing points

Due to the presence of the proposed verge aligning the kerbside of pedestrian routes, there is the potential for those pedestrians with visual impairments to be unable to detect the proposed tactile paving of pedestrian crossing points at these locations, creating disorientation and subsequent use of less safe locations for these pedestrians to cross the internal road carriageway.

Recommendation:

Increase the depth of the tactile paving at these crossing points to align the back of the verge adjacent to these pedestrian crossing points.

3.24 Problem: Potential for pedestrian slip injuries on utility service covers

Utility covers will be located within pedestrian, cyclists and vehicle routes, increasing the potential for pedestrian slip injuries and forced cyclist dismount injuries particularly in wet or icing conditions, and creates differential surface skid resistance for vehicles and potential for loss-of control type collisions.

Recommendation:

Provide high friction covers for utility service covers which are located within pedestrian, cyclist and vehicle routes of the proposed development.

3.25 Problem: Hazardous positioning of proposed landscape vegetation

Landscape vegetation is positioned to cause obstruction to safe access for road-users at the following locations: within the footpath route on the north-east of building block 3 and within carriageway of the road located between the community facilities building and building block 4. Landscape vegetation proposed immediately kerbside to the parking bays of the northern section of internal road numbered 1 and the western side of the community facilities building will create hazardous pedestrian access between these parking bays and the adjacent pedestrian route.

Recommendation:

Remove proposed landscape vegetation positioned within pedestrian and vehicle routes. Reposition the proposed landscape vegetation positioned between parking bays and pedestrian routes used to access these parking bays, providing paved surface for access to these parking bays.

3.26 Problem: Opening of doors of community facilities building into pedestrian route

Door infrastructure of the proposed building complex will open out into the pedestrian area aligning eastern side of the proposed community facilities building, increasing the risk of pedestrians being struck whilst these doors are being opened, particularly those pedestrians with visual impairments using the building line as guidance.

Recommendation:

Provide physical measures to prevent pedestrians walking immediately adjacent to the opening of doors of this building.

3.27 Problem: Detail of design elements

No details have been provided for this stage of audit of the following elements of the design of the proposed development: proposed tie-in with the existing carriageway of Pa Healy Road; proposed removal of existing site access junction and bus lay-by and associated construction of cycle route, pedestrian route and site boundary aligning Pa Healy Road; proposed location of public lighting column infrastructure and associated luminance levels for the site including the luminance of glazed paving with under slab lights; construction details of proposed landscaped pedestrian and cyclist routes and surfaces; proposed levels and cross-fall of road-side parking bays; proposed movable bollards; proposed site boundary infrastructure and internal landscape fence/gate infrastructure (including the operation of self closing gates); proposed tree pit covers/infrastructure; proposed gradient and profile of ramp accesses located at the access points of the buildings; proposed pedestrian/cycle route gate infrastructure and inter-visibility splays between the site access points and the existing pedestrian/cycle routes adjacent to the site; proposed kerbing adjacent to disabled parking bays and associated access to and from these proposed disabled parking bays; surface material and physical access to proposed seating and cycle parking located within the landscaped area; boundary infrastructure and pedestrian access to the proposed sports court located within the landscaped area and the proposed junior play area; proposed surface material, cross-section details, surface water drainage, and cycle route access of internal road numbered 5 including access to frontage parking bays; proposed electric car charging infrastructure. These elements of the design can individually, or in combination, adversely affect safety for all types of road users.

Recommendation:
Undertake a Stage 2 RSA on the detailed design of these elements of the proposed development site prior to construction taking full account of the recommendations of this report.

4.0 Audit Statement

We certify that we have examined the documentation provided for the audit as detailed in Section 2 of this report, and visited the site as detailed in Section 1 of this report. The audit has been carried out in accordance with TIIGE-STY-01024 with the sole purpose of identifying any features of the design that could be removed or modified in order to improve the safety of the scheme. The problems that we have identified have been noted in this report, together with suggestions for safety improvement that in our opinion should be studied for implementation. The Audit has been conducted by the persons named below who are independent from the design team for the scheme.

Matthew Steele (Audit Team Leader)	Signed:	Date: 20thDecember 2019
Pamela Townley (Audit Team Member)	Signed:	Date: 20thDecember 2019

Appendix A – Stage 1 Road Safety Audit Brief

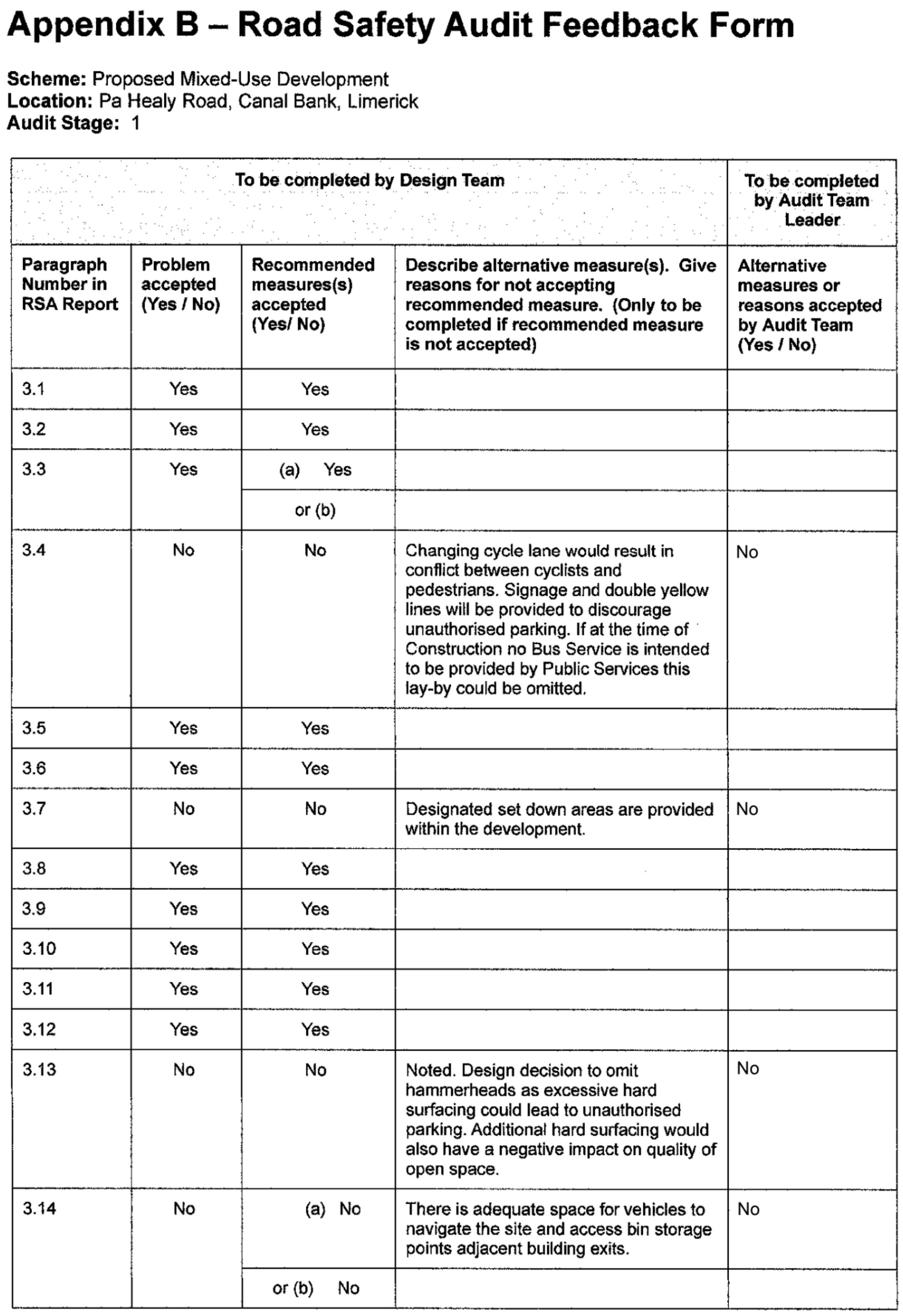
Scheme: Proposed Mixed-Use Development at Pa Healy Road, Canal Bank, Limerick

TII Checklist Item	**Yes/No/Not Applicable (N/A)**	**Comment**
Design Brief	Yes	Undertake a Stage 1 Road Safety Audit (RSA) of the design of the site layout of a proposed mixed-use development at Pa Healy Road, Canal Bank, Limerick. The scope of this RSA is limited to the proposed site layout of the development and the two proposed site access junctions onto Pa Healy Road.
Design Standard Applied	Yes	The proposed site will accord with DMURS design standards.
Design Speed Applied	Yes	The design speed for the proposed development is 30km/h.
Departures from Standard	No	
Scheme Drawings	Yes	Documents prepared by OCA Architects Ltd, and provided to TTRSA on 12th December 2019: • Drawing Title: 'Proposed Site Layout – Open Spaces'; drawing number: 1248-18-P01 Rev H; dated Jan 2018. Documents prepared by OCA Architects Ltd, and provided to TTRSA on 13th December 2019: • Document: Cycleway Integration.pdf (no drawing reference or date). • Document: Segregated Waste Collection Stragety.pdf (no drawing reference or date). • Document: Residential + Communal (1).pdf [details of floor plans and elevations of proposed buildings] Documents prepared by PHM Consulting, and provided to TTRSA on 17th December 2019: • Drawing Title: 'Roads – General Arrangement'; Drawing Reference: 108-96-101; dated 12/2019. • Drawing Title: 'Roads – Signage and Road Markings'; Drawing Reference: 108-96-102; dated 12/2019. • Drawing Title: 'Drainage General Arrangement'; Drawing Reference: 108-96-201; dated 12/2019. • Drawing Title: 'Watermains General Arrangement'; Drawing Reference: 108-96-301; dated 12/2019. • Drawing Title: 'Roads Details'; Drawing Reference: 108-96-401; dated 12/2019. • Drawing Title: 'Drainage Details 1 of 2'; Drawing Reference: 108-96-402; dated 12/2019.

		Documents prepared by PC Roche Associates, and provided to TTRSA on 18th December 2019: • Drawing: 'Landscape Strategy Proposals'; Drawing Number: 1453-4010; dated Dec 19. • Drawing: 'Area Detail'; Drawing Number: 1453-4011; dated Dec 19. • Drawing: 'Area Detail 2'; No drawing reference of drawing date provided. • Drawing: 'Planting Proposals'; Drawing Number: 1453-4013; dated Dec 19. • Document: 'PCR Landscape Report'; dated December 19. • Document: 'PCR Specification'; dated December 19.
Other scheme details, e.g. signs schedules/traffic signal staging	No	
Collision data for existing roads affected by the scheme	Yes	Consultation of the Road Safety Authority online collision data (for the period 2005 to 2016 inclusive) available to the date of this report indicates that one collision resulting in injury has been reported on Pa Healy Road in the vicinity of the proposed development. This collision occurred on a Saturday evening (19:00-23:00) in 2012 and involved a car. This collision resulted in minor injuries to three casualties.
Traffic surveys	Yes	A traffic and transport assessment (TTA) for the proposed development has been prepared under separate cover. This TTA incorporates traffic surveys at the following junctions: 1) the Corbally Roundabout; 2) PA Healy Road/Park Road; 3) Park Road/Rhebogue Road; 4) Park Road/Upper Clare Street; 5) Park Road/Dublin Road; and, 6) Clare Street/Upper Clare Street/Dublin Road/Pennywell Road.
Previous Road Safety Audit Reports and Designer Responses/Feedback Form	No	
Previous Exception Reports	N/A	
Start date for construction and expected opening date	Yes	If planning is granted, opening year for the proposed development is anticipated in year 2022.
Any elements to be excluded from audit	Yes	Lighting design and an indicative access point to adjacent lands is excluded from this Stage 1 RSA.
Any other information (list separately)	Yes	The design team has informed the audit team of the following: an indicative access point serving lands immediately east of the proposed development has been depicted within the drawing information provided for this Stage 1 RSA; electric car charging facilities will be implemented within the site in the future.

Proposed Mixed-Use Development – Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit with Appended Re-audit



Appendix B – Road Safety Audit Feedback Form

Scheme: Proposed Mixed-Use Development
Location: Pa Healy Road, Canal Bank, Limerick
Audit Stage: 1

To be completed by Design Team				To be completed by Audit Team Leader
Paragraph Number in RSA Report	**Problem accepted (Yes / No)**	**Recommended measures(s) accepted (Yes/ No)**	**Describe alternative measure(s). Give reasons for not accepting recommended measure. (Only to be completed if recommended measure is not accepted)**	**Alternative measures or reasons accepted by Audit Team (Yes / No)**
3.1	Yes	Yes		
3.2	Yes	Yes		
3.3	Yes	(a) Yes		
		or (b)		
3.4	No	No	Changing cycle lane would result in conflict between cyclists and pedestrians. Signage and double yellow lines will be provided to discourage unauthorised parking. If at the time of Construction no Bus Service is intended to be provided by Public Services this lay-by could be omitted.	No
3.5	Yes	Yes		
3.6	Yes	Yes		
3.7	No	No	Designated set down areas are provided within the development.	No
3.8	Yes	Yes		
3.9	Yes	Yes		
3.10	Yes	Yes		
3.11	Yes	Yes		
3.12	Yes	Yes		
3.13	No	No	Noted. Design decision to omit hammerheads as excessive hard surfacing could lead to unauthorised parking. Additional hard surfacing would also have a negative impact on quality of open space.	No
3.14	No	(a) No	There is adequate space for vehicles to navigate the site and access bin storage points adjacent building exits.	No
		or (b) No		

3.15	Yes	Yes		
3.16	Yes	Yes		
3.17	Yes	Yes		
3.18	Yes	Yes		
3.19	No	No	Adequate permeability is provided through the public park and communal open space area. Traffic speeds will be low at ends of roads 1,2,3 and 7.	No
3.20	Yes	Yes		
3.21	Yes	Yes		
3.22	Yes	Yes		
3.23	Yes	Yes		
3.24	Yes	Yes		
3.25	Yes	Yes		
3.26	Yes	Yes		
3.27	Yes	Yes – issues to be addressed in Stage 2 RSA		

PRINT Name: Neil Fanning
Design Team Representative
(OCA Architects Limited)

Signature:

Date: 17/1/20

PRINT Name: Gary Lawlor
Scheme Client
(Revington Developments Limited)

Signature:

Date: 17/1/20

Road Safety Audit signed of by:
Matthew Steele
BA(Hons) MSc FCILT FRGS MCIHT
(Audit Team Leader)

Signature:

Date: 17 January 2020

Appendix C – Re-audit of Design Changes

Appendix C 4.1 – Background to this Re-audit

Where changes are made to a scheme following the preparation of a Road Safety Audit (RSA), Section 3.18 of the Transport Infrastructure Ireland Road Safety Audit Guidelines (GE-STY-01027) allows for a re-audit of the changes to the scheme.

Minor changes have been made to the preliminary design of highway related aspects of the proposed development, primarily as a result of the scheme Client agreeing to undertake recommendations contained within this Stage 1 RSA. The scheme client has therefore requested a re-audit limited to these minor changes.

The audit team for this RSA re-audit comprises the same audit team members who prepared this RSA report. The audit team undertook an additional site visit to the proposed scheme locality on 14th October 2021 during which the weather was dry and the road surface was dry.

The scope of this RSA re-audit is limited to the proposed design scheme detailed within the information provided for the RSA re-audit does not include traffic management or implemented construction of the scheme.

The following three sub-sections cover the following: the information provided for this RSA re-audit; a summary review of the Stage 1 RSA findings and recommendations; and, the findings of this RSA re-audit presented in standard RSA problem and recommendation format.

In common with Section 3 of the RSA report, the problems identified are considered to require action in order to improve the safety of the scheme and minimise collision occurrence.

The scheme employer and designer are required to respond to this re-audit by completing a Road Safety Audit Feedback Form, included as Appendix D of this report. If any of the recommendations within this RSA re-audit are not accepted, a written response is required within the feedback form stating the reasons for non-acceptance and where relevant, alternative measures proposed by the design team. Where the audit team does not accept the alternative measures or reasons, the client is required to submit an exception report to the Director of Service of the relevant highway authority.

Appendix C 4.2 – Information provided for this RSA re-audit

The following information has been provided by the design team to the audit team for this RSA re-audit:

Documents prepared by PC Roche Associates and received by audit team on 17thSeptember 2021:

- *Drawing: 'Landscape Strategy Proposals' – Drawing Number: 1453-6010 – dated Jan 2020;*
- *Drawing: 'Area Detail' – Drawing Number: 1453-6011 – dated Jan 2020;*
- *Drawing: 'Area Detail 2' – Drawing Number: 1453-6012 – dated Jan 2020;*
- *Drawing: 'Planting Proposals' – Drawing Number: 1453-6013 – dated Jan 2020; and,*
- *Drawing: 'Boundary Proposals' – Drawing Number: 1453-6014 – dated Jan 2020.*

Proposed Mixed-Use Development – Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit with Appended Re-audit

Documents prepared by PHM Consulting and received by audit team on 23rd September 2021:

- *Drawing: 'Roads – General Arrangement' – Drawing Reference: 108-96-101 – dated 09/2021;*
- *Drawing: 'Roads – Signage and Road Markings' – Drawing Reference: 108-96-102 – dated 09/2021;*
- *Drawing: 'Roads – Auto-Tracking' – Drawing Reference: 108-96-103 – dated 09/2021;*
- *Drawing: 'Drainage General Arrangement' – Drawing Reference: 108-96-201 – dated 09/2021;*
- *Drawing: 'Watermains General Arrangement' – Drawing Reference: 108-96-301 – dated 09/2021;*
- *Drawing: 'Roads Details' – Drawing Reference: 109-96-401 – dated 09/2021;*
- *Drawing Title: 'Drainage Details Sheet 1 of 2' – Drawing Reference: 109-96-402 – dated 09/2021.*

Appendix C 4.3 – Summary Review of Stage 1 Road Safety Audit Findings
As part of preparing this RSA re-audit, the audit team have undertaken a summary review of whether the problems and recommendations identified in Section 3 of this report have been incorporated into the information provided for this RSA re-audit. The findings of this summary review are included in the table below.

Paragraph Number in RSA Report	RSA report section 3 Problem Heading	Incorporated into the information provided for this RSA re-audit (Yes / No / Not Applicable / Partly).
3.1	Lack of inter-visibility splay at western site access junction	Partly. Whilst the position of the crossing point has been altered and a raised crossing provided as indicated in the drawing information provided for this RSA re-audit, it is unclear from this information provided whether inter-visibility will be obstructed by the proposed 1.5m high railing fence, and the resulting road safety problem is therefore covered in Appendix C.4.4.1.
3.2	Inadequate left-turn access for large vehicle into eastern site access junction	Partly. The junction has been amended to one-way (left-in). The swept paths shown on PHM Drawing Reference: 108-96-103 provided for this RSA re-audit are shown in conflict with kerbing and this resulting road safety problem is covered in Appendix C.4.4.2.

3.3	Hazardous proposed central median on Pa Healy Road	Yes. It is proposed within the design to replace the proposed median with ghost island road markings and a left-turn in only access restriction has been proposed at the eastern site access junction.
3.4	Potential for collisions involving cyclists at cycle route on off-side of bus lay-by	No. The problem and recommendation in the Stage 1 RSA were not accepted by the design team and the alternative measures proposed were not accepted by the Audit Team. No exception report has been submitted. The road safety problem identified has been exacerbated by the potential traffic movements related to the grant of planning permission for the school site on the southern side of the carriageway of Pa Healy Road opposite the proposed site and is covered in Appendix C 4.4.3.
3.5	Landscape vegetation located within and immediately adjacent to bus lay-by	Yes. The relevant landscape vegetation has been removed from the proposed design.
3.6	Inappropriate road markings on Pa Healy Road for western site access junction	Yes. The road markings have been amended within the proposed design as depicted on PHM Drawing Reference: 108-96-102.
3.7	Potential for kerb-side pick-up/set-down on Pa Healy Road at building block 2	No. The problem and recommendation in the Stage 1 RSA were not accepted by the design team and the alternative measures proposed were not accepted by the Audit Team. No exception report has been submitted. The road safety problem remains and is covered in Appendix C 4.4.4.
3.8	Obstruction of visibility splays by proposed vegetation	Partly. Whilst the landscape vegetation has been amended within the proposed design, there is still potential for restricted visibility and inter-visibility at a number of locations within the site. The road

		safety problem remains and is covered in Appendix C 4.4.5.
3.9	Obstruction of pedestrian, cyclist and vehicles routes by proposed vegetation	No. The client and design team accepted the problem and recommendation detailed in Section 3.9 of this report. However, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain an RSA issue.
3.10	Potential for inappropriate vehicle speeds on internal road numbered 4	Yes. Traffic calming road humps are now depicted within the information provided for this RSA re-audit.
3.11	Inadequate visibility splays for egressing internal junctions	Yes. The yield control has been amended to stop control as depicted within the information provided for this RSA re-audit.
3.12	Lack of defined right-of-way for the junction of internal road numbered 5	Yes. Stop control has been proposed at this junction as depicted within the information provided for this RSA re-audit.
3.13	Inadequate internal turning head facilities	No. The problem and recommendation in the Stage 1 RSA were not accepted by the design team and the alternative measures proposed were not accepted by the Audit Team. No exception report has been submitted. The road safety problem remains and is covered in Appendix C 4.4.6.
3.14	Hazardous manoeuvres for access to waste collection points by refuse vehicles	No. The problem and recommendation in the Stage 1 RSA were not accepted by the design team and the alternative measures proposed were not accepted by the Audit Team. No exception report has been submitted. The road safety problem remains and is covered in Appendix C 4.4.7.

3.15	Potential for collision with site infrastructure whilst manoeuvring into parking bays	No. Whilst the client and design team accepted the problem and recommendation detailed in Section 3.15 of this report, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.16	Inadequate access at delivery bay at community facilities building	Not Applicable. Whilst the client and design team accepted the problem and recommendation in Section 3.16 of this report, the information provided for this RSA re-audit indicates that the delivery bay has been removed from the scheme design.
3.17	Potential obstruction of set-down bay by parked vehicles	Partly. The information provided for this RSA re-audit indicates that a revised loading bay is proposed. Signing and road markings remain to be incorporated into the proposed design. Therefore the problem still remains in part, and is covered in Appendix C 4.4.8.
3.18	Restricted inter-visibility splays at the proposed set-down bay	Yes. The information provided for this RSA re-audit indicates that the loading bay has been shortened to provide inter-visibility.
3.19	Lack of pedestrian route connectivity at northern extents of internal roads	Partly. Whilst the information provided for this RSA re-audit indicates that some of the identified locations are shown with gates providing access through the park area, the problem still remains in relation to Road 1 and is covered in Appendix C 4.4.9.
3.20	Potential non-adherence of segregated pedestrian/cycle routes of landscaped area	No. Whilst the client and design team accepted the problem and recommendation detailed in Section 3.20 of this report, the accepted recommendation remains to be incorporated into the proposed

		design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.21	Hazardous access at proposed bicycle parking area	No. Whilst the client and design team accepted the problem and recommendation detailed in Section 3.21 of this report, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.22	Displacement of proposed gravel surfacing of cycle parking onto pedestrian route	No. Whilst the client and design team accepted the problem and recommendation detailed in Section 3.22 of this report, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.23	Potential for non detection of tactile paving of pedestrian crossing points	Yes. The information provided for this RSA re-audit indicates that the relevant tactile paving has been extended.
3.24	Potential for pedestrian slip injuries on utility service covers	No. Whilst the client and design team accepted the problem and recommendation detailed in Section 3.24 of this report, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.25	Hazardous positioning of proposed landscape vegetation	Partly. The information provided for this RSA re-audit indicates that whilst a tree has been removed from the carriageway of the road to the west of building block 4, the road safety problem remains and is covered in Appendix C 4.4.10.
3.26	Opening of doors of community facilities building into pedestrian route	No. Whilst the client and design team accepted the problem and

		recommendation detailed in Section 3.26 of this report, the accepted recommendation remains to be incorporated into the proposed design. The accepted problem and recommendation are not therefore restated and remain a RSA issue.
3.27	Detail of design elements	No. The detailed design of the identified elements are to be completed and subjected to a Stage 2 Road Safety Audit, prior to construction.

Appendix C 4.4 – Findings of this RSA re-audit

Appendix C 4.4.1 – Problem: Potential for restricted inter-visibility between road users turning left into the site at the western site access junction and pedestrians crossing the site access
Due to the position of the proposed uncontrolled pedestrian crossing at, and site boundary fencing in the vicinity of, the western site access junction, there is potential for inter-visibility to be restricted between those pedestrians and cyclists preparing to cross at this crossing and other road-users accessing this access junction, thereby increasing the risk of collision involving these road-users.

Recommendation:
Ensure that appropriate inter-visibility is provided between pedestrians, cyclists and other road users at this location. Additionally, provide advance warning signing with directional arrows on the Pa Healy Road approaches to this junction.

Appendix C 4.4.2 – Problem: Conflict between the swept-path of large vehicles and highway related infrastructure at the eastern site access junction
The wheel track of the articulated vehicle swept-path entering the site at the eastern site access junction as depicted in PHM Drawing Reference 108-96-103 provided for this RSA re-audit, is shown to strike/over-run both the proposed nearside and off-side kerb-lines. Such vehicles colliding with and/or over-running kerb-lines can lead to injury to the vehicle's occupant(s) and also damage to and displacement of kerbing and adjacent surfaces, and subsequent collision with other infrastructure such as road signing.

Recommendation:
Taking into account the problem and recommendation covered in section C 4.4.11 of this RSA re-audit appendix, ensure appropriate highway geometry is provided to safely cater for the entry of articulated and other large commercial vehicles at this location.

Appendix C 4.4.3 – Problem: Potential for collisions involving cyclists at cycle route on off-side of bus lay-by
There is potential for vehicles to utilise the proposed bus lay-by located at the frontage of the retail units of the site for parking, loading or set-down/pick-up, and as the access manoeuvres of these vehicles differs from bus vehicle access this increases the risk of conflict and collision between these vehicles and cyclists traversing the cycle route positioned on the off-side of this bus lay-by. Following the grant of permission for the school site on the opposite side of Pa Healy Road there is potential for this lay-by to be used for school drop-off and/or undertaking of vehicles queuing to make a right turn from Pa Healy Road into the school site.

Recommendation:
Omit the proposed bus lay-by and prevent vehicles from entering the cycle track through either retention of the existing kerbing and the provision of flexible bollards, or the provision of cycle lane separators.

Appendix C 4.4.4 – Problem: Potential for kerb-side pick-up/set-down on Pa Healy Road at building block 2
The distance between building block 2 and the proposed set-down area located internally within the development site will increase the likelihood for kerb-side pick-up/set-down on Pa Healy Road at the road-side frontage of building block 2. This situation increases the risk of a range of collision types including rear-end and side-impact type collisions, and collisions between cyclists on the cycle route adjacent to the kerb-side and those traversing across this cycle route to access pick-up/set-down vehicles.

Recommendation:
Provide a set-down facility for this building block at a safe location, taking full account of adjacent pedestrian and cycle routes and visibility splays. Provide measures to ensure that this set-down facility is not used as a parking area.

Appendix C 4.4.5 – Problem: Obstruction of visibility splays by proposed vegetation
Visibility splays including inter-visibility between vehicles, and between pedestrians/cyclists and vehicles, will be obstructed by the proposed landscape vegetation positioned adjacent to access junctions, parking bays, crossing points, and set-down area, increasing the potential for collision involving these road-users. Tree vegetation will also restrict forward visibility of road signs on

both the horizontal and vertical planes, reducing road-users awareness of this signing and increasing the potential for non-adherence of priority right-of-way, with increased risk of a range of collisions.

Recommendation:
Remove the proposed landscape vegetation from the vicinity of access junctions, parking bays, crossing points, and set-down area to ensure that clear visibility splays are provided at these locations all times on both the horizontal and vertical planes. Ensure that tree vegetation does not mask forward visibility of road signs.

Appendix C 4.4.6 – Problem: Inadequate internal turning areas

The proposed turning areas located at the northern extents of internal roads 2, 3, 7 and 8, and eastern extent of internal road 6, do not provide adequate access for the safe u-turn movements of vehicles, increasing the potential for collision with other manoeuvring vehicles/pedestrians accessing the car parking, or forcing turning vehicles to either utilise the ramp area of the building frontages to u-turn or to reverse back towards the junction, increasing the risk of collision to all types of road-users. Whilst the swept-path of an articulated vehicle entering the site at the western site access junction is depicted on PHM Drawing Reference 108-96-103 provided for this RSA re-audit, due to the lack of adequate turning areas such a vehicle would not be able to then safely exit the site.

Recommendation:
Either (a) Provide turning head facilities of adequate dimension for safe u-turn access for vehicles for each of these internal roads, **or (b)** Provide advance map type signing on Pa Healy Road to inform heavy goods vehicle drivers of the route for safe access to the site, and heavy goods vehicle directional signing within the site.

Appendix C 4.4.7 – Problem: Hazardous manoeuvres for access to waste collection points by refuse vehicles

As the waste collection points of the proposed development are positioned in the vicinity of the access points to each of the buildings blocks and dwellings of the development, the lack of turning heads of adequate dimensions for refuse vehicles will result in refuse vehicles undertaking long section lengths of reverse manoeuvres at internal junctions and also stopping kerb-side on Pa Healy Road at building block 2. This situation increases the risk of a range of collision types involving all types of road-users.

Recommendation:
Either: a) Provide adequate turning head facilities for each refuse collection point (excluding building block 2) or **b)** Provide refuse collection points which are accessed by the refuse vehicle kerb-side to the internal roads of the development only.

Appendix C 4.4.8 – Problem: Potential of obstruction of set-down bay by parked vehicles

There is potential for the proposed set-down bay located on the northern perimeter of building block 1 to be obstructed by parked vehicles, forcing delivery vehicles to utilise the traffic lane of the internal road carriageway for servicing/loading and creating road-safety hazard for all types of road-users.

Recommendation:
Provide restrictions and signing to ensure that this servicing/loading bay is actively managed, and that inappropriate parking, such as long-stay parking does not occur within this servicing/loading bay.

Appendix C 4.4.9 – Problem: Lack of pedestrian route connectivity
There is a lack of pedestrian route connectivity at the northern extent of internal road 1, and at the southern extent of the footpath aligning the eastern side of the internal road 4. This situation increases the risk of conflict and collision involving pedestrians crossing between parking bays.

Recommendation:
Provide defined connected pedestrian routes for these internal roads for safe pedestrian access.

Appendix C 4.4.10 – Problem: Hazardous positioning of proposed landscape vegetation
Landscape vegetation is positioned to cause obstruction to safe access for pedestrians within the footpath route on the north-east of building block 3. Landscape vegetation proposed immediately kerbside to the parking bays (including designated disabled parking spaces) at the northern section of internal road 1 and the western side of the community facilities building will create hazardous pedestrian access between these parking bays and the adjacent pedestrian routes.

Recommendation:
Taking full account of the recommendation contained within Section 3.9 of this report, remove proposed landscape vegetation positioned within pedestrian and vehicle routes. Reposition the proposed landscape vegetation located between parking bays and pedestrian routes used to access these parking bays, providing an appropriate paved surface for safe pedestrian access to these parking bays.

Appendix C 4.4.11 – Problem: Management and use of set-down area
The area on internal road 8 to the east of the Community Facilities Building was previously demarcated as a 'delivery area' and is now identified as a 'set-down area' with space for six vehicles. No information has been provided for this RSA re-audit in relation to how this area will be managed, or is intended to be used. Without appropriate management, this area will be used for long-stay parking with those road-users intending to set-down in this location then being forced to use other less safe areas for set-down purposes for example junctions, increasing the risk of conflict and collision with other road-users.

Recommendation:
Ensure that appropriate management is applied to the proposed set-down area on the internal road 8, including limitations to the duration of stay, clearly defined through road signing and markings.

Appendix C 4.4.12 – Problem: Potential for vehicle exit through the left-in eastern site access

Due to the short one-way section immediately to the north of the eastern site access, some road users are likely to exit the site via this access, increasing the risk of head-on collision with vehicles entering the site, or collision with pedestrian and cyclists crossing the site access who are not anticipating north-south vehicle movements.

Recommendation:

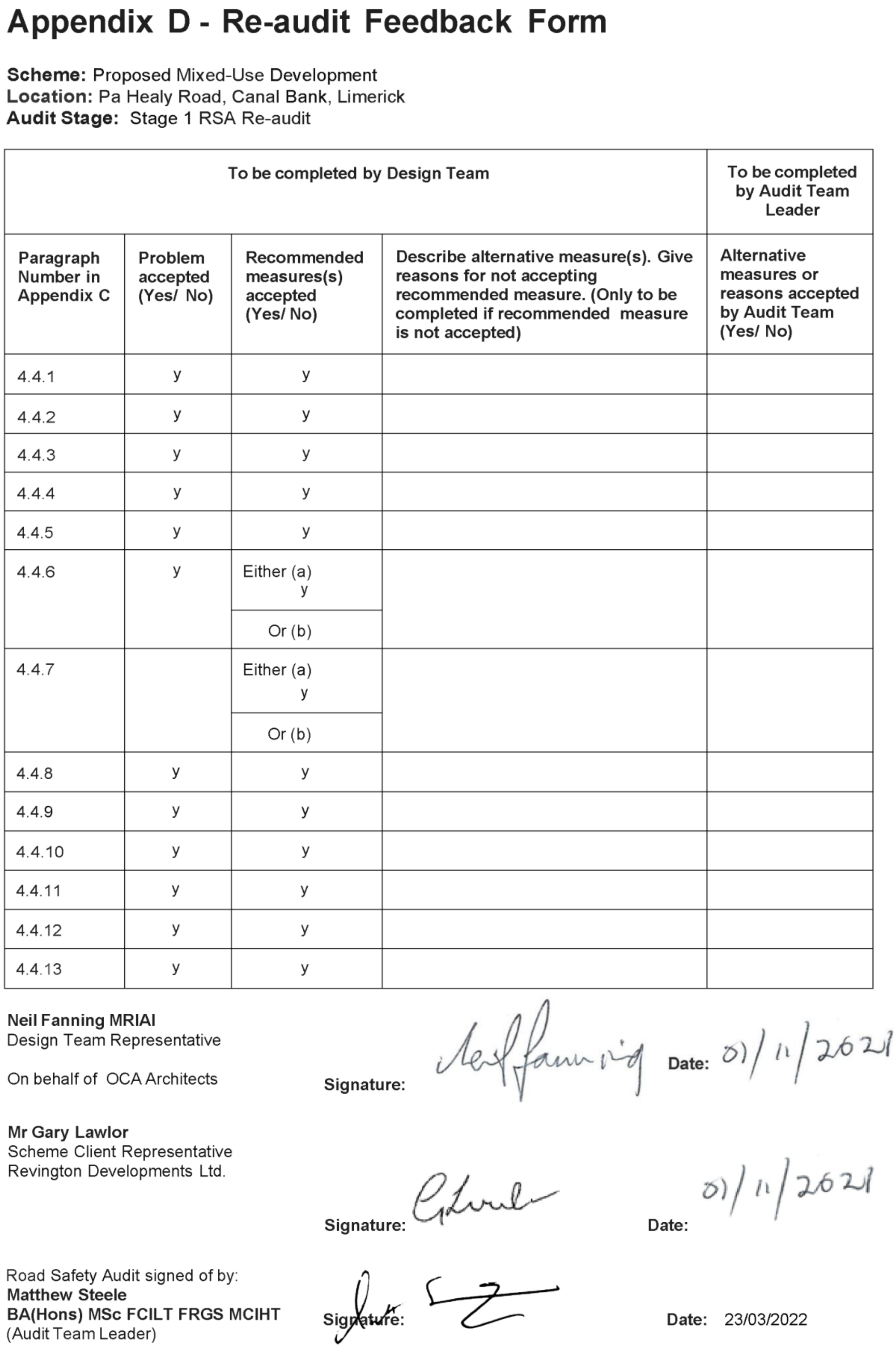
Taking into account the problem and recommendation covered in section 4.4.2 of this RSA re-audit appendix, extend the proposed south to north one-way restriction to cover the full extent of internal road 4, amending road signing and markings appropriately.

Appendix C 4.4.13 – Problem: Discrepancies between design drawings

There are a number of minor discrepancies between the engineering and landscape drawings provided or this RSA re-audit, for example, car parking on the internal road 4. Such discrepancies can result in and/or increasing the severity of collisions if implemented within the constructed scheme.

Recommendation:

Ensure that a consistent set of design drawings is provided for the Audit Team for the Stage 2 RSA to be undertaken prior to construction.



Appendix D - Re-audit Feedback Form

Scheme: Proposed Mixed-Use Development
Location: Pa Healy Road, Canal Bank, Limerick
Audit Stage: Stage 1 RSA Re-audit

To be completed by Design Team				To be completed by Audit Team Leader
Paragraph Number in Appendix C	Problem accepted (Yes/ No)	Recommended measures(s) accepted (Yes/ No)	Describe alternative measure(s). Give reasons for not accepting recommended measure. (Only to be completed if recommended measure is not accepted)	Alternative measures or reasons accepted by Audit Team (Yes/ No)
4.4.1	y	y		
4.4.2	y	y		
4.4.3	y	y		
4.4.4	y	y		
4.4.5	y	y		
4.4.6	y	Either (a) y Or (b)		
4.4.7		Either (a) y Or (b)		
4.4.8	y	y		
4.4.9	y	y		
4.4.10	y	y		
4.4.11	y	y		
4.4.12	y	y		
4.4.13	y	y		

Neil Fanning MRIAI
Design Team Representative

On behalf of OCA Architects

Signature: Neil fanning **Date:** 01/11/2021

Mr Gary Lawlor
Scheme Client Representative
Revington Developments Ltd.

Signature: **Date:** 01/11/2021

Road Safety Audit signed of by:
Matthew Steele
BA(Hons) MSc FCILT FRGS MCIHT
(Audit Team Leader)

Signature: **Date:** 23/03/2022

Proposed Mixed-Use Development – Pa Healy Road, Canal Bank, Limerick

Stage 1 Road Safety Audit with Appended Re-audit

Appendix 11.5 Mobility Management Plan

Proposed Mixed-Use Development Pa
Healy Road, Canal Bank, Limerick

Mobility Management Plan

Revington Developments Limited

25 March 2022

TTRSA
Traffic : Transport : Road Safety

Document Control Sheet

Project Title	Proposed Mixed-Use Development Pa Healy Road, Canal Bank, Limerick
Report Title	Mobility Management Plan
TTRSA Ref:	210602
Revision	2
Status	Update - Final
Control Date	25 March 2022

Record of Issue

Issue	Status	Date
1/1	Draft	20/12/2019
1/2	Final	17/01/2020
2/1	Update - Draft	30/09/2021
2/2	Update - Final	25/03/2022

Distribution

Organisation	Copies
Revington Developments Limited	1 Electronic

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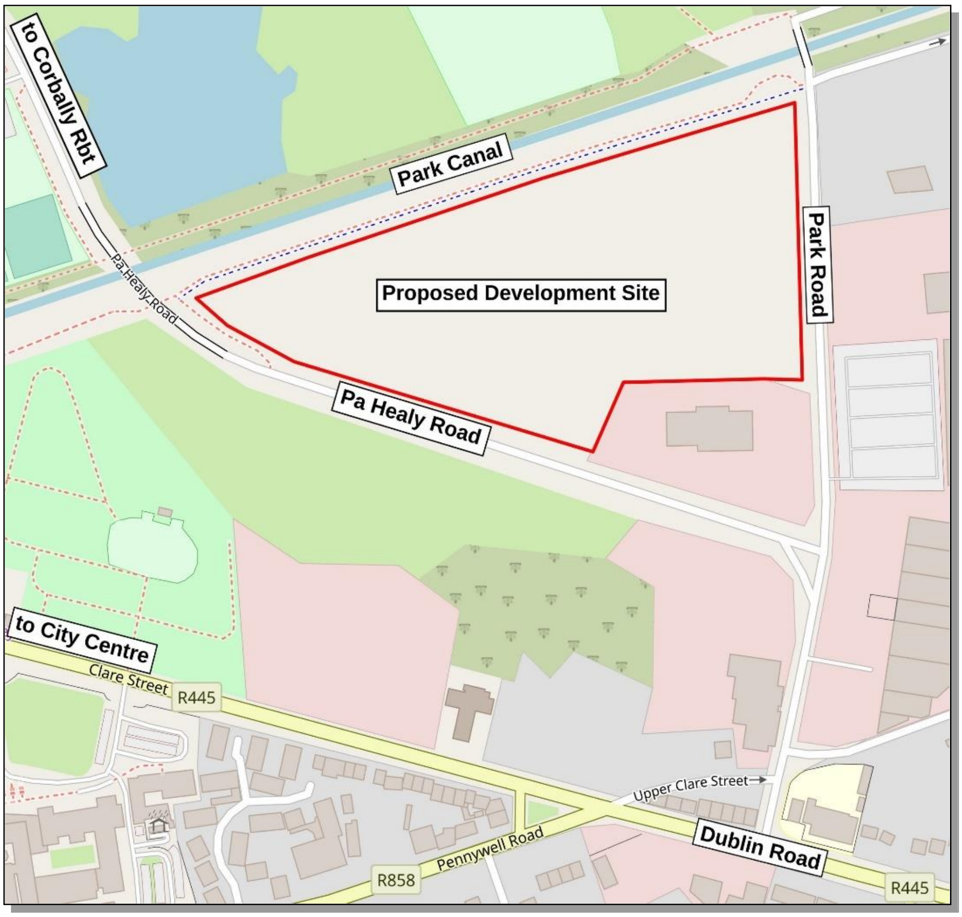
1 Introduction

1.1 Proposed Development

1.1.1 The nature of the development

The scheme is a mixed-use development of: 363 build-to-rent apartments; 61 student apartments; a café; three retail units; a crèche and management facilities building; and 18 dwelling houses, by Revington Developments Limited. The development covers approximately four hectares bounded by Limerick's Park Canal to the north, Pa Healy Road to the south and Park Road to the west (Figure 1.1). The design process for the development has been structured to incorporate mobility management measures from conception, through design, construction and opening of the development.

Figure 1.1: Development Site Location



Base-mapping © OpenStreetMap contributors

As part of the pre-planning for the development, Limerick City and County Council have requested Revington Developments Limited to develop and submit a Mobility Management

Plan (MMP), also often referred to as a Travel Plan, as part of a Strategic Housing Development Application to An Bord Pleanála.

1.2 The Background to Mobility Management Plans

1.2.1 What is a MMP?

A MMP is a package of measures resulting from a collaborative process in which organisations and individuals can work together to reduce the negative impact which their travel and transportation related activities have on the environment. This is achieved by promoting the use of the most appropriate mode of transport for each journey. MMPs are not 'anti-car', but typically result in reduced car-dependency. The concept originated in the USA during the 1980s and has become established business practice. Put simply a MMP is the start of a new and better way of living and working.

1.2.2 What policies inform the development of a Mobility Management Plan?

This MMP is being developed as part of a planning application. Local policies related to MMPs are contained within the Limerick City Development Plan 2010-2016 (as Extended), which is in turn directed by national guidance such as the National Transport Authority (NTA) document 'Achieving Effective Workplace Travel Plans: Guidance for Local Authorities', which seeks to implement the overarching policy 'smarter travel >>> A Sustainable Transport Future: A New Transport Policy for Ireland 2009-2020'. This MMP has also been updated to make it fully consistent with the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040[33].

1.2.3 Who has developed the Mobility Management Plan?

This MMP has been developed by Traffic Transport and Road Safety Associates Ltd. (TTRSA), a specialist traffic and transport consultancy. To develop the MMP, TTRSA has worked in collaboration with the developer, Revington Developments Limited, and the wider architectural, engineering and planning team for the proposed development. As the end users of the development (employees, residents and customers) are not yet determined, the MMP has been prepared as a strategic framework document, intended to be developed further based on the outcome of travel surveys once the development opens.

1.2.4 What are the main benefits resulting from a MMP?

For a development of this type, the main benefits resulting from the implementation of the MMP will typically include:

- Helping to minimise potential parking and accessibility related issues;

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[33] https://www.nationaltransport.ie/wp-content/uploads/2020/09/Draft_LSMATS_Report.pdf

- Reducing car use on the local highway network, for example, improving air quality; and
- Promoting active access, for example by walking and cycling which helps people establish and maintain a healthy lifestyle.

1.3 This Mobility Management Plan

It is intended that this MMP will cover all aspects of the development on this site, including: those living at the site; those working at the site; and, those visiting the site for both social and business activities.

1.3.1 The structure of this MMP

This MMP provides the basis for the preparation of a detailed MMP to be completed once the site is opened. This MMP is intended to detail the obligations on the developer and end users in relation to the management and provision of travel related to the site.

This MMP is comprised of a number of sections:

- Section 2 outlines the roles and responsibilities for the management and implementation of the MMP;
- Section 3 sets out the objectives of the MMP, with targets and indicators to guide the successful implementation of the MMP;
- Section 4 outlines existing sustainable transport provision in the vicinity of the site;
- Section 5 details the initial range of MMP (Action Plan) measures that it is intended to implement; and,
- Section 6 provides a framework for monitoring and evaluation of the MMP.

2 Roles and Responsibilities

2.1 Responsibility and Commitment to Delivery

The person with overall responsibility for delivery of this MMP will be the Site Manager. Due to the mixed-use nature of the development the Site Manager will work collaboratively to manage the delivery of this MMP through a MMP Working Group consisting of the following team:

- A representative of the crèche;
- A representative of the retail units;
- A representative of the students on site;
- Representatives of the residents on site;
- A representative of the proposed Bicycle User Group; and,
- A representative of Limerick City and County Council.

2.2 The Role of the Mobility Management Plan Co-ordinator

The Site Manager will either fulfil the role of, or appoint a designated, MMP Co-ordinator[34]. For a development of this scale, this role is not full-time, but the MMP Coordinator should receive appropriate training, support and resources to enable successful delivery of this MMP.

The MMP Co-ordinator role will include the following:

- Day-to-day management of the MMP;
- Taking responsibility for implementation of the MMP measures, including regular dissemination of travel related information;
- Ensuring that traffic and transportation implications are considered within the operations and planning for all employers operating within the development;
- Acting as the focal point for the MMP Working Group; and,
- Coordinating MMP monitoring and evaluation (with third party support as necessary), including undertaking related traffic and travel surveys.

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[34] Prior to the development being opened, Revington Developments Limited will provide the contact details of the MMP Co-ordinator to Limerick City and County Council.

2.3 The Role of the MMP Working Group

The MMP Working Group, comprising those listed in Section 2.1, will be established within three months of the opening of the development. Revington Developments Limited will work with the MMP Working Group to define its remit and operating procedures. The MMP Working Group should meet as often as required, but not less than once every six months.

3 Objectives, Targets and Indicators

3.1 Objectives

The main objective of this MMP is to '*Implement all necessary measures to provide and promote active and sustainable travel options for those living in, working at, and using, the development".*

The secondary objectives of this MMP are focused on ensuring that individuals make informed travel choices.

"Promoting walking, cycling and public transport as the primary modes of travel to the development for all"; and,

"Reducing car dependency and minimising car-based trips to and from the development".

3.2 Outcome Based Indicators & Targets

3.2.1 Being SMART

The difficulty in setting relevant indicators and targets has been recognised for decades. However, it is generally accepted that if indicators meet certain criteria then they are more effective at guiding a team or organisation towards their ultimate goal. The criteria are given the acronym 'SMART', which can have several interpretations. For the purposes of setting the indicators and targets within this Mobility Management Plan, the traditional interpretation developed by Doran[35] has been applied.

- **Specific** – target a specific area for improvement.
- **Measurable** – quantify or at least suggest an indicator of progress.
- **Assignable** – specify who will do it.
- **Realistic** – state what results can realistically be achieved, given available resources.
- **Time-related** – specify when the result(s) can be achieved.

3.2.2 Being focused on outcomes

Being SMART is not enough. In the past, targets related to SMART indicators were often written in the form, for example, 'to install one hundred bicycle stands within the development prior to the completion of construction'. Whilst this meets the requirements of being SMART, the provision of a certain number of bicycle stands by a certain date or point in time, this does not necessarily result in an increase in the number of people living within the development

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[35] Doran, G. T. (1981). "There's a S.M.A.R.T. way to write management's goals and objectives". Management Review (AMA FORUM) 70 (11): 35–36

cycling regularly, or the number of cycling journeys being made to and from the development. The starting point for selecting outcome-based indicators and targets is understanding the desired outcome itself. For example: a more sustainable mix of travel modes being used to access the development; an increased level of active travel by those living and working within the development; or, an overall reduction in the number of car parking spaces required within the development, allowing space to be reallocated to other uses.

3.3 Existing Travel Patterns in Limerick

In the 2016 Census, the development (site) was located in the Abbey B Electoral Division (ED). There are 2356 people who live within this ED, of which 998 travel to work and 835 travel to school or college.

A total of 630 households live in the six 2016 Census Small Areas (SAs) surrounding the development[36]. These households own 636 cars, an average of approximately one car per household.

Tables 3.1 and 3.2 show the 2016 Census modal split for journeys to work and school for Limerick City as a whole, and for the SAs surrounding the development. The main notable difference between the two tables is the slightly higher levels of car dependency for journeys to school for those already living in the vicinity of the development.

Table 3.1: 2016 Census Modal Split for Journeys to Work and School in Limerick City

Journey	Walk	Bicycle	Bus	Car Driver	Car Passenger	Other
To Work	22%	3%	6%	57%	7%	5%
To School	42%	3%	11%	6%	37%	1%

Data rounded to whole percentages

Table 3.2: 2016 Census SAs Modal Split for Journeys to Work and School (local area)

Journey	Walk	Bicycle	Bus	Car Driver	Car Passenger	Other
To Work	21%	4%	5%	59%	6%	5%
To School	33%	7%	7%	7%	45%	1%

Data rounded to whole percentages

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[36] Small Areas 128001001, 128001008, 128001012, 128002001, 128002002 and 128002006

Table 3.3 shows the 2016 Census modal split for those working or in education in the four Census workplace zones[37] bordering the development. The data shows appears to be skewed by a relatively high percentage of travel to work or education as a car passenger which is consistent with local observation.

Table 3.3: 2016 Census Modal Split for those working or in education adjacent to development based on Workplace Zones

Walk	**Bicycle**	**Bus**	**Car Driver**	**Car Passenger**	**Other**
22%	3%	3%	19%	45%	8%

Data rounded to whole percentages

3.4 Primary Indicator & Targets

3.4.1 Modal split

The primary outcome-based indicator in terms of the effective delivery of this Mobility Management Plan will be the modal split of all access to the development. This will be expressed as a target percentage by main mode of travel. Table 3.4 shows indicative modal split targets for access to the site based on similar mixes of land use in the 2016 Census, in an opening year (full occupancy) of 2023; and, a future target years of 2026 and 2031, consistent with the short term and medium term actions within the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040. The targets focus on increased cycle use, which is consistent with the facilities provided on site, cycle route improvements in the local area by Limerick City and County Council and journey distances to key facilities. The 2031 targets exceed the targets set by ‘smarter travel >>> A Sustainable Transport Future: A New Transport Policy for Ireland 2009-2020’.

The primary drivers towards meeting the modal split targets will be encouraging car-free living by: supporting Mobility as a Service (MaaS); limiting access to private cars though restricted access to car parking, and encouraging and removing barriers to bicycle use. The targets show a slight reduction in walking over time as cycling facilities are improved in line with the Limerick Metropolitan Cycle Network Study[38], the distances of many trips from the site being conducive to cycling.

The modal split targets with be developed further as additional information becomes available through the monitoring and evaluation process outlined in Section 6.

Table 3.4: Indicative Modal Split Targets for All Access to the Site

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[37] Workplace Zones LK0004, LK0005, LK0006 and LK0007

[38] https://www.limerick.ie/sites/default/files/media/documents/2019-04/Limerick-Metropolitan-Cycle-Network-Study.pdf

Year	Walk	Bicycle	Bus	Car (alone)	Car share	Other*
2016 Census	30%	7%	9%	25%	27%	2%
2023	29%	12%	9%	23%	25%	2%
2026	29%	18%	11%	19%	21%	2%
2031	30%	20%	13%	17%	18%	2%

*Data rounded to whole percentages: * includes motorcycle and taxi*

3.5 Secondary Indicators

Secondary indicators are useful in assessing trajectories towards the primary indicator where additional data can be collected without incurring significant time or cost penalties that could impact on delivery of the MMP. Some suggested indicators are listed below. These can be developed further by the MMP Co-ordinator and the MMP Working Group once baseline information is available.

- The number of cars entering the site – with an aim of reducing the number over time;
- The number of private bicycles parked on site;
- The usage of shared public bicycles docked at the site;
- The occupancy of cars entering the site – with an aim of increasing the number over time;
- The occupancy of, and duration of stay in, car parking spaces on site – as an aid to further development car park management strategies;
- The number of cars owned by those living on the site – with an aim of reducing the number over time; and,
- The usage of car-club vehicles based at the site.

It is likely that the construction of the development will impact on the Small Area(s) within future censuses. This may facilitate the creation of additional indicators and targets based on publicly available census output.

4 Existing Sustainable Transport Provision

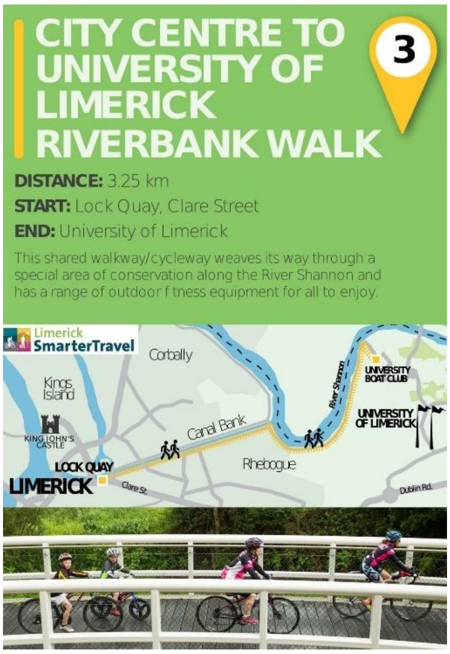
4.1 Walking

There is a well developed walking network in the vicinity of the proposed development (site), including 2m wide footpaths on Pa Healy Road, linking to the wider pedestrian route network. The canal bank off-road route which aligns the northern boundary of the site also provides onward connectivity to the city centre, the University of Limerick, and Corbally. Figure 4.1 shows the areas within five, ten, fifteen and twenty minutes walking time respectively, also showing 500m and 1km and 1.5km distance isochrones.

Figure 4.1 – Walking Accessibility Map – Walking Times and Distance Isochrones

Base-mapping © OpenStreetMap contributors

Figure 4.2 – City Centre to University of Limerick Riverbank Walk – Via Canal Bank



CITY CENTRE TO UNIVERSITY OF LIMERICK RIVERBANK WALK

3

DISTANCE: 3.25 km

START: Lock Quay, Clare Street

END: University of Limerick

This shared walkway/cycleway weaves its way through a special area of conservation along the River Shannon and has a range of outdoor fitness equipment for all to enjoy.

Extract of Limerick City and County Council ‘Limerick walk it – run it – love it’ routes and maps leaflet published 2019

4.2 Cycling

The proposed development site is bounded on all sides by formal and informal cycling facilities, including off-road cycle tracks on Pa Healy Road, and the traffic-free Canal Bank route. Pa Healy Road, the Canal Bank and Park Road are all identified as routes within the Limerick Metropolitan Cycle Network Study, being classified as secondary, greenway and feeder routes respectively. These routes provide connectivity to the proposed primary cycle route on Dublin Road and the existing Rhebogue Neighbourhood Greenway. These routes have also been identified by the local cycling campaign group Limerick Cycling, which considers: Park Road to be suitable for most cyclists; Pa Healy Road to be more suited to confident cyclists; and, also identifies the Canal Bank as a traffic free route. Limerick City and County Council's scheme to improve facilities on Park Road for cyclists, including providing a new bridge for traffic across the canal, whilst retaining the existing bridge for pedestrian and cycle use was approved by An Bord Pleanála on 22nd September 2021[39]. Figure 4.3 shows the areas within five, ten, fifteen and twenty minutes cycling time of the development (site), also showing kilometre distance isochrones. The City Centre, Limerick IT, University of Limerick, and major employment areas are all located within distances typically considered to be conducive to cycling trips.

The nearest docking station for Limerick's Coca-Cola Zero® Bike scheme is currently at Abbey Bridge, approximately 500m to the west of the proposed development, accessed via the canal site path.

Figure 4.3 – Cycling Accessibility Map – Walking Times and Distance Isochrones

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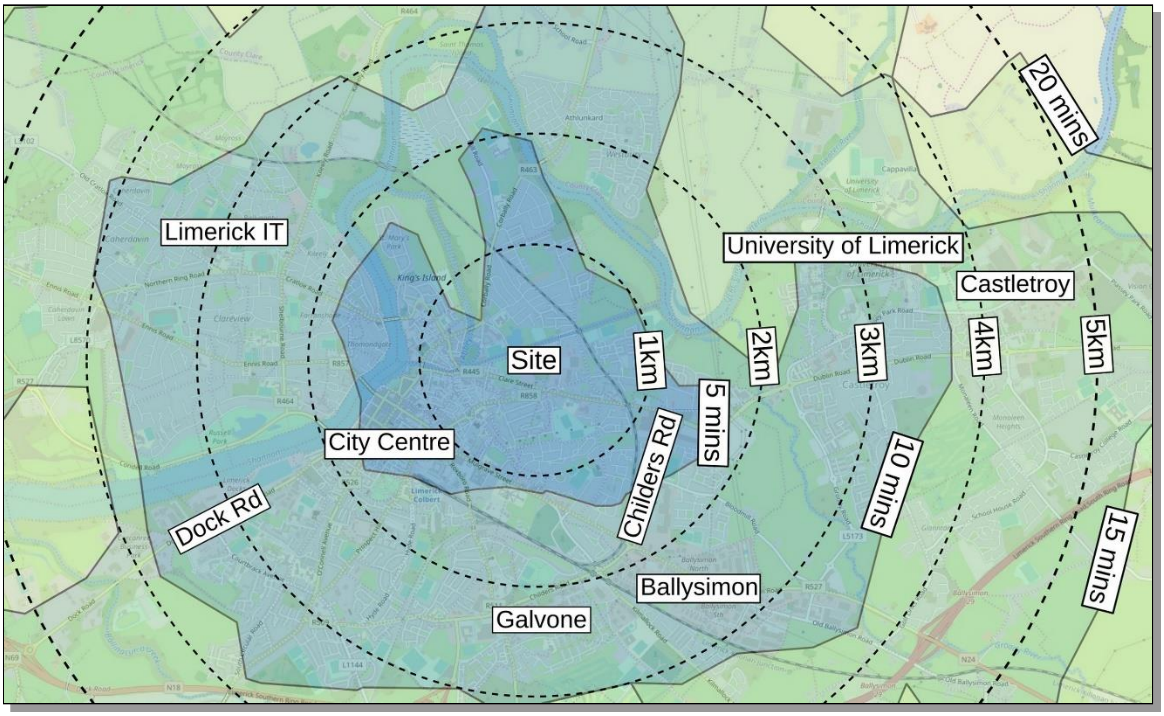
[39] https://www.pleanala.ie/anbordpleanala/media/abp/cases/orders/309/d309360.pdf



Base-mapping © OpenStreetMap contributors

4.3 Public Transport

4.3.1 Bus routes and services

There are three local bus services providing access within the local area of the proposed development. Routes 301 and 304A are operated by Bus Éireann and Route 308 is operated by Dublin Coach. The services are detailed below:

- Route 301 – accessed from bus stops located on Bridge Street and Corbally Road, both approximately 750m to the north-west of the development, operates a 7-day 30 minute frequency, between Raheen, University Hospital Limerick and Westbury.
- Route 304A – accessed from bus stops located on Pennywell Road approximately 500m to the south of the development, operates a 7-day 30 minute frequency, between Raheen and the University of Limerick, being the main local bus service on the Dublin Road corridor.
- Route 308 – accessed from bus stops located on Clare Street and Dublin Road, approximately 700m to the south and 760m to the east of the development respectively, operates on a 30 minute frequency Monday through Saturday and hourly on Sunday, between Limerick City Centre, the University of Limerick, and residential estates on the western side of the City.

The journey time by bus from the city centre to and from the development (site) is approximately 20 minutes including walking to and from bus stops. The adult single trip bus fare from the city centre to the development is currently €1.68 if using a Leap Card. Leap Card weekly tickets are available for €21.00 for adults, €16.60 for students and €9.80 for children. From May 2021, users of the 301 and 304A bus services can also make payment using the TFI Go App[40].

Whilst bus stops are located on Pa Healy Road, no bus routes currently serve these stops. Whilst the bus network is due to be amended as part of the bus connects project, the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040 does not envisage a bus route on Pa Healy Road, but identifies Dublin Road as a '*Core Bus Corridor*'.

4.3.2 Taxis

There are numerous taxi operators serving Limerick and its suburbs.

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[40] https://www.transportforireland.ie/tfi-go-app/

5 Actions and Measures

5.1 The Action Plan

The actions and measures included in this MMP have been developed as an integrated package (Action Plan) to specifically deliver the overall objective of the MMP (stated in Section 3.1). Many of the measures contained within this MMP are designed to promote rather than force behavioural change. However, the measures will be supported by parking management within the development. The measures contained within this Section of the MMP are illustrated diagrammatically, with timescales for implementation, in Appendix 1.

5.1.1 The role of the action plan

The main roles of the Action Plan are: to provide focus to the delivery of the MMP for the development to achieve the objectives detailed in Section 3.1; to ensure that maximum benefit is derived from the investment in MMP related measures; and, to ensure that the end-users of the development are provided with travel choices including the optimal modes for their individual journeys, for example, facilitating journeys on foot, by bicycle and by public transport within the city.

5.1.2 Amendments to the action plan

As the MMP has been prepared in advance of the development, is intended, that the Action Plan will be further developed and updated by the MMP Working Group based on the initial travel surveys conducted following the opening of the development. Thereafter, the MMP will continue be a ‘live’ document which is updated annually. Inability to deliver a specific measure to the timescale indicated, should not in itself be considered to be a failure of this Action Plan or the travel planning process as a whole, particularly if progress is still being made towards the targets set within Sections 3.4 and 3.5. Conversely if measures are not being delivered as intended and targets are likely to be missed, the priorities and timescales within this Action Plan should be altered by the MMP Working Group as part of the monitoring and evaluation process detailed in Section 6.

5.1.3 The role of communication in delivery of the action plan

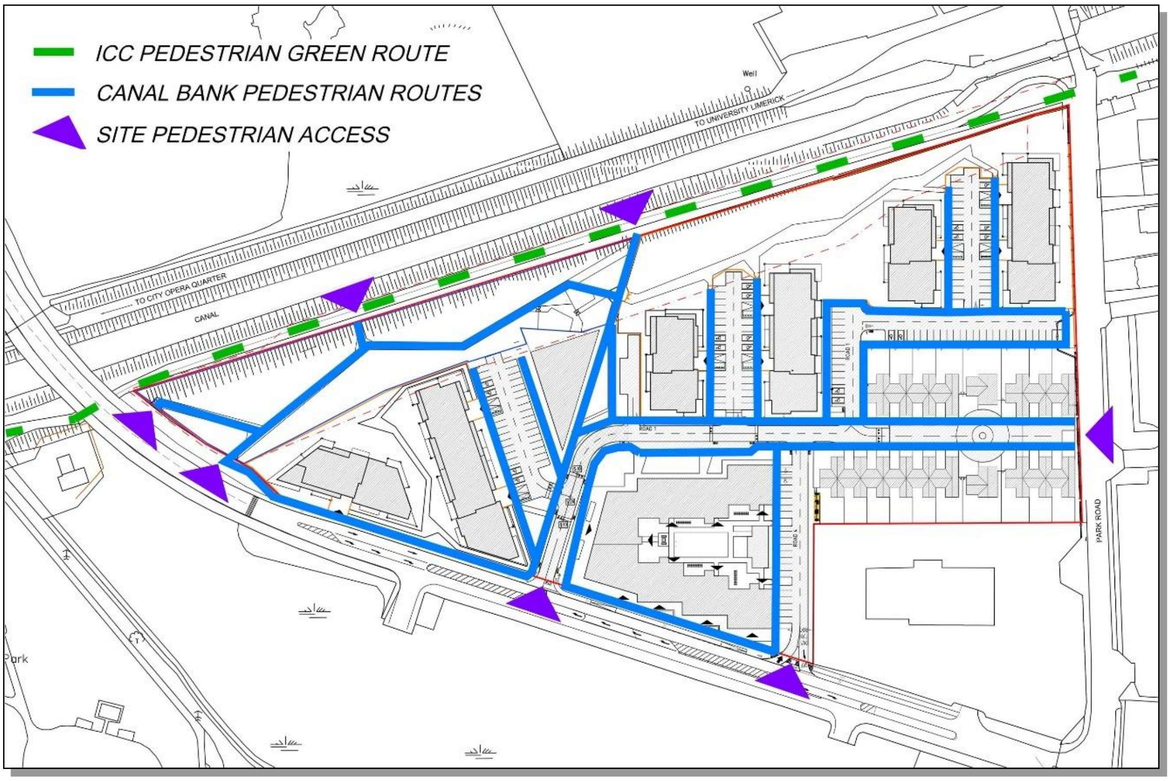
Communication and openness is critical to the successful implementation of this Action Plan. The measures containing within the Action Plan may challenge the pre-conceptions of those living and working on the site in relation to their travel choices and entitlements. Due to the mixed-use nature of the development, communication will need to be managed through a number of channels such as: MMP noticeboards within the Community Facilities Building and direct communication through electronic newsletters and interactive social media, the latter being harnessed for more regular two-way communications and marketing.

5.2 Walking

5.2.1 On-site walking routes

Through the design process for the development, a network of accessible walking routes has been provided within the site, including the provision of additional pedestrian accesses to and from the Canal Bank route. This approach is consistent with the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040 objective which seeks all new development areas to '*be fully permeable for pedestrians and cyclists*' whilst applying '*the principle of filtered permeability, whereby through private car traffic is discouraged*'. Footpaths within the development have also been designed to be overlooked in order to provide natural surveillance.

Figure 5.1 – Pedestrian access to, and routes within, the proposed development site



Source: OCA Architects Ltd

5.2.2 Promotion of walking

The location of the site, adjacent to the off-road Canal Bank route, and wider connections, makes the location ideal for promoting walking as a mode of transport, and the developer has indicated a willingness to consider the promotion of walking activities such as organised lunchtime walks and participation in events such as the Irish Heart Foundation's Step Challenge.

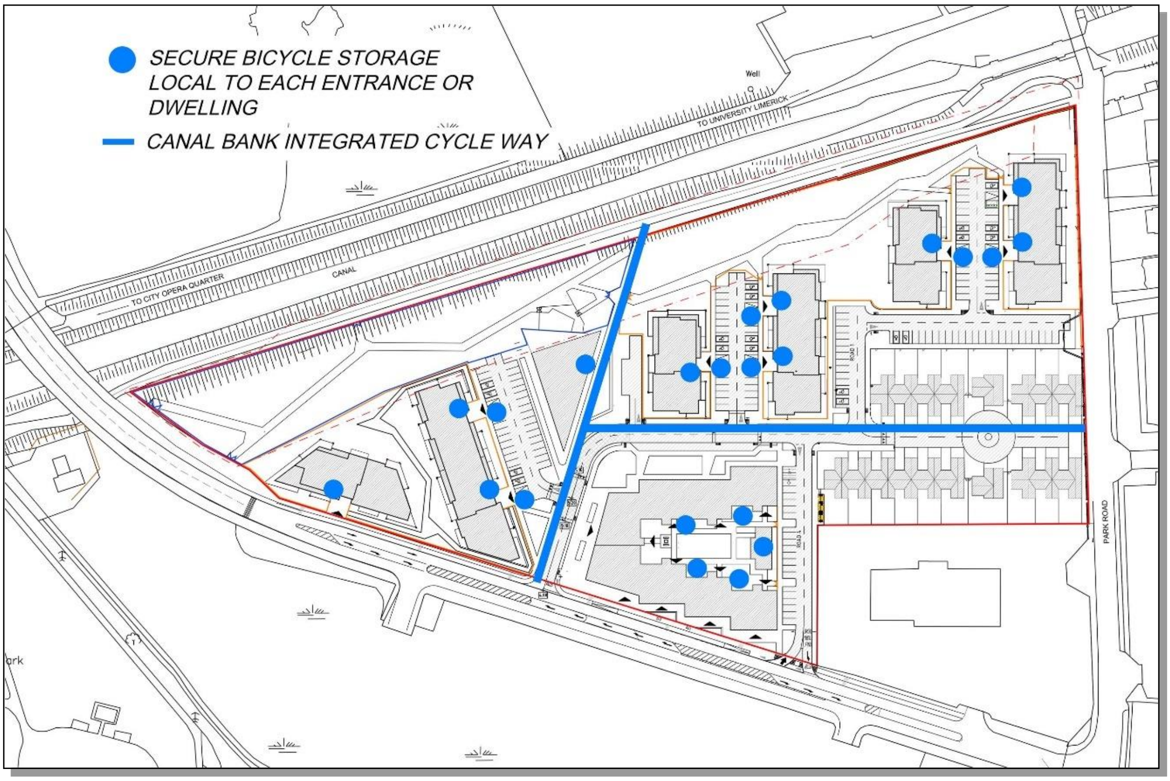
To reduce the impact of the development on the local road network at each end of the school day, walking buses should be established between the site and local schools.

5.3 Cycling

5.3.1 Secure cycle parking and on-site cycle tracks

420 bicycle parking spaces will be provided at numerous locations throughout the development, including in secure enclosures inside and adjacent to the entrances to all building units. Bicycle parking locations within the site, and the proposed cycle tracks internal to the site are shown on Figure 5.2.

Figure 5.2 – Bicycle parking and cycle tracks internal to the proposed development site



Source: OCA Architects Ltd

5.3.2 Public bike share

The developer has agreed to encouraging registration for Limerick's Coca-Cola Zero® Bike scheme, and will facilitate any future extension of the scheme to the Canal Bank site, by making space available for a public docking station. Expanding the current scheme where feasible, is an objective of the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040.

5.3.3 Cycle training

Depending on the level of demand identified through travel surveys, the MMP co-ordinator will arrange courses annually in safe cycling (Cycle Right[41]), and bicycle maintenance, for those living and working within the development.

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[41] http://www.cycleright.ie/

5.3.4 Cycle promotion

Following completion of the development, the MMP Coordinator will establish a bicycle user group (BUG) for those living and working on the site who already cycle or have an interest in taking up cycling. The MMP Coordinator will work with the BUG to hold promotional events on a regular basis. Additional promotional activities will also be arranged during National Bike to Work week, held in June each year. The nature of these activities should be determined by the BUG with the assistance of the MMP Coordinator, with input from the MMP Working Group as required.

As part of the development, it is intended to produce a map of the local area, including: formal cycling facilities; routes which Limerick Cycling consider to be suitable for most cyclists; also the cycling journey times across the local area and to specific destinations based on the analysis contained within Figure 4.3. This map will be displayed within the site and also distributed to all new residents as part of their welcome pack, and to employees on side as part of their induction.

The Cycle to Work scheme allows employers to purchase a bicycle and related equipment for an employee. The employee then pays the employer back through a salary sacrifice arrangement for up to 12 months. The employee is not liable for tax, PRSI or the Universal Social Charge on their repayments. The scheme will be offered to employees on-site, but the limited number of employees on site will reduce the impact of this scheme in terms of modal shift.

5.4 Public Transport

The proximity of the development to both centres of employment and educational facilities; and the current availability of bus services, means that both walking and cycling are likely to be favoured over public transport for access to and from the site, at least in the short term. In the medium to longer-term, physical improvements to the bus corridor between the University of Limerick and City Centre via Dublin Road, and associated increases in service frequency that may be anticipated, have the potential to increase the modal share for buses. This increase is reflected in the targets set out in Table 3.4 for 2031, consistent with the timescale proposed for implementing medium term measures within the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040.

As part of the development, it is intended to display maps of the local area, including bus stops and routes. Public transport information, including details of the Limerick Leap Card, and the National Transport Authority (NTA) "Real Time Ireland" public transport information app[42] will

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[42] https://www.transportforireland.ie/real-time/real-time-ireland/

also be provided to all new residents as part of their welcome pack, and to employees on side as part of their induction.

The Tax Saver scheme[43] allows employers to purchase monthly or annual public transport tickets for employees, and deduct the cost of the tickets through a salary sacrifice arrangement, saving employees between 29% and 52% of the cost of the ticket, will be offered to employees. However, the limited number of employees on site will reduce the impact of this scheme in terms of modal shift.

5.5 Measures to Reduce Car-dependency

5.5.1 Car parking and parking management

The main measure to reduce car dependence within the site will be limiting car parking for private vehicles. This approach is generally consistent with the Project Ireland 2040 National Planning Framework[44] and supported by the Draft Limerick Shannon Metropolitan Area Transport Strategy 2040. Student rentals will not include car parking spaces, whilst rental apartments will only be provided with 0.35 shared car parking spaces per apartment. This level of car parking is below the level of existing car ownership within the surrounding area. Electric vehicle charging facilities will be provided. Car parking on site will be actively managed to ensure that demand for car parking spaces does not exceed supply and that traffic lanes of the site will be kept clear of informal kerb-side parking.

5.5.2 Car club

To facilitate access to vehicles when needed, without the need to own a personal vehicle, the developer has indicated that car parking spaces on site could be made available for use by a car club such as GoCar which is already established in Limerick. GoCar offer pay-as-you-go driving with hourly rates on a return to base scheme. The closest parking location (base) is currently located on Charlotte’s Quay approximately 700m to the west of the development.

The Draft Limerick Shannon Metropolitan Area Transport Strategy 2040 highlights research which indicates that over 10 private cars can be removed for each car club vehicle as users’ dispose of their cars, and a further further 22 private cars are not purchased for each car club vehicle as members would not buy a car as a result of their need for a car being satisfied by car club membership.

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[43] https://www.taxsaver.ie/

[44] https://npf.ie/wp-content/uploads/Project-Ireland-2040-NPF.pdf

5.5.3 Car sharing

To facilitate car sharing, particularly for those living on the site, the MMP Coordinator will facilitate meetings of potential car sharers to let them find out what's involved, and allow them to meet with potential car sharing partners.

5.5.4 Dynamic loading and drop-off area

Following completion of the development, the proposed loading bay to the north of Block 1 will be trialled as a dynamic loading and drop-off area, whereby loading activity is restricted to a portion of day, with the bay being used for drop-off, for example by taxis during the remainder of the day. Subject to the success of this trial it will be extended to other areas of the site, for example, dynamic management of car parking spaces combining drop-off and servicing with short stay car parking.

5.5.5 Community 'Click and Collect' facility

The Draft Limerick Shannon Metropolitan Area Transport Strategy 2040 supports the placement of local 'Click and Collect' facilities in new residential developments to reduce the amount of individual personal deliveries to homes where the recipient is often absent. The developer has agreed to investigate the potential for providing such a facility either within the proposed Community Facilities Building, or as part of the retail offer on site.

6 Monitoring and Evaluation

6.1 Monitoring

Monitoring of the implementation of this MMP will be a key role of the MMP Coordinator.

The primary form of monitoring will be travel surveys of those living on, working on, and utilising the development. These travel surveys will be carried out annually during the same month each year, and will be focused on travel behaviour and the monitoring of action plan related measures. The surveys will also be used to monitor the uptake of MMP measures such as the take-up of Cycle to Work scheme and Limerick Leap travel cards.

An annual monitoring report, including current trajectories towards established targets will be prepared and submitted to Limerick City and County Council, within three months of completion of the surveys.

6.2 Evaluation

This MMP Plan will be reviewed annually by the aforementioned MMP Working Group, taking full account of the results of the travel surveys and the trajectories toward established targets.

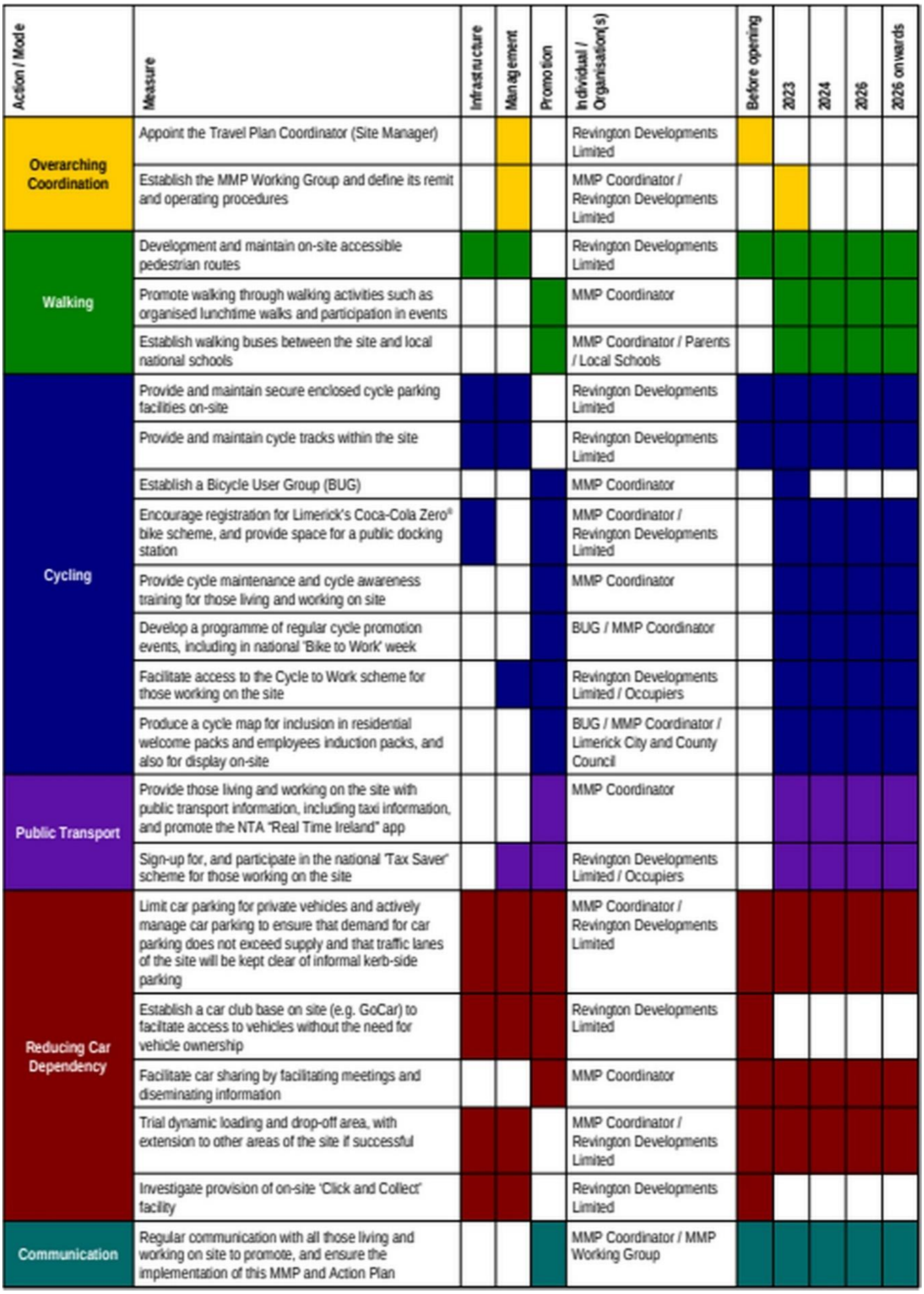
The review of the MMP may involve:

- Changing priorities within the implementation of the Action Plan based on progress and experience to ensure that the MMP modal split targets are achieved;
- The setting of increasingly challenging targets if the proposed targets are achieved ahead of schedule; and,
- The introduction of additional activities and/or measures to the Action Plan through the following of national best practice or local innovation.

If the trajectories towards established targets suggest that the targets will not be met, the MMP Working Group should, as appropriate, recommend the level of annual budget increase required to meet the targets in the following year, for example to fund the implementation of additional Action Plan measures.

The findings of this MMP review will be disseminated to those living and working within the development, and Limerick City and County Council, within three months of completion of the review.

Appendix 1 – Outline Action Plan



Action / Mode	Measure	Infrastructure	Management	Promotion	Individual / Organisation(s)	Before opening	2023	2024	2026	2026 onwards
Overarching Coordination	Appoint the Travel Plan Coordinator (Site Manager)		■		Revington Developments Limited	■				
	Establish the MMP Working Group and define its remit and operating procedures		■		MMP Coordinator / Revington Developments Limited		■			
Walking	Development and maintain on-site accessible pedestrian routes	■	■		Revington Developments Limited	■	■	■	■	■
	Promote walking through walking activities such as organised lunchtime walks and participation in events			■	MMP Coordinator		■	■	■	■
	Establish walking buses between the site and local national schools			■	MMP Coordinator / Parents / Local Schools		■	■	■	■
Cycling	Provide and maintain secure enclosed cycle parking facilities on-site	■	■		Revington Developments Limited	■	■	■	■	■
	Provide and maintain cycle tracks within the site	■	■		Revington Developments Limited	■	■	■	■	■
	Establish a Bicycle User Group (BUG)			■	MMP Coordinator		■			
	Encourage registration for Limerick's Coca-Cola Zero® bike scheme, and provide space for a public docking station	■		■	MMP Coordinator / Revington Developments Limited		■	■	■	■
	Provide cycle maintenance and cycle awareness training for those living and working on site			■	MMP Coordinator		■	■	■	■
	Develop a programme of regular cycle promotion events, including in national 'Bike to Work' week			■	BUG / MMP Coordinator		■	■	■	■
	Facilitate access to the Cycle to Work scheme for those working on the site		■	■	Revington Developments Limited / Occupiers		■	■	■	■
	Produce a cycle map for inclusion in residential welcome packs and employees induction packs, and also for display on-site			■	BUG / MMP Coordinator / Limerick City and County Council		■	■	■	■
Public Transport	Provide those living and working on the site with public transport information, including taxi information, and promote the NTA "Real Time Ireland" app			■	MMP Coordinator		■	■	■	■
	Sign-up for, and participate in the national 'Tax Saver' scheme for those working on the site		■	■	Revington Developments Limited / Occupiers		■	■	■	■
Reducing Car Dependency	Limit car parking for private vehicles and actively manage car parking to ensure that demand for car parking does not exceed supply and that traffic lanes of the site will be kept clear of informal kerb-side parking	■	■	■	MMP Coordinator / Revington Developments Limited	■	■	■	■	■
	Establish a car club base on site (e.g. GoCar) to facilitate access to vehicles without the need for vehicle ownership	■	■	■	Revington Developments Limited	■				
	Facilitate car sharing by facilitating meetings and disseminating information			■	MMP Coordinator	■	■	■	■	■
	Trial dynamic loading and drop-off area, with extension to other areas of the site if successful	■	■		MMP Coordinator / Revington Developments Limited	■	■	■	■	■
	Investigate provision of on-site 'Click and Collect' facility	■	■		Revington Developments Limited	■				
Communication	Regular communication with all those living and working on site to promote, and ensure the implementation of this MMP and Action Plan			■	MMP Coordinator / MMP Working Group	■	■	■	■	■

APPENDIX 12.1 – Construction & Demolition Waste Management Plan

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CONSTRUCTION & DEMOLITION WASTE MANAGEMENT PLAN FOR A PROPOSED DEVELOPMENT

CANAL BANK, PA HEALY ROAD, LIMERICK.

Report Prepared For

Revington Developments Limited.

Report Prepared By

Chonaill Bradley, Senior Environmental Consultant

Our Reference

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Signature		
Name	Chonaill Bradley	Fergal Callaghan
Title	Senior Environmental Consultant	Director
Date	01 November 2021	01 November 2021

1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) has prepared this Construction & Demolition Waste Management Plan (C&D WMP) on behalf of Revington Developments Limited. The development will principally consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

This plan will provide information necessary to ensure that the management of C&D waste at the site is undertaken in accordance with the current legal and industry standards including the *Waste Management Acts 1996 - 2011* and associated Regulations [1], *Protection of the Environment Act 2003* as amended [2], *Litter Pollution Act 1997* as amended [3] and the *Southern Region Waste Management Plan 2015 – 2021* [4]. In particular, this Plan aims to ensure maximum recycling, reuse and recovery of waste with diversion from landfill, wherever possible. It also seeks to provide guidance on the appropriate collection and transport of waste from the site to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil and/or water).

This C&D WMP includes information on the legal and policy framework for C&D waste management in Ireland, estimates of the type and quantity of waste to be generated by the proposed development and makes recommendations for management of different waste streams. The C&D WMP should be viewed as a live document that will be update by the site construction contractor as and when changing site conditions require it to do so.

2.0 CONSTRUCTION & DEMOLITION WASTE MANAGEMENT IN IRELAND

2.1 National Level

The Irish Government issued a policy statement in September 1998*, Changing Our Ways*[5], which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. The target for C&D waste in this report was to recycle at least 50% of C&D waste within a five year period (by 2003), with a progressive increase to at least 85% over fifteen years (i.e. 2013).

In response to the *Changing Our Ways* report, a task force (Task Force B4) representing the waste sector of the already established Forum for the Construction Industry, released a report entitled '*Recycling of Construction and Demolition Waste'* [6] concerning the development and implementation of a voluntary construction industry programme to meet the Government's objectives for the recovery of C&D waste.

In September 2020 the government released a new national policy document outlining a new action plan for Ireland and its waste to cover the period of 2020-2025. This plan, 'A Waste Action Plan for a Circular Economy' [7], was prepared in response to the 'European Green Deal' which sets a roadmap for a transition to a new economy, where climate and environmental challenges are turned into opportunities, replacing the previous national waste management plan 'A Resource Opportunity (2012)'

It aims to fulfil the commitment in the Programme for Government to publish and start implementing a new National Waste Action Plan. It is intended that this new national waste policy will inform and give direction to waste planning and management in Ireland over the coming years. It will be followed later this year by an All of Government Circular Economy Strategy. The policy document shifts focus away from waste disposal and moves it back up the production chain. To support the policy, regulation is already in place (Circular Economy Legislative Package) or in the pipeline. The policy document contains over 200 measures across various waste areas including circular economy, municipal waste, consumer protection and citizen engagement, plastics and packaging, construction and demolition, textiles, green public procurement and waste enforcement.

One of the first actions to be taken is the development of a high-level, whole of Government Circular Economy Strategy to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity. This strategy was issued for public consultation in April 2021.

The National Construction and Demolition Waste Council (NCDWC) was launched in June 2002, as one of the recommendations of the Forum for the Construction Industry, in the Task Force B4 final report. The NCDWC subsequently produced '*Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects'* [8] in July 2006 in conjunction with the then Department of the Environment, Heritage and Local Government (DoEHLG). The guidelines outline the issues that need to be addressed at the pre-planning stage of a development all the way through to its completion. These guidelines have been followed in the preparation of this document and include the following elements:

- Predicted C&D wastes and procedures to prevent, minimise, recycle and reuse wastes;
- Waste disposal/recycling of C&D wastes at the site;
- Provision of training for waste manager and site crew;
- Details of proposed record keeping system;
- Details of waste audit procedures and plan; and
- Details of consultation with relevant bodies i.e. waste recycling companies, Limerick City and County Council, etc.

Section 3 of the Guidelines identifies thresholds above which there is a requirement for the preparation of a C&D Waste Management Plan for developments. This development requires a C&D WMP under the following criterion:

- New residential development of 10 houses or more; and
- Demolition/renovation/refurbishment projects generating in excess of 100 m^3 in volume, of C&D waste.

Other guidelines followed in the preparation of this report include *'Construction and Demolition Waste Management – a handbook for Contractors and Site Managers'* [9], published by FÁS and the Construction Industry Federation in 2002 and the Environmental Protection Agency (EPA) *'Best Practice Guidelines for the Preparation of Resource*

Management Plans for Construction & Demolition Projects' Draft for public consultation [10] (April 2021).

These guidance documents are considered to define best practice for C&D projects in Ireland and describe how C&D projects are to be undertaken such that environmental impacts and risks are minimised and maximum levels of waste recycling are achieved.

2.2 Regional Level

The proposed development is located in the Local Authority area of Limerick City and County Council (LCCC).

The *Southern Region Waste Management Plan 2015 – 2021* is the regional waste management plan for the LCCC area published in 2014.

The Regional Plan sets out the strategic targets for waste management in the region and sets a specific target for C&D waste of *"70% preparing for reuse, recycling and other recovery of construction and demolition waste"* (excluding natural soils and stones and hazardous wastes) to be achieved by 2020.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Munster Region, charges are approximately €130 - €150 per tonne of waste which includes a €75 per tonne landfill levy introduced under the *Waste Management (Landfill Levy) (Amendment) Regulations 2012.*

Limerick County Development Plan 2010-2016 (as Extended) [12] sets out a number of objectives for the Limerick City and County area, in line with the objectives of the regional waste management plan. The plan identifies the Council's commitment to the promotion of the Waste Hierarchy. Waste objectives with a particular relevance to the proposed development are:

Objectives:

- **IN 043: Education and Awareness** To promote education and awareness on all issues associated with waste management, both at industry and community level. This will include the promotion of waste reduction by encouraging the minimisation, re-use, recycling and recovery of waste within the county.
- **IN 044: Polluter pays principle** To ensure the provision of quality cost effective waste infrastructure and services, which reflect and meet the needs of the community and to ensure that the 'polluter pays' principle is adhered to in all waste management activities.
- **IN O46:** Proposed waste disposal It is the objective of the Council in assessing planning applications to have regard to the waste produced by proposed developments including the nature and amount produced and proposed method of disposal. Developments should ensure that production/disposal methods do not give rise to environmental pollution, result in undue loss of amenity or be detrimental to public health.

The Draft Limerick Development Plan 2022-2028 [13] sets out a number of objectives for the Limerick City and County area, in line with the objectives of the regional waste management plan and the Circular Economy Policy. Waste objectives with a particular relevance to the proposed development are:

Objective IN O15 *Waste Management and the Circular Economy It is an objective of the Council to:*

- Support innovative, smart solutions and processes, based on the principles of the circular economy to implement the Regional Waste Management Plan for the Southern Region 2015 – 2021 and any subsequent plan, including any targets contained therein.
- Collaborate with the Regional Waste Management Office and other agencies to implement the EU Action Plan for the Circular Economy – Closing the Loop, 2015, its successor the Circular Economy Action Plan: A New Circular Economy Action Plan for a Cleaner More Competitive Europe, 2020 and the Resource Opportunity-Waste Management Policy, DECLG, 2012 and any subsequent plans.
- Promote sustainable patterns of consumption and production in the areas of product design, production processes and waste management.
- Implement the provisions of the Waste Action Plan for a Circular Economy – Ireland's National Waste Policy 2020 - 2025, DECC, 2020 in the assessment of planning applications.
- Protect existing civic amenity sites and bring sites throughout Limerick and support the development of additional sites in accordance with the Southern Regional Waste Management Plan 2015 – 2021 and any subsequent plans.

2.3 Legislative Requirements

The primary legislative instruments that govern waste management in Ireland and applicable to the development are:

- Waste Management Act 1996 as amended. Sub-ordinate legislation includes:
    - European Communities (Waste Directive) Regulations 2011 (SI 126 of 2011) as amended
    - Waste Management (Collection Permit) Regulations (S.I No. 820 of 2007) as amended
    - Waste Management (Facility Permit and Registration) Regulations 2007, (S.I No. 821 of 2007) as amended
    - Waste Management (Licensing) Regulations 2004 (S.I. No. 395 of 2004) as amended
    - Waste Management (Packaging) Regulations 2014 (S.I. 282 of 2014) as amended
    - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997)
    - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
    - European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
    - European Union (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended

    - Waste Management (Food Waste) Regulations 2009 (S.I. 508 of 2009), as amended
    - European Union (Household Food Waste and Bio-waste) Regulation 2015 (S.I. No. 191 of 2015)
    - Waste Management (Hazardous Waste) Regulations, 1998 (S.I. No. 163 of 1998) as amended
    - Waste Management (Shipments of Waste) Regulations, 2007 (S.I. No. 419 of 2007) as amended
    - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended;
    - European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994)
    - European Union (Properties of Waste which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended

- Environmental Protection Act 1992 as amended.
- Litter Pollution Act 1997 as amended.
- Planning and Development Act 2000 as amended.

One of the guiding principles of European waste legislation, which has in turn been incorporated into the *Waste Management Act 1996 - 2001* and subsequent Irish legislation, is the principle of *"Duty of Care"*. This implies that the waste producer is responsible for waste from the time it is generated through until its legal recycling, recovery or disposal (including its method of disposal). As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final destination, waste contractors will be employed to physically transport waste to the final destination. Following on from this is the concept of *"Polluter Pays"* whereby the waste producer is liable to be prosecuted for pollution incidents, which may arise from the incorrect management of waste produced, including the actions of any contractors engaged (e.g. for transportation and disposal/recovery/recycling of waste).

It is therefore imperative that the Developer ensures that the waste contractors engaged by demolition and construction contractors are legally compliant with respect to waste transportation, recycling, recovery and disposal. This includes the requirement that a contractor handle, transport and recycle/recover/dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the *Waste Management (Facility Permit & Registration) Regulations 2007 and Amendments* or a Waste or Industrial Emissions Licence granted by the EPA. The COR / permit / licence held will specify the type and quantity of waste able to be received, stored, sorted, recycled, recovered and/or disposed of at the specified site.

3.0 DESCRIPTION OF THE DEVELOPMENT

3.1 Location, Size and Scale of the Development

Revington Developments Limited, intend to apply to An Bord Pleanala for permission for a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the west, Canal Bank, Limerick.

3.2 Details of the Non-Hazardous Wastes to be Produced

There will be waste materials generated from the demolition of the existing warehouse building and hardstanding areas on site, as well as from the further excavation of the building foundations. The volume of waste generated from demolition will be more difficult to segregate than waste generated from the construction phase, as many of the building materials will be bonded together or integrated i.e. plasterboard on timber ceiling joists, steel embedded in concrete, etc.

There will be soil, stones, clay and made ground excavated to facilitate construction of new foundations, underground services, and the installation of the proposed basements. The development Engineers, PHM Consulting have estimated that 14,043m^3 of material will need to be excavated to do so. The material will need to be removed offsite due to the limited opportunities for reuse on site. This will be taken for appropriate offsite reuse, recovery, recycling and / or disposal.

During the construction phase there may be a surplus of building materials, such as timber off-cuts, broken concrete blocks, cladding, plastics, metals and tiles generated. There may also be excess concrete during construction which will need to be disposed of. Plastic and cardboard waste from packaging and supply of materials will also be generated. The contractor will be required to ensure that oversupply of materials is kept to a minimum and opportunities for reuse of suitable materials is maximised.

Waste will also be generated from construction workers e.g. organic / food waste, dry mixed recyclables (waste paper, newspaper, plastic bottles, packaging, aluminium cans, tins and Tetra Pak cartons), mixed non-recyclables and potentially sewage sludge from temporary welfare facilities provided on site during the construction phase. Waste printer / toner cartridges, waste electrical and electronic equipment (WEEE) and waste batteries may also be generated infrequently from site offices.

3.3 Potential Hazardous Wastes Arising

3.3.1 Contaminated Soil

As part of the preparation of the scheme design a site investigation was undertaken by VERDE Environmental Consultants.

The results of the soil analysis are summarised below:

Metals

All metals were below the relevant GACs for all land use categories with the exception of Beryllium and Lead.

Very slightly elevated Beryllium (1.8mg/kg) concentrations were reported in the deeper natural soils obtained from trial pit TP-108B at 3.1-3.4mbgl. The recorded concentrations exceeded both Residential HP and Residential GAC of 1.7mg/kg. Concentrations Beryllium in the made ground soils sampled in this trial pits at the depth between 1.4 and 3.1mbgl did not exceed any of the relevant standards.

Very elevated concentrations of Lead (6,371mg/kg) were reported in TP-110 in the made ground sample taken from between 2.4 and 2.8mbgl. This concentration exceeds all available GAC standards.

Speculated Total Petroleum Hydrocarbons (TPH-CWG)

Low concentrations of hydrocarbon were reported in 12 of 15 excavated trial pits; however, the majority of the hydrocarbon concentrations were reported below all GAC standards.

Elevated concentrations of hydrocarbons were reported in the soil sample TP-108A obtained from made ground taken between 1.4 and 3.1mbgl. The concentration exceeded Residential HP and Residential GACs. Hydrocarbon concentrations in a deeper sample taken from this trial pit at the depth between 3.1-3.4mbgl, although being slightly elevated, did not exceed any of the GAC standards. In both cases, encountered TPH contamination was interpreted by the analytical laboratory as degraded diesel.

In the soil sample TP-115 an elevated concentration of Benzo(b)fluoranthene of 3,549µg/kg was reported which exceeded the Residential HP GAC standard. The concentrations of Benzo(a)pyrene (4,330µg/kg) were also elevated above both the Residential and Residential HP GAC standards. An exceedance of Dibenzo(ah)anthracene was also reported in the sample from TP-115 with a concentration of 768µg/kg. This concentration exceeds all available GAC standards including residential, commercial and public open spaces GAC.

Free asbestos fibres were present in 12 of 15 excavated trial pit locations on site. The laboratory identified the fibres mainly as Chrysotile and Crocidolite and quantified as less than 0.1%. Further specialist testing is recommended to confirm these results.

The results of the groundwater analysis are summarised below:

Elevated Barium was reported in groundwater samples obtained from all four monitoring wells and ranged between 104µg/l in MW-101 and 1215µg/l in MW104 exceeding the IGV standard.

If any potentially contaminated material is encountered, it will need to be segregated from clean / inert material, tested and classified as either non-hazardous or hazardous in accordance with the EPA publication entitled *'Waste Classification: List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [12] using the *HazWasteOnline* application (or similar approved classification method). The material will then need to be classified as clean, inert, non-hazardous or hazardous in accordance with the *EC Council Decision 2003/33/EC* [13], which establishes the criteria for the acceptance of waste at landfills.

In the event that Asbestos Containing Materials (ACMs) are found within the excavated material, the removal will only be carried out by a suitably permitted waste contractor, in accordance with *S.I. No. 386 of 2006 Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006-2010.* All asbestos will be taken to a suitably licensed or permitted facility.

In the event that hazardous soil, or historically deposited waste is encountered during the construction phase, the contractor will notify LCCC and provide a Hazardous / Contaminated Soil Management Plan, to include estimated tonnages, description of location, any relevant mitigation, destination for disposal / treatment, in addition to information on the authorised waste collector(s).

3.3.2 Fuel/Oils

Fuels and oils are classed as hazardous materials; any on-site storage of fuel / oil, and all storage tanks and all draw-off points will be bunded and located in a dedicated, secure area of the site. Provided that these requirements are adhered to and the site crew are trained in the appropriate refuelling techniques, it is not expected that there will be any fuel / oil waste generated at the site.

3.3.3 Invasive Plant Species

A baseline invasive species survey will be carried out at the site to identify the presence and location of any invasive species (listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2015)) by a suitably qualified ecologist. If the presence of such species is found at or adjacent to the site, particularly in areas where its excavation may be required, an invasive species management plan will be prepared for the site to prevent the introduction or spread of any invasive species within the footprint of the works. An invasive species management plan, if required, will set out best practice control methods as summarised in the following sections.

3.3.4 Asbestos

An Asbestos Containing Materials (ACM) Survey was undertaken by Precision Group and completed in 2019 on the existing industrial building located within the development site. The survey was based upon the methodology set out in HSG264. Each accessible area was inspected to locate materials presumed or strongly presumed to contain asbestos, and samples were taken where necessary

Asbestos Cement products containing Chrysotile were identified in six samples/inspections - in all of the incidents the cement products were unsealed and in fair condition whilst attached to the building the fragments on the ground externally have exposed fibres on edges.

Removal of asbestos or ACMs will be carried out by a suitably qualified contractor and ACMs will only be removed from site by a suitably permitted / licenced waste contractor, in accordance with *S.I. No. 589 of 2010 Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006-2010.* All material will be taken to a suitably licensed or permitted facility.

3.3.5 Other Known Hazardous Substances

Paints, glues, adhesives and other known hazardous substances will be stored in designated areas. They will generally be present in small volumes only and associated waste volumes generated will be kept to a minimum. Wastes will be stored in appropriate receptacles pending collection by an authorised waste contractor.

In addition, WEEE (containing hazardous components), printer toner / cartridges, batteries (Lead, Ni-Cd or Mercury) and / or fluorescent tubes and other mercury containing waste may be generated from during C&D activities or temporary site offices. These wastes, if generated, will be stored in appropriate receptacles in designated areas of the site pending collection by an authorised waste contractor.

3.4 Main Construction and Demolition Waste Categories

The main non-hazardous and hazardous waste streams that could be generated by the construction activities at a typical site are shown in Table 3.1. The List of Waste (LoW) code (applicable as of 1 June 2015) (also referred to as the European Waste Code (EWC)) for each waste stream is also shown.

Table 3.1 *Typical waste types generated and LoW codes (individual waste types may contain hazardous substances)*

Waste Material	LoW/EWC Code
Concrete, bricks, tiles, ceramics	17 01 01-03 & 07
Wood, glass and plastic	17 02 01-03
Treated wood, glass, plastic, containing hazardous substances	17-02-04*
Bituminous mixtures, coal tar and tarred products	17 03 01*, 02 & 03*
Metals (including their alloys) and cable	17 04 01-11
Soil and stones	17 05 03* & 04
Gypsum-based construction material	17 08 01* & 02
Paper and cardboard	20 01 01
Mixed C&D waste	17 09 04
Green waste	20 02 01
Electrical and electronic components	20 01 35 & 36
Batteries and accumulators	20 01 33 & 34
Liquid fuels	13 07 01-10
Chemicals (solvents, pesticides, paints, adhesives, detergents etc.)	20 01 13, 19, 27-30
Insulation materials	17 06 04
Organic (food) waste	20 01 08
Mixed Municipal Waste	20 03 01

** Individual waste type may contain hazardous substances*

4.0 WASTE MANAGEMENT

4.1 Demolition Waste Generation

The demolition stage will involve the demolition of the existing warehouse building and hardstanding areas on site, as well as from the further excavation of the building foundations. The demolition areas are identified in the planning drawings provided with this application. The project engineers (PHM Consulting) have calculated the demolition waste and rates of reuse, recycling / recovery and disposal are shown in Table 0.2, below.

Table 4.1 *Estimated off-site reuse, recycle and disposal rates for demolition waste*

Waste Type	Tonnes	Reuse/Recover		Recycle		Disposal	
		%	Tonnes	%	Tonnes	%	Tonnes
Steel	27.0	0	0.0	80	21.6	20	5.4
Concrete	408.0	0	0.0	0	0.0	100	408.0
Masonry	296.0	0	0.0	40	118.4	60	117.6
Hardcore	285.0	0	0.0	0	0.0	100	285.0
ACM	10.0	0	0.0	0	0.0	100	10.0
Hardstanding Area							
Steel	7.0	0	0.0	100	7.0	0	0.0
Concrete	380.0	0	0.0	60	228.0	40	152.0
Tarmacadam	80.0	0	0.0	25	20.0	75	60.0
Hardcore	650.0	0	0.0	50	325.0	50	325.0
Total	**2143.0**		**0.0**		**720.0**		**1362.7**

4.2 Construction Waste Generation

Table 4.2 shows the breakdown of C&D waste types produced on a typical site based on data from the EPA *National Waste Reports* [15] *and the joint EPA & GMIT study* [16].

Table 4.2: *Waste materials generated on a typical Irish construction site*

Waste Types	%
Mixed C&D	33
Timber	28
Plasterboard	10
Metals	8
Concrete	6
Other	15
Total	**100**

Table 4.3, below, shows the estimated construction waste generation for the proposed Project based on the gross floor area of construction and other information available to date, along with indicative targets for management of the waste streams. The estimated amounts for the main waste types (with the exception of soils and stones) are based on an average large-scale development waste generation rate per m^2, using the waste breakdown rates shown in Table 4.2. These have been calculated from the schedule of development areas provided by the architect.

***Table 4.3**:* *Predicted on and off-site reuse, recycle and disposal rates for construction waste*

Waste Type	**Tonnes**	**Reuse**		**Recycle / Recovery**		**Disposal**	
		%	**Tonnes**	**%**	**Tonnes**	**%**	**Tonnes**
Mixed C&D	893.0	10	89.3	80	714.4	10	89.3
Timber	757.7	40	303.1	55	416.7	5	37.9
Plasterboard	270.6	30	81.2	60	162.4	10	27.1
Metals	216.5	5	10.8	90	194.8	5	10.8
Concrete	162.4	30	48.7	65	105.5	5	8.1
Other	405.9	20	81.2	60	243.5	20	81.2
Total	**2706.0**		**614.3**		**1837.4**		**254.4**

In addition to the waste streams in Table 4.3, there will be c. 14,043m^3 of soil, stones, clay and made ground excavated to facilitate construction of new foundations and underground services. Any suitable excavated material will be temporarily stockpiled for reuse as fill, where possible, but reuse on site is expected to be limited and the excavated material is expected to be removed off- site for appropriate reuse, recovery and / or disposal.

It should be noted that until final materials and detailed construction methodologies have been confirmed, it is difficult to predict with a high level of accuracy the construction waste that will be generated from the proposed works as the exact materials and quantities may be subject to some degree of change and variation during the construction process.

4.3 Proposed Waste Management Options

Waste materials generated will be segregated on- site, where it is practical. Where the on-site segregation of certain wastes types is not practical, off- site segregation will be carried out. There will be skips and receptacles provided to facilitate segregation at source, where feasible. All waste receptacles leaving site will be covered or enclosed. The appointed waste contractor will collect and transfer the wastes as receptacles are filled. There are numerous waste contractors in the Dublin region that provide this service.

All waste arisings will be handled by an approved waste contractor holding a current waste collection permit. All waste arisings requiring disposal off- site will be reused, recycled, recovered or disposed of at a facility holding the appropriate registration, permit or licence, as required.

During construction, some of the sub-contractors on site will generate waste in relatively low quantities. The transportation of non-hazardous waste by persons who are not directly involved with the waste business, at weights less than or equal to 2 tonnes, and in vehicles not designed for the carriage of waste, are exempt from the requirement to have a waste collection permit (per Article 30 (1) (b) of the Waste Collection Permit Regulations 2007, as amended). Any sub-contractors engaged that do not generate more than 2 tonnes of waste at any one time can transport this waste off- site in their work vehicles (which are not designed for the carriage of waste). However, they are required to ensure that the receiving facility has the appropriate COR / permit / licence.

Written records will be maintained by the contractor(s), detailing the waste arising throughout the C&D phases, the classification of each waste type, waste collection permits for all waste contactors who collect waste from the site and COR / permit / licence for the receiving waste facility for all waste removed off- site for appropriate reuse, recycling, recovery and / or disposal

Dedicated bunded storage containers will be provided for hazardous wastes which may arise, such as batteries, paints, oils, chemicals, if required.

The anticipated management of the main waste streams is outlined as follows:

Soil, Stone, Gravel & Clay

The waste hierarchy states that the preferred option for waste management is prevention and minimisation of waste, followed by preparing for reuse and recycling / recovery, energy recovery (i.e. incineration) and, least favoured of all, disposal. The excavations are required to facilitate construction works so the preferred option (prevention and minimisation) cannot be accommodated for the excavation phase.

When material is removed off- site it could be reused as a by-product (and not as a waste). If this is done, it will be done in accordance with Article 27 of the *European Communities (Waste Directive) Regulations 2011*, which requires that certain conditions are met and that by-product notifications are made to the EPA via their online notification form. Excavated material should not be removed from site until approval from the EPA has been received. Article 27 will be investigated to see if the material can be exported off this site for beneficial reuse instead of disposal.

The next option (beneficial reuse) may be appropriate for the excavated material, pending environmental testing to classify the material as hazardous or non-hazardous in accordance with the EPA *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* publication. Clean inert material may be used as fill material in other construction projects or engineering fill for waste licensed sites. Beneficial reuse of surplus excavation material as engineering fill may be subject to further testing to determine if materials meet the specific engineering standards for their proposed end use.

Any nearby sites requiring clean fill/capping material will be contacted to investigate reuse opportunities for clean and inert material. If any of the material is to be reused on another site as a by-product (and not as a waste), this will be done in accordance with Article 27. Similarly, if any soils/stones are imported onto the site from another construction site as a by-product, this will also be done in accordance with Article 27. Article 27 will be investigated to see if the material can be imported onto this site for beneficial reuse instead of using virgin materials.

If the material is deemed to be a waste, then removal and reuse / recovery / disposal of the material will be carried out in accordance with the *Waste Management Acts 1996 – 2011* as amended, the *Waste Management (Collection Permit) Regulations 2007* as amended and the *Waste Management (Facility Permit & Registration) Regulations 2007* as amended. Once all available beneficial reuse options have been exhausted, the options of recycling and recovery at waste permitted and licensed sites will be considered.

In the event that contaminated material is encountered and subsequently classified as hazardous, this material will be stored separately to any non-hazardous material. It will require off-site treatment at a suitable facility or disposal abroad via Transfrontier Shipment of Wastes (TFS).

Bedrock

While it is not envisaged that bedrock will be encountered, if bedrock is encountered, it is anticipated that it will not be crushed on site. Any excavated rock is expected to be removed off- site for appropriate reuse, recovery and / or disposal. If bedrock is to be crushed on- site, the appropriate mobile waste facility permit will be obtained from LCCC.

Silt & Sludge

During the construction phase, silt and petrochemical interception will be carried out on run-off and pumped water from site works, where required. Sludge and silt will then be collected by a suitably licensed contractor and removed off- site.

Concrete Blocks, Bricks, Tiles & Ceramics

The majority of concrete blocks, bricks, tiles and ceramics generated as part of the construction works are expected to be clean, inert material and should be recycled, where possible. If concrete is to be crushed on- site, the appropriate mobile waste facility permit will be obtained from LCCC.

Hard Plastic

As hard plastic is a highly recyclable material, much of the plastic generated will be primarily from material off-cuts. All recyclable plastic will be segregated and recycled, where possible.

Timber

Timber that is uncontaminated, i.e. free from paints, preservatives, glues, etc., will be disposed of in a separate skip and recycled off- site.

Metal

Metals will be segregated, where practical, and stored in skips. Metal is highly recyclable and there are numerous companies that will accept these materials.

Plasterboard

There are currently a number of recycling services for plasterboard in Ireland. Plasterboard from the construction phases will be stored in a separate skip, pending collection for recycling. The site Manager will ensure that oversupply of new plasterboard is carefully monitored to minimise waste.

Glass

Glass materials will be segregated for recycling, where possible.

Waste Electrical & Electronic Equipment (WEEE)

Any WEEE will be stored in dedicated covered cages / receptacles / pallets pending collection for recycling.

Other Recyclables

Where any other recyclable wastes, such as cardboard and soft plastic, are generated, these will be segregated at source into dedicated skips and removed off- site.

Non-Recyclable Waste

C&D waste which is not suitable for reuse or recovery, such as polystyrene, some plastics and some cardboards, will be placed in separate skips or other receptacles. Prior to removal from site, the non-recyclable waste skip / receptacle will be examined by a member of the waste team (see Section 7.0) to determine if recyclable materials have been placed in there by mistake. If this is the case, efforts will be made to determine the cause of the waste not being segregated correctly and recyclable waste will be removed and placed into the appropriate receptacle.

Asbestos Containing Materials

Any asbestos or ACM found on- site should be removed by a suitably competent contractor and disposed of as asbestos waste before the demolition works begin. All asbestos removal work or encapsulation work must be carried out in accordance with *S.I. No. 589 of 2010 Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006-2010.*

Other Hazardous Wastes

On-site storage of any hazardous wastes produced (i.e. contaminated soil if encountered and / or waste fuels) will be kept to a minimum, with removal off-site organised on a regular basis. Storage of all hazardous wastes on-site will be undertaken so as to minimise exposure to on-site personnel and the public and to also minimise potential for environmental impacts. Hazardous wastes will be recovered, wherever possible, and failing this, disposed of appropriately.

On-Site Crushing

It is currently not envisaged that the crushing of waste materials will occur on- site. However, if the crushing of material is to be undertaken, a waste facility permit will first be obtained from LCCC and the destination of the accepting waste facility will be supplied to the LCCC waste unit.

4.4 Tracking and Documentation Procedures for Off-Site Waste

All waste will be documented prior to leaving the site. Waste will be weighed by the contractor, either by a weighing mechanism on the truck or at the receiving facility. These waste records will be maintained on site by the nominated project Waste Manager (see Section 7.0).

All movement of waste and the use of waste contractors will be undertaken in accordance with the *Waste Management Acts 1996 - 2011*, *Waste Management (Collection Permit) Regulations 2007* as amended and *Waste Management (Facility Permit & Registration) Regulations 2007* and amended. This includes the requirement for all waste contractors to have a waste collection permit issued by the NWCPO. The nominated project Waste Manager (see Section 7.0) will maintain a copy of all waste collection permits on-Site.

If the waste is being transported to another site, a copy of the Local Authority waste COR / permit or EPA Waste / Industrial Emissions Licence for that site will be provided to the nominated project Waste Manager (see Section 7.0). If the waste is being shipped abroad, a copy of the Transfrontier Shipping (TFS) notification document will be obtained from DCC (as the relevant authority on behalf of all Local Authorities in Ireland) and kept on-Site along with details of the final destination (COR, permits, licences, etc.). A receipt from the final destination of the material will be kept as part of the on-Site waste management records.

All information will be entered in a waste management recording system to be maintained on-Site.

5.0 ESTIMATED COST OF WASTE MANAGEMENT

An outline of the costs associated with different aspects of waste management is outlined below. The total cost of C&D waste management will be measured and will take into account handling costs, storage costs, transportation costs, revenue from rebates and disposal costs.

5.1 Reuse

By reusing materials on site, there will be a reduction in the transport and recycle / recovery / disposal costs associated with the requirement for a waste contractor to take the material off-Site. Clean and inert soils, gravel, stones, etc., which cannot be reused on-Site may be used as access roads or capping material for landfill sites, etc. This material is often taken free of charge or at a reduced fee for such purposes, reducing final waste disposal costs.

5.2 Recycling

Salvageable metals will earn a rebate, which can be offset against the costs of collection and transportation of the skips.

Clean, uncontaminated cardboard and certain hard plastics can also be recycled. Waste contractors will charge considerably less to take segregated wastes, such as recyclable waste, from a site than mixed waste.

Timber can be recycled as chipboard. Again, waste contractors will charge considerably less to take segregated wastes, such as timber, from a site than mixed waste.

5.3 Disposal

Landfill charges are currently at around €130 - €150 per tonne which includes a €75 per tonne landfill levy specified in the *Waste Management (Landfill Levy) Regulations 2015*. In addition to disposal costs, waste contractors will also charge a collection fee for skips.

Collection of segregated C&D waste usually costs less than municipal waste. Specific C&D waste contractors take the waste off-site to a licensed or permitted facility and, where possible, remove salvageable items from the waste stream before disposing of the remainder to landfill. Clean soil, rubble, etc., is also used as fill / capping material, wherever possible.

6.0 DEMOLITION PROCEDURES

The demolition stage will involve demolition of the existing warehouse building and hardstanding areas on site, as well as from the further excavation of the building foundations. The demolition areas are identified in the planning drawings submitted as part of this application. A formal demolition plan including safety procedures will be prepared by the demolition contractor. However, in general, the following sequence of works should be followed during the demolition stage:

Check for Hazards

Prior to commencing works, buildings and structures to be demolished will be checked for any likely hazards including asbestos, ACMs, electrical power lines or cables, gas reticulation systems, telecommunications, unsafe structures and fire / explosion hazards, e.g. combustible dust, chemical hazards, oil, fuels and contamination.

Removal of Components

All hazardous materials will be removed first. All components from within the buildings that can be salvaged will be removed next. This will primarily be comprised of metal; however, may also include timbers, doors, windows, wiring and metal ducting, etc.

Removal of Roofing

Steel roof supports, beams, etc., will be dismantled and taken away for recycling / salvage.

Excavation of Services, Demolition of Walls and Concrete

Services will be removed from the ground and the breakdown of walls will be carried out once all salvageable or reusable materials have been taken from the buildings. Finally, any existing foundations and hard standing areas will be excavated.

7.0 TRAINING PROVISIONS

A member of the construction team will be appointed as the Waste Manager to ensure commitment, operational efficiency and accountability in relation to waste management during the C&D phases of the development.

7.1 Waste Manager Training and Responsibilities

The nominated Waste Manager will be given responsibility and authority to select a waste team if required, i.e. members of the site crew that will aid them in the organisation, operation and recording of the waste management system implemented on site.

The Waste Manager will have overall responsibility to oversee, record and provide feedback to the client on everyday waste management at the site. Authority will be given to the Waste Manager to delegate responsibility to sub-contractors, where necessary, and to coordinate with suppliers, service providers and sub-contractors to prioritise waste prevention and material salvage.

The Waste Manager will be trained in how to set up and maintain a record keeping system, how to perform an audit and how to establish targets for waste management on site. The Waste Manager will also be trained in the best methods for segregation and storage of recyclable materials, have information on the materials that can be reused on site and be knowledgeable in how to implement this C&D WMP.

7.2 Site Crew Training

Training of site crew in relation to waste is the responsibility of the Waste Manager and, as such, a waste training program should be organised. A basic awareness course will be held for all site crew to outline the C&D WMP and to detail the segregation of waste materials at source. This may be incorporated with other site training needs such as general site induction, health and safety awareness and manual handling.

This basic course will describe the materials to be segregated, the storage methods and the location of the Waste Storage Areas (WSAs). A sub-section on hazardous wastes will be incorporated into the training program and the particular dangers of each hazardous waste will be explained.

8.0 RECORD KEEPING

Records should be kept for all waste material which leaves the site, either for reuse on another site, recycling or disposal. A recording system will be put in place to record the waste arisings on Site.

A waste tracking log should be used to track each waste movement from the site. On exit from the site, the waste collection vehicle driver should stop at the site office and sign out as a visitor and provide the security personnel or Waste Manager with a waste docket (or Waste Transfer Form (WTF) for hazardous waste) for the waste load collected. At this time, the security personnel should complete and sign the Waste Tracking Register with the following information:

- Date
- Time
- Waste Contractor
- Company waste contractor appointed by, e.g. Contractor or subcontractor name
- Collection Permit No.
- Vehicle Reg.
- Driver Name
- Docket No.
- Waste Type
- EWC / LoW

The waste vehicle will be checked by security personal or the Waste Manager to ensure it has the waste collection permit no. displayed and a copy of the waste collection permit in the vehicle before they are allowed to remove the waste from the site.

The waste transfer dockets will be transferred to the Waste Manager on a weekly basis and can be placed in the Waste Tracking Log file. This information will be forwarded onto the LCCC Waste Regulation Unit when requested.

Alternatively, each subcontractor that has engaged their own waste contractor will be required to maintain a similar waste tracking log with the waste dockets / WTF maintained on file and available for inspection on site by the main contractor as required.

Waste receipts from the receiving waste facility will also be obtained by the site contractor(s) and retained. A copy of the Waste Collection Permits, CORs, Waste Facility Permits and Waste Licences will be maintained on site at all times. Subcontractors who have engaged their own waste contractors, should provide the main contractor with a copy of the waste collection permits and COR / permit / licence for the receiving waste facilities and maintain a copy on file, available for inspection on site as required.

9.0 OUTLINE WASTE AUDIT PROCEDURE

9.1 Responsibility for Waste Audit

The appointed Waste Manager will be responsible for conducting a waste audit at the site during the C&D phase of the proposed Project. Contact details for the nominated Waste Manager will be provided to the LCCC Waste Regulation Unit after the main contractor is appointed and prior to any material being removed from site.

9.2 Review of Records and Identification of Corrective Actions

A review of all waste management costs and the records for the waste generated and transported off-site should be undertaken mid-way through the demolition and construction phase of the proposed Project.

If waste movements are not accounted for, the reasons for this should be established in order to see if and why the record keeping system has not been maintained. The waste records will be compared with the established recovery / reuse / recycling targets for the site. Each material type will be examined, in order to see where the largest percentage waste generation is occurring. The waste management methods for each material type will be reviewed in order to highlight how the targets can be achieved.

Upon completion of the C&D phase, a final report will be prepared, summarising the outcomes of waste management processes adopted and the total recycling / reuse / recovery figures for the development.

10.0 CONSULTATION WITH RELEVANT BODIES

10.1 Local Authority

Once construction contractors have been appointed and have appointed waste contractors, and prior to removal of any C&D waste materials off-site, details of the proposed destination of each waste stream will be provided to the LCCC Waste Regulation Unit.

LCCC will also be consulted, as required, throughout the demolition, excavation and construction phases in order to ensure that all available waste reduction, reuse and recycling opportunities are identified and utilised and that compliant waste management practices are carried out.

10.2 Recycling / Salvage Companies

The appointed waste contractor for the main waste streams managed by the demolition and construction contractors will be audited in order to ensure that relevant and up-to-date waste collection permits and facility registrations / permits / licences are held. In addition, information will be obtained regarding the feasibility of recycling each material, the costs of recycling / reclamation, the means by which the wastes will be collected and transported off- site, and the recycling / reclamation process each material will undergo off- site.

11.0 REFERENCES

1. Waste Management Act 1996 (No. 10 of 1996) as amended. Sub-ordinate and associated legislation includes:
    - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended.
    - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended.
    - Waste Management (Facility Permit and Registration) Regulations 2007 (S.I No. 821 of 2007) as amended.
    - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended.
    - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended.
    - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended.
    - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
    - European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
    - European Union (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended.
    - Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended.
    - European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 430 of 2015)
    - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended.
    - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended.
    - European Communities (Shipments of Hazardous Waste exclusively within Ireland) Regulations 2011 (S.I. No. 324 of 2011)
    - European Union (Properties of Waste which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended
2. Protection of the Environment Act 2003, (No. 27 of 2003) as amended.
3. Litter Pollution Act 1997 (S.I. No. 12 of 1997) as amended
4. Southern Region Waste Management Plan 2015 – 2021 (2015).
5. Department of Environment and Local Government (DoELG) *Waste Management – Changing Our Ways, A Policy Statement* (1998).
6. Forum for the Construction Industry – *Recycling of Construction and Demolition Waste.*
7. Department of Communications, Climate Action and Environment (DCCAE), *Waste Action Plan for the Circular Economy - Ireland's National Waste Policy 2020-2025* (Sept 2020).
8. Department of Environment, Heritage and Local Government, *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006).
9. FÁS and the Construction Industry Federation (CIF), *Construction and Demolition Waste Management – a handbook for Contractors and* site *Managers* (2002).

10. Environmental Protection Agency (EPA) *‘Best Practice Guidelines for the Preparation of Resource Management Plans for Construction & Demolition Projects’* Draft *(April 2021)*

11. Limerick City & County Council (LCCC), *Limerick County Development Plan 2010-2016 (as Extended)* (2010)

12. LCCC, Draft Limerick Development Plan 2022 -2028 (2021)

13. Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended

14. EPA, *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* (2015)

15. Council Decision 2003/33/EC, establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC.

16. Environmental Protection Agency (EPA), *National Waste Database Reports 1998 – 2012*.

17. EPA and Galway-Mayo Institute of Technology (GMIT), *EPA Research Report 146 – A Review of Design and Construction Waste Management Practices in Selected Case Studies – Lessons Learned* (2015).

APPENDIX 12.2 – Operational Waste Management Plan

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OPERATIONAL WASTE MANAGEMENT PLAN FOR A PROPOSED DEVELOPMENT

CANAL BANK, PA HEALY ROAD, LIMERICK.

Report Prepared For

Revington Developments Limited.

Report Prepared By

Chonaill Bradley, Senior Environmental Consultant

Our Reference

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1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) has prepared this Operational Waste Management Plan (OWMP) on behalf of Revington Developments Limited. The development will principally consist of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

This OWMP has been prepared to ensure that the management of waste during the operational phase of the proposed Development is undertaken in accordance with the current legal and industry standards including, the Waste Management Act 1996 – 2011 as amended and associated Regulations [1], *Protection of the Environment Act 2003* as amended [2], *Litter Pollution Act 2003* as amended [3], the *'Southern Region Waste Management Plan 2014 – 2020'* [4] and the LCCC *"City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019)"* [5]*.* In particular, this OWMP aims to provide a robust strategy for the storage, handling, collection and transport of the wastes generated at Site.

This OWMP aims to ensure maximum recycling, reuse and recovery of waste with diversion from landfill, wherever possible. The OWMP also seeks to provide guidance on the appropriate collection and transport of waste to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil or water resources). The plan estimates the type and quantity of waste to be generated from the proposed Development during the operational phase and provides a strategy for managing the different waste streams.

At present, there are no specific guidelines in Ireland for the preparation of OWMPs. Therefore, in preparing this document, consideration has been given to the requirements of national and regional waste policy, legislation and other guidelines.

2.0 OVERVIEW OF WASTE MANAGEMENT IN IRELAND

2.1 National Level

The Government issued a policy statement in September 1998 entitled *'Changing Our Ways'* [6], which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. A heavy emphasis was placed on reducing reliance on landfill and finding alternative methods for managing waste. Amongst other things, *Changing Our Ways* stated a target of at least 35% recycling of municipal (i.e. household, commercial and non-process industrial) waste.

A further policy document, *'Preventing and Recycling Waste – Delivering Change'* was published in 2002 [7]. This document proposed a number of programmes to increase recycling of waste and allow diversion from landfill. The need for waste minimisation at source was considered a priority.

This view was also supported by a review of sustainable development policy in Ireland and achievements to date, which was conducted in 2002, entitled *'Making Irelands Development Sustainable – Review, Assessment and Future Action'* [8]. This document also stressed the need to decouple economic growth and waste generation, again through waste minimisation and reuse of discarded material.

In order to establish the progress of the Government policy document *Changing Our Ways*, a review document was published in April 2004 entitled *'Taking Stock and Moving Forward'* [9]. Covering the period 1998 – 2003, the aim of this document was to assess progress to date with regard to waste management in Ireland, to consider developments since the policy framework and the local authority waste management plans were put in place, and to identify measures that could be undertaken to further support progress towards the objectives outlined in *Changing Our Ways*.

In particular, *Taking Stock and Moving Forward* noted a significant increase in the amount of waste being brought to local authority landfills. The report noted that one of the significant challenges in the coming years was the extension of the dry recyclable collection services.

In September 2020, the Irish Government published a new policy document outlining a new action plan for Ireland to cover the period of 2020-2025. This plan *'A Waste Action Plan for a Circular Economy'* [10], was prepared in response to the 'European Green Deal' which sets a roadmap for a transition to a new economy, where climate and environmental challenges are turned into opportunities, replacing the previous national waste management plan *"A Resource Opportunity"* (2012).

It aims to fulfil the commitment in the Programme for Government to publish and start implementing a new National Waste Action Plan. It is intended that this new national waste policy will inform and give direction to waste planning and management in Ireland over the coming years. It will be followed later this year by an All of Government Circular Economy Strategy. The policy document shifts focus away from waste disposal and back up the production chain. To support the policy, regulation is already in place (Circular Economy Legislative Package) or in the pipeline. The policy document contains over 200 measures across various waste areas including circular economy, municipal waste, consumer protection and citizen engagement, plastics and packaging, construction and demolition, textiles, green public procurement and waste enforcement.

One of the first actions to be taken is the development of a high-level, whole of Government Circular Economy Strategy to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity. This strategy was issued for public consultation in April 2021.

Since 1998, the Environmental Protection Agency (EPA) has produced periodic *'National Waste (Database) Reports'* [11] detailing, among other things, estimates for household and commercial (municipal) waste generation in Ireland and the level of recycling, recovery and disposal of these materials. The *2018 National Waste Statistics*, which is the most recent study published, along with the national waste statistics web resource (August 2020) reported the following key statistics for 2018:

- **Generated –** Ireland produced 2,912,353 t of municipal waste in 2018. This is almost a 5% increase since 2017. This means that the average person living in Ireland generated 600 kg of municipal waste in 2018.
- **Managed –** Waste collected and treated by the waste industry. In 2018, a total of 2,865,207 t of municipal waste was managed and treated.
- **Unmanaged –**Waste that is not collected or brought to a waste facility and is, therefore, likely to cause pollution in the environment because it is burned, buried or dumped. The EPA estimates that 47,546 t was unmanaged in 2017.
- **Recovered –** The amount of waste recycled, used as a fuel in incinerators, or used to cover landfilled waste. In 2018, around 85% of municipal waste was recovered – an increase from 77% in 2017.
- **Recycled –** The waste broken down and used to make new items. Recycling also includes the breakdown of food and garden waste to make compost. The recycling rate in 2018 was 38%, which is down from 41% in 2017.
- **Disposed –** Less than a quarter (15%) of municipal waste was landfilled in 2018. This is a decrease from 23% in 2017.

2.2 Regional Level

The proposed development is located in the Local Authority area of Limerick City and County Council (LCCC).

The *Southern Region Waste Management Plan 2015 – 2021* is the regional waste management plan for the LCCC area published in 2014.

The Regional Plan sets out the strategic targets for waste management in the region and sets a specific target for C&D waste of *"70% preparing for reuse, recycling and other recovery of construction and demolition waste"* (excluding natural soils and stones and hazardous wastes) to be achieved by 2020.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Munster Region, charges are approximately €130 - €150 per tonne of waste which includes a €75 per tonne landfill levy introduced under the *Waste Management (Landfill Levy) (Amendment) Regulations 2012.*

Limerick County Development Plan 2010-2016 (as Extended) [14] sets out a number of objectives for the Limerick City and County area, in line with the objectives of the regional waste management plan. The plan identifies the Council's commitment to the promotion of the Waste Hierarchy. Waste objectives with a particular relevance to the proposed development are:

<u>Objectives:</u>

- **IN 043: Education and Awareness** To promote education and awareness on all issues associated with waste management, both at industry and community level. This will include the promotion of waste reduction by encouraging the minimisation, re-use, recycling and recovery of waste within the county.

- **IN 044: Polluter pays principle** To ensure the provision of quality cost effective waste infrastructure and services, which reflect and meet the needs of the community and to ensure that the 'polluter pays' principle is adhered to in all waste management activities.

- **IN O46:** Proposed waste disposal It is the objective of the Council in assessing planning applications to have regard to the waste produced by proposed developments including the nature and amount produced and proposed method of disposal. Developments should ensure that production/disposal methods do not give rise to environmental pollution, result in undue loss of amenity or be detrimental to public health.

The Draft Limerick Development Plan 2022-2028 [14] sets out a number of objectives for the Limerick City and County area, in line with the objectives of the regional waste management plan and the Circular Economy Policy. Waste objectives with a particular relevance to the proposed development are:

Objective IN O15 *Waste Management and the Circular Economy It is an objective of the Council to:*

- Support innovative, smart solutions and processes, based on the principles of the circular economy to implement the Regional Waste Management Plan for the Southern Region 2015 – 2021 and any subsequent plan, including any targets contained therein.
- Collaborate with the Regional Waste Management Office and other agencies to implement the EU Action Plan for the Circular Economy – Closing the Loop, 2015, its successor the Circular Economy Action Plan: A New Circular Economy Action Plan for a Cleaner More Competitive Europe, 2020 and the Resource Opportunity-Waste Management Policy, DECLG, 2012 and any subsequent plans.
- Promote sustainable patterns of consumption and production in the areas of product design, production processes and waste management.
- Implement the provisions of the Waste Action Plan for a Circular Economy – Ireland's National Waste Policy 2020 - 2025, DECC, 2020 in the assessment of planning applications.
- Protect existing civic amenity sites and bring sites throughout Limerick and support the development of additional sites in accordance with the Southern Regional Waste Management Plan 2015 – 2021 and any subsequent plans.

2.3 Legislative Requirements

The primary legislative instruments that govern waste management in Ireland and applicable to the proposed Development are:

- Waste Management Act 1996 as amended. Sub-ordinate and associated legislation includes:
    - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended
    - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended
    - Waste Management (Facility Permit and Registration) Regulation 2007 (S.I No. 821 of 2007) as amended
    - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended
    - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended.
    - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended
    - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
    - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
    - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended
    - Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended
    - European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 191 of 2015)
    - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended
    - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended
    - *European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994)*
    - European Union (Properties of Waste Which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended
- Environmental Protection Act 1992 as amended;
- Litter Pollution Act 1997 as amended and
- Planning and Development Act 2000 as amended [15]

These Acts and subordinate Regulations transpose the relevant European Union Policy and Directives into Irish law.

One of the guiding principles of European waste legislation, which has in turn been incorporated into the Waste Management Act 1996 - 2011 and subsequent Irish legislation, is the principle of “Duty of Care”. This implies that the waste producer is responsible for waste from the time it is generated through until its legal disposal (including its method of disposal.) As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final disposal area, waste contractors will be employed to physically transport waste to the final waste disposal site.

It is, therefore, imperative that the residents, tenants and the proposed facilities management company undertake on-Site management of waste in accordance with all legal requirements and that the facilities management company employ suitably permitted

/ licenced contractors to undertake off-Site management of their waste in accordance with all legal requirements. This includes the requirement that a waste contactor handle, transport and reuse / recover / recycle / dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the Waste Management (Facility Permit & Registration) Regulations 2007, as amended, or a Waste or Industrial Emissions (IE) Licence granted by the EPA. The COR / permit / licence held will specify the type and quantity of waste able to be received, stored, sorted, recycled, recovered and / or disposed of at the specified site.

2.3.1 Limerick City and County Council Waste Bye-Laws

The LCCC "City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019)" came into use in March 2019. The Bye-Laws set a number of enforceable requirements on waste holders with regard to storage, separation and presentation of waste within the LCCC functional area. Key requirements under these Bye-Laws of relevance to the proposed development include the following

- Kerbside waste presented for collection shall not be presented for collection earlier than 6.00 pm on the day immediately preceding the designated waste collection day; while the Metropolitan District of Limerick area shall not be presented for collection earlier than 8.00 pm on the day immediately preceding the designated waste collection day.
- All containers used for the presentation of kerbside waste and any uncollected waste shall be removed from any roadway, footway, footpath or any other public place no later than 9.00pm the day of collection; while the Metropolitan District of Limerick area shall removed their bins no later than 9.30am on the designated waste collection day.
- Documentation, including receipts, is obtained and retained for a period of no less than one year to provide proof that any waste removed from the premises has been managed in a manner that conforms to these bye-laws, to the Waste Management Act and, where such legislation is applicable to that person, to the European Union (Household Food Waste and Bio-Waste) Regulations 2015; and
- Adequate access and egress onto and from the premises by waste collection vehicles is maintained.

The full text of the Waste Bye-Laws is available from the LCCC website.

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2.4 Regional Waste Management Service Providers and Facilities

Various contractors offer waste collection services for the residential sector in the LCCC region. Details of waste collection permits (granted, pending and withdrawn) for the region are available from the NWCPO.

There are a number of licensed and permitted facilities in operation in the region including waste transfer stations, hazardous waste facilities and integrated waste management facilities. There is a proposed thermal treatment facility in Ringaskiddy, Co. Cork which was approved by An Bord Pleanála in 2018. However, a legal challenge in the high court has overturned this decision and the project is now in limbo.

There is a LCCC Civic Centre located on the eastern side of the development on Park Road which can be utilised by the residents of the proposed Development for other household waste streams while a bring bank can be found c. 320m to the south at the LIT School of Art, Clare Street.

A copy of all CORs and waste permits issued by the Local Authorities are available from the NWCPO website and all Waste / Industrial Emissions Licenses issued are available from the EPA.

3.0 DESCRIPTION OF THE DEVELOPMENT

3.1 Location, Size and Scale of the Development

Revington Lands Limited, intend to apply to An Bord Pleanala for permission for a strategic housing development consisting of a mixed-use development of build-to-rent apartments, student apartments incorporating common areas, café and 3no retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick.

The development will consist of a 4ha area bounded by City Canal to the north, Pa Healy Road to the south and Park Road to the west, Canal Bank, Limerick.

3.2 Typical Waste Categories

The typical non-hazardous and hazardous wastes that will be generated at the proposed Development will include the following:

- Dry Mixed Recyclables (DMR) - includes waste paper (including newspapers, magazines, brochures, catalogues, leaflets), cardboard and plastic packaging, metal cans, plastic bottles, aluminium cans, tins and Tetra Pak cartons;
- Organic waste – food waste and green waste generated from internal plants / flowers;
- Glass; and

- Mixed Non-Recyclable (MNR)/General Waste.

In addition to the typical waste materials that will be generated at the development on a daily basis, there will be some additional waste types generated less frequently / in smaller quantities which will need to be managed separately including:

- Green / garden waste may be generated from external landscaping;
- Batteries (both hazardous and non-hazardous);
- Waste electrical and electronic equipment (WEEE) (both hazardous and non-hazardous);
- Printer cartridges / toners;
- Chemicals (paints, adhesives, resins, detergents, etc.);
- Light bulbs;
- Textiles;
- Waste cooking oil (if any generated by the residents and tenants);
- Furniture (and, from time to time, other bulky wastes); and
- Abandoned bicycles.

Wastes should be segregated into the above waste types to ensure compliance with waste legislation and guidance while maximising the re-use, recycling and recovery of waste with diversion from landfill wherever possible.

3.3 European Waste Codes

In 1994, the *European Waste Catalogue* [14] and *Hazardous Waste List* [15] were published by the European Commission. In 2002, the EPA published a document titled the *European Waste Catalogue and Hazardous Waste List* [16], which was a condensed version of the original two documents and their subsequent amendments. This document has recently been replaced by the EPA '*Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [17], applicable since the 1st June 2015. This waste classification system applies across the EU and is the basis for all national and international waste reporting, such as those associated with waste collection permits, CORs, permits and licences and the EPA National Waste Database.

Under the classification system, different types of wastes are fully defined by a code. The List of Waste (LoW) code (also referred to as European Waste Code (EWC)) for typical waste materials expected to be generated during the operation of the proposed development are provided in Table 3.1, below.

Table 3.1 Typical Waste Types Generated and LoW Codes

Waste Material	LoW/EWC Code
Paper and Cardboard	20 01 01
Plastics	20 01 39
Metals	20 01 40
Mixed Non-Recyclable Waste	20 03 01
Glass	20 01 02
Biodegradable Kitchen Waste	20 01 08

Oils and Fats	20 01 25
Textiles	20 01 11
Batteries and Accumulators*	20 01 33* - 34
Printer Toner/Cartridges*	20 01 27* - 28
Green Waste	20 02 01
WEEE*	20 01 35*-36
Chemicals (solvents, pesticides, paints & adhesives, detergents, etc.) *	20 01 13*/19*/27*/28/29*30
Fluorescent tubes and other mercury containing waste*	20 01 21*
Bulky Wastes	20 03 07

** Individual waste type may contain hazardous materials*

4.0 ESTIMATED WASTE ARISINGS

A waste generation model (WGM) developed by AWN has been used to predict waste types, weights and volumes expected to arise from operations within the proposed Development. The WGM incorporates building area and use and combines these with other data, including Irish and US EPA waste generation rates.

The estimated quantum / volume of waste that will be generated from the residential and student units has been determined based on the predicted occupancy of the units. While the floor area usage (m^2) has been used to estimate the waste arising from the crèche and retail/café units.

The estimated waste generation for the proposed Development for the main waste types is presented in Tables 4.1 – 4.3.

Table 4.3 *Estimated Waste Generation for Residential Blocks 1 – 4*

Waste Type	**Waste Volume (m^3 / week)**			
	Block 1 Student (Combined)	**Block 2 Residential (Combined)**	**Block 3 Residential (Combined)**	**Block 4 Residential (Combined)**
Organic Waste	1.03	1.00	1.35	0.66
Dry Mixed Recyclables	7.04	7.10	9.58	4.65
Glass	0.40	0.19	0.26	0.13
Mixed Non-Recyclables	4.09	3.73	5.04	2.44
Total	**12.57**	**12.03**	**16.24**	**7.88**

Table 4.2 *Estimated Waste Generation for Residential Blocks 5 – 7 and Houses*

Waste Type	**Waste Volume (m^3 / week)**			
	Block 5 Residential (Combined)	**Block 6 Residential (Combined)**	**Block 7 Residential (Combined)**	**Residential House (Individual)**
Organic Waste	0.96	0.66	0.70	0.02
Dry Mixed Recyclables	6.83	4.65	4.94	0.18
Glass	0.19	0.13	0.13	<0.01
Mixed Non-Recyclables	3.59	2.44	2.60	0.09
Total	**11.57**	**7.88**	**8.37**	**0.29**

Table 4.3 *Estimated Waste Generation for Commercial units Block 1 and Community Facilities Building*

Waste Type	**Waste Volume (m^3 / week)**		
	Residential Amenity **Community Facilities Building**	**Commercial Units Block 1 (Combined)**	**Creche Unit Community Facilities Building**
Organic Waste	0.15	0.23	0.03
Dry Mixed Recyclables	0.95	2.06	1.10
Glass	0.15	0.05	0.00
Mixed Non-Recyclables	1.16	1.16	0.49
Total	**2.41**	**3.51**	**1.62**

BS5906:2005 Waste Management in Buildings – Code of Practice[18] has been considered in the calculations of waste estimates. AWN's modelling methodology is based on recently published data and data from numerous other similar developments in Ireland and is based on AWN's experience, it provides a more representative estimate of the likely waste arisings from the proposed Development.

5.0 WASTE STORAGE AND COLLECTION

This section provides information on how waste generated within the Site will be stored and collected. This has been prepared with due consideration of the proposed Site layout as well as best practice standards, local and national waste management requirements, including those of LCCC. In particular, consideration has been given to the following documents:

- *BS 5906:2005 Waste Management in Buildings – Code of Practice,*
- *SR Waste Management Plan 2015 – 2021;*
- *Dublin City Council Development Plan 2016 – 2022 (Appendix 10);*
- LCCC City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019) and

- *DoHLGH, Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities* (2020) [19].

Waste Storage Areas

Locations of all Waste Storage Areas (WSAs) can be viewed on the drawings submitted with the planning application under separate cover.

Residential Block (Student) Block1

One (1 no.) shared communal WSA ha been allocated within the development design for the student apartment block. The WSA has been strategically located on the ground floor level, in an external and central location.

Residential Blocks 2 - 7

One (6 no. in total) shared communal WSA per building, has been allocated within the development design for the residential apartment blocks. These have been strategically located on the ground floor level, in an external location in close proximity to cores.

Individual Houses

Residents in houses will have individual waste stores allocated at the rear of their property where external access to the rear yard is possible. When rear is storage is not possible a shielded bin store will be allocated at the front of the unit.

Residents in houses 2,3,5,9 and 10 will have their waste stores allocated on the western side of their block. While the WSA will be shared they will each have their own bins.

Community Facilities Building - Creche & Amenity

One (1 no.) WSAs has been allocated within the development design for the creche unit and one (1 no.) has been allocated for the residential amenities. These WSAs have been strategically located at ground floor level, in close proximity to the cores.

Retail / Café Units Block 1

Four (4 no.) WSAs have been allocated for use by the commercial units in this building. The retail /café units in this block will have their own individual WSAs allocated adjacent to their unit.

The waste receptacles from the WSA will be collected by facilities management, immediately prior to collection and brought through the nearest carpark to where the bins will be staged prior to collection. The staging areas are such that they will not obstruct traffic or pedestrians (allowing a footway path of at least 1.8m, the space needed for two wheelchairs to pass each other) as is recommended in the *Design Manual for Urban Roads and Streets* (2019) [20].

Using the estimated waste generation volumes in Tables 4.1 – 4.3, above, the waste receptacle requirements for MNR, DMR, organic waste and glass have been established for the WSA. It is envisaged that organic waste and glass will be collected on a weekly basis while MNR and DMR will be collected on a twice weekly basis.

Waste Storage Requirements

Estimated waste storage requirements for the operational phase of the proposed Development are detailed in Table 5.1, below.

Table 5.1 *Waste storage requirements for the proposed development*

Area/Use	**Bins Required**			
	MNR[1]	**DMR[2]**	**Glass**	**Organic**
Block 1 Student (Combined)	4 no. 1100 L	7 no. 1100 L	2 no. 240 L	4 no. 240 L
Block 2 Residential (Combined)	4 no. 1100 L	7 no. 1100 L	1 no. 240 L	4 no. 240 L
Block 3 Residential (Combined)	5 no. 1100 L	9 no. 1100 L	1 no. 240 L	6 no. 240 L
Block 4 Residential (Combined)	3 no. 1100 L	5 no. 1100 L	1 no. 240 L	3 no. 240 L
Block 5 Residential (Combined)	4 no. 1100 L	7 no. 1100 L	1 no. 240 L	4 no. 240 L
Block 6 Residential (Combined)	5 no. 1100 L	5 no. 1100 L	1 no. 240 L	3 no. 240 L
Block 7 Residential (Combined)	3 no. 1100 L	5 no. 1100 L	1 no. 240 L	3 no. 240 L
House (Individual)	1 no. 240 L	1 no. 240 L	Bottle Bank	1 no. 120 L

Area/Use	**Bins Required**			
	MNR[1]	**DMR**[2]	**Glass**	**Organic**
Residential Amenity Community Facilities Building	1 no. 1100 L	1 no. 1100 L	1 no. 240 L	1 no. 240 L
Commercial Units Block 1 (Individual)	1 no. 240 L	1 no. 1100 L	1 no. 240 L	1 no. 120 L
Creche Unit	2 no. 240 L	1 no. 1100 L	1 no. 120 L	1 no. 120 L

Note: 1 = Mixed Non-Recyclables
2 = Dry Mixed Recyclables

The waste receptacle requirements have been established from distribution of the total weekly waste generation estimate into the holding capacity of each receptacle type. Waste storage receptacles as per Table 5.1, above, (or similar appropriate approved containers) will be provided by the facilities management company company in the residential WSA.

The types of bins used will vary in size, design and colour dependent on the appointed waste contractor. However, examples of typical receptacles to be provided in the WSAs are shown in Figure 5.1. All waste receptacles used will comply with the IS EN 840 2012 standard for performance requirements of mobile waste containers, where appropriate.

Figure 5.1 *Typical waste receptacles of varying size (240 L and 1100 L)*

5.1 Waste Storage – Residential Units

Residents will be required to segregate waste into the following main waste streams:

- DMR;
- MNR;
- Glass; and

- Organic waste.

Residents will be required to take their segregated waste materials to their designated WSA and deposit their segregated waste into the appropriate bins. The location of the WSAs is illustrated in the drawings submitted with the planning application under separate cover.

Residents in houses will have individual waste stores allocated at the rear of their property where external access to the rear yard is possible. When rear is storage is not possible a shielded bin store will be allocated at the front of the unit. Houses 2,3,5,9 and 10 will have their waste stores allocated on the western side of their block. While the WSA will be shared they will each have their own bins.

Space will be provided in the residential units to accommodate 3 no. bin types to facilitate waste segregation at source.

Each bin / container in the WSAs will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which waste types can be placed in each bin.

Access to the apartment block WSAs will be restricted to authorised residents, facilities management and waste contractors by means of a key or electronic fob access.

Other waste materials such as textiles, batteries, printer toner / cartridges, light bulbs and WEEE may be generated infrequently by the residents. Residents will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Further details on additional waste types can be found in Section 5.6.

5.2 Waste Storage – Student Accommodation

Students in the accommodation will be required to segregate waste into the following main waste streams:

- DMR;
- MNR;
- Organic Waste; and
- Glass.

Segregated bins for DMR, MNR, organic waste and glass will be provided within the kitchens of the student cluster units by the facilities management company. Additional bins for segregation of DMR and MNR will also be provided in the common areas, where appropriate. Students will be required to segregate their waste as above into the provided receptacles in accordance with the terms of the letting agreements of the Operator (The Student Housing Company).

No food macerators will be installed within any area of the student accommodation building.

All bins/containers will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted on or above the bins to show which wastes can be put in each bin.

As required, the students will bring waste from within their clusters to the dedicated WSAs. Students on the floors above ground level will use the lifts or stairs of their building to bring waste to the ground floor. Students will be provided with access fobs/key/code by the Operator to access the WSA. Building cleaning staff will bring waste from within the common areas to the WSA as required.

Larger segregated waste receptacles (as per Table 5.1) will be provided by the facilities management company in the WSA. Receptacles will also be labelled, and colour coded to avoid cross contamination.

Other waste materials such as textiles, batteries, printer toner / cartridges, light bulbs and WEEE may be generated infrequently by the residents. Residents will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Further details on additional waste types can be found in Section 5.6.

5.3 Waste Storage – Crèche

Staff at the crèche will be required to segregate their waste into the following waste categories within their own units:

- DMR;
- MNR;
- Organic waste; and
- Glass.

As required, the staff will need to take segregated DMR, MNR, glass and organic waste to their allocated WSA.

Each bin / container in the WSA will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which waste types can be placed in each bin.

Other waste materials such as textiles, batteries, WEEE, lightbulbs, cooking oil and printer toner / cartridges may be generated infrequently by the tenants. Tenants will be required to identify suitable temporary storage areas for these waste items within the crèche and dispose of them appropriately. Further details on additional waste types can be found in Section 5.6.

5.4 Waste Storage – Retail & Café Units

The commercial tenants will be required to segregate waste within their own units into the following main waste types:

- DMR;
- Organic waste;
- Glass;
- MNR; and
- Carboard

As required, the staff will need to bring segregated DMR, MNR, glass and organic waste to their individual WSA.

Suppliers for the commercial tenants should be requested by the tenants to make deliveries in reusable containers, minimize packaging or remove any packaging after delivery, where possible, to reduce waste generated by the proposed Development.

All bins / containers in the commercial tenants' areas as well as in the WSA will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which wastes can be put in each.

Other waste materials such as textiles, batteries, lightbulbs, WEEE, cooking oil and printer toner / cartridges will be generated less frequently. The tenant will be required to store these waste types within their own unit and arrange collection with an appropriately licensed waste contractor. Facilties management may arrange collection, depending on the agreement. Further details on additional waste types can be found in Section 5.6.

5.5 Waste Collection

There are numerous private contractors that provide waste collection services in the LCCC area. All waste contractors servicing the proposed development must hold a valid waste collection permit for the specific waste types collected. All waste collected must be transported to registered / permitted / licensed facilities only.

Bins from the development will be brought to collection / staging points by the waste contractor or facilities management, immediately prior to collection. All locations for collection can be viewed on the drawings submitted with the planning application under separate cover.

Residents in houses with their own individual bins will be responsible for convey their bins to and from the curtilage for collection.

A trolley / tug or suitable vehicle may be required to convey the bins to and from the collection area. The facilities management or waste contractor will ensure that empty bins are promptly returned to the WSAs after collection / emptying.

Suitable access and egress has been provided to enable the bins to be moved easily from the WSA to the waste collection vehicles on the appropriate days. Waste will be collected at agreed days and times by the nominated waste contractors.

All waste receptacles should be clearly identified as required by waste legislation and the requirements of the LCCC *Waste Bye-Laws*. Waste will be presented for collection in a manner that will not endanger health, create a risk to traffic, harm the environment or create a nuisance through odours or litter.

It is recommended that bin collection times are staggered to reduce the number of bins required to be emptied at once and the time the waste vehicle is on-Site. This will be determined during the process of appointment of a waste contractor.

5.6 Additional Waste Materials

In addition to the typical waste materials that are generated on a daily basis, there will be some additional waste types generated from time to time that will need to be managed separately. A non-exhaustive list is presented below.

Green Waste

Green waste may be generated from gardens, external landscaping and internal plants / flowers. Green waste generated from landscaping of external areas will be removed by external landscape contractors. Green waste generated from gardens internal plants / flowers can be placed in the organic waste bins.

Batteries

A take-back service for waste batteries and accumulators (e.g. rechargeable batteries) is in place in order to comply with the S.I. No. 283/2014 - European Union (Batteries and Accumulators) Regulations 2014, as amended. In accordance with these regulations, consumers are able to bring their waste batteries to their local civic amenity centre or can return them free of charge to retailers which supply the equivalent type of battery, regardless of whether or not the batteries were purchased at the retail outlet and regardless of whether or not the person depositing the waste battery purchases any product or products from the retail outlet.

The commercial tenants cannot use the civic amenity centre. They must segregate their waste batteries and either avail of the take-back service provided by retailers or arrange for recycling / recovery of their waste batteries by a suitably permited / licenced contractor. Facilties management may arrange collection, depending on the agreement.

Waste Electrical and Electronic Equipment (WEEE)

The WEEE Directive (Directive 2002/96/EC) and associated Waste Management (WEEE) Regulations have been enacted to ensure a high level of recycling of electronic and electrical equipment. In accordance with the regulations, consumers can bring their waste electrical and electronic equipment to their local recycling centre. In addition, consumers can bring back WEEE within 15 days to retailers when they purchase new equipment on a like for like basis. Retailers are also obliged to collect WEEE within 15 days of delivery of a new item, provided the item is disconnected from all mains, does not pose a health and safety risk and is readily available for collection.

As noted above, the commercial tenants cannot use the civic amenity centre. They must segregate their WEEE and either avail of the take-back / collection service provided by retailers or arrange for recycling / recovery of their WEEE by a suitably permited / licenced contractor. Facilties management may arrange collection, depending on the agreement.

Printer Cartridge / Toners

It is recommended that a printer cartridge / toner bin is provided in the commercial unit, where appropriate. The commercial tenant will be required to store this waste within their unit and arrange for return to retailers or collection by an authorised waste contractor, as required.

Waste printer cartridge / toners generated by residents can usually be returned to the supplier free of charge or can be brought to a civic amenity centre.

Chemicals

Chemicals (such as solvents, paints, adhesives, resins, detergents, etc) are largely generated from building maintenance works. Such works are usually completed by external contractors who are responsible for the off-site removal and appropriate recovery / recycling / disposal of any waste materials generated.

Any waste cleaning products or waste packaging from cleaning products generated in the commercial units that is classed as hazardous (if they arise) will be appropriately stored within the tenants' own space. Facilties management may arrange collection, depending on the agreement.

Any waste cleaning products or waste packaging from cleaning products that are classed as hazardous (if they arise) generated by the residents should be brought to a civic amenity centre.

Light Bulbs

Waste light bulbs (fluorescent, incandescent and LED) may be generated by lighting at the commercial units. It is anticipated that commercial tenants will be responsible for the off-site removal and appropriate recovery / disposal of these wastes. Facilties management may arrange collection, depending on the agreement.

Light bulbs generated by residents should be taken to the nearest civic amenity centre for appropriate storage and recovery / disposal.

Textiles

Where possible, waste textiles should be recycled or donated to a charity organisation for reuse. Commercial and residential tenants will be responsible for disposing of waste textiles appropriately.

Waste Cooking Oil

If the commerial tenants use cooking oil, waste cooking oil will need to be stored within the unit on a bunded area or spill pallet and regular collections by a dedicated waste contractor will need to be organised as required. Under sink grease traps will be installed in any cooking space.

If the residents generate waste cooking oil, this can be brought to a civic amenity centre.

Furniture & Other Bulky Waste Items

Furniture and other bulky waste items (such as carpet, etc.) may occasionally be generated by the commercial tenant. The collection of bulky waste will be arranged, as required by the tenant. If residents wish to dispose of furniture, this can be brought a civic amenity centre.

Abandoned Bicycles

Bicycle parking areas are planned for the development. As happens in other developments, residents sometimes abandon faulty or unused bicycles, and it can be difficult to determine their ownership. Abandoned bicycles should be donated to charity if they arise or Facilties management willmay arrange collection by a licensed waste contractor.

Covid-19 Waste

Any waste generated by residential and commercial tenants that have tested positive for Covid-19 should be manged in accordance with the current Covid-19 HSE Guidelines at the time that that waste arises. At the time this report was prepared, the HSE Guidelines require the following procedure for any waste from a person that tests positive for Covid-19:

- Put all waste (gloves, tissues, wipes, masks) from that person in a bin bag and tie when almost full;
- Put this bin bag into a second bin bag and tie a knot;
- Store this bag safely for 3 days, then put the bag into the non-recyclable waste / general waste wheelie bin for collection / emptying.

Please note that this guidance is likely to be updated by the time the proposed Development is open and occupied and the relevant guidance at the time will need to be reviewed.

5.7 Waste Storage Area Design

The shared WSAs should be designed and fitted-out to meet the requirements of relevant design Standards, including:

- Be fitted with a non-slip floor surface;
- Provide ventilation to reduce the potential for generation of odours with a recommended 6-10 air changes per hour for a mechanical system for internal WSAs;
- Provide suitable lighting – a minimum Lux rating of 220 is recommended;
- Be easily accessible for people with limited mobility;
- Be restricted to access by nominated personnel only;
- Be supplied with hot or cold water for disinfection and washing of bins;
- Be fitted with suitable power supply for power washers;
- Have a sloped floor to a central foul drain for bins washing run-off;
- Have appropriate signage placed above and on bins indicating correct use;
- Have access for potential control of vermin, if required; and

- Be fitted with CCTV for monitoring.

The facilities management company, tenants and residents will be required to maintain the resident bins and storage areas in good condition as required by the LCCC Waste Bye-Laws.

6.0 CONCLUSIONS

In summary, this OWMP presents a waste strategy that addresses all legal requirements, waste policies and best practice guidelines and demonstrates that the required storage areas have been incorporated into the design of the proposed Development.

Implementation of this OWMP will ensure a high level of recycling, reuse and recovery at the development. All recyclable materials will be segregated at source to reduce waste contractor costs and ensure maximum diversion of materials from landfill, thus contributing to the targets set out in the *SR Waste Management Plan 2015 – 2021*.

Adherence to this plan will also ensure that waste management at the development is carried out in accordance with the requirements of the *LCCC Waste Bye-Laws.*

The waste strategy presented in this document will provide sufficient storage capacity for the estimated quantity of segregated waste. The designated areas for waste storage will provide sufficient room for the required receptacles in accordance with the details of this strategy.

7.0 REFERENCES

1. Waste Management Act 1996 as amended. Sub-ordinate and associated legislation includes:
   - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended
   - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended
   - Waste Management (Facility Permit and Registration) Regulations 2007 (S.I No. 821 of 2007) as amended
   - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended
   - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014)
   - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997)
   - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
   - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
   - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended
   - Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended 2015 (S.I. No. 190 of 2015)
   - European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 191 of 2015)
   - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended 2000 (S.I. No. 73 of 2000)
   - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended
   - *European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994)*
   - European Union (Properties of Waste which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended
2. Environmental Protection Act 1992 as amended;
3. Litter Pollution Act 1997 as amended;
4. Southern Waste Region, *Southern (SR) Waste Management Plan 2015 – 2021* (2015)
5. Limerick City and County Council (LCCC) *City and County of Limerick (Segregation, Storage and Presentation of Household and Commercial Waste) Bye-Laws (2019)*
6. Department of Environment and Local Government (DoELG) *Waste Management – Changing Our Ways, A Policy Statement* (1998)
7. Department of Environment, Heritage and Local Government (DoEHLG) *Preventing and Recycling Waste - Delivering Change* (2002)
8. DoELG, *Making Ireland's Development Sustainable – Review, Assessment and Future Action (World Summit on Sustainable Development)* (2002)
9. DoEHLG, *Taking Stock and Moving Forward* (2004)
10. Department of Communications, Climate Action and Environment (DCCAE), *Waste Action Plan for the Circular Economy - Ireland's National Waste Policy 2020-2025* (2020).
11. Environmental Protection Agency (EPA), *National Waste Database Reports 1998 – 2012*.
12. Limerick City & County Council (LCCC), *Limerick County Development Plan 2010-2016 (as Extended)* (2010)
13. LCCC, Draft Limerick Development Plan 2022 -2028 (2021)

14. Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended 2010 (S.I. No. 30 of 2010) and 2015 (S.I. No. 310 of 2015).
15. European Waste Catalogue - Council Decision 94/3/EC (as per Council Directive 75/442/EC).
16. Hazardous Waste List - Council Decision 94/904/EC (as per Council Directive 91/689/EEC).
17. EPA, *European Waste Catalogue and Hazardous Waste List* (2002)
18. EPA, *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* (2015)
19. BS 5906:2005 Waste Management in Buildings – Code of Practice.
20. *Department of Housing Local Government and Heritage (DoHLGH) Design Manual for Urban Roads and Streets* (2019)
21. DoHLGH, Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities (2020).