FASSAROE PHASE 1 SHD APPLICATION ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Volume 4 - Appendices

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EIA Scoping Report, RPS, March 2020

STRATEGIC HOUSING DEVELOPMENT AT FASSAROE, BRAY, CO. WICKLOW

EIA Scoping Report

CP19001
Strategic Housing Development at Fassaroe, Bray, Co. Wicklow
F01
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1 INTRODUCTION AND SITE CONTEXT

Cosgrave Property Group proposes to lodge a planning application for a Strategic Housing Development to An Bord Pleanála on lands at Fassaroe, Bray, Co. Wicklow under section 4 of the Planning and Development (Housing) and Residential Tenancies Act 2016. The proposed development will comprise of 1,084 no. dwellings, a 750sq.m. creche, a district park and various supporting infrastructural requirements. The development will be subject of mandatory environmental impact assessment.

This scoping report outlines the information proposed to be included in the Environmental Impact Assessment Report (EIAR) for the project. It should be noted that the information requirements of the EIAR may change as the assessment is undertaken and project may be revised on foot of the findings of environment assessments or other factors.

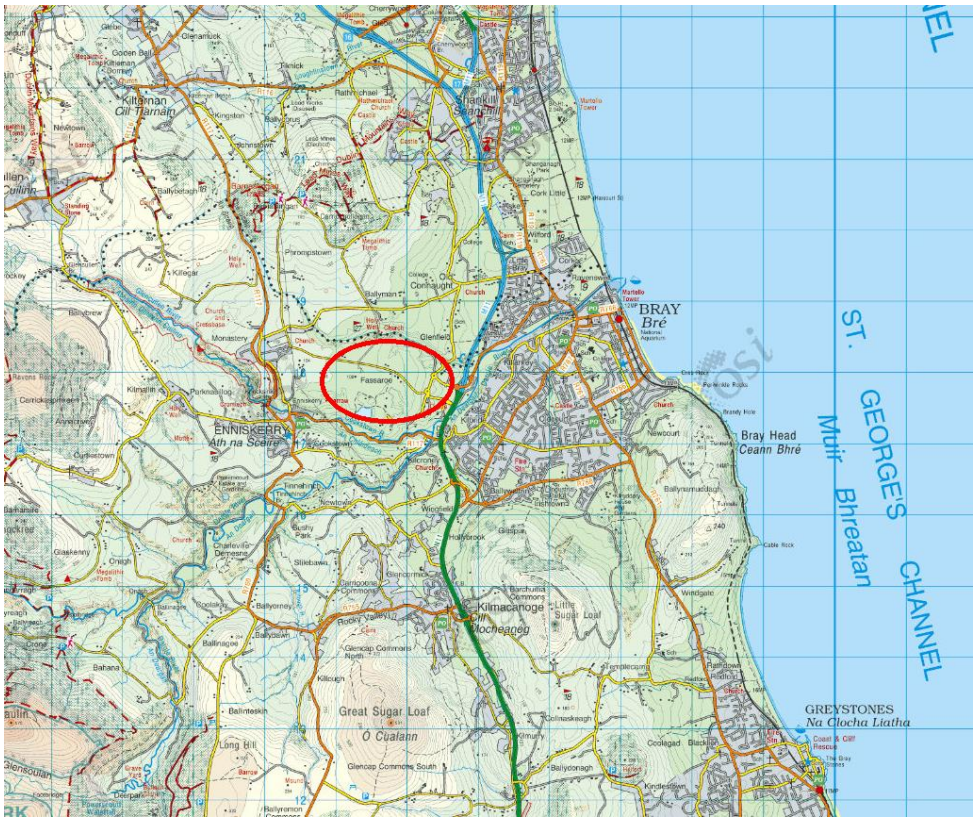
The report is structured as follows:

- **Section 1** provides a project description and site context.
- **Section 2** sets out the EIA process.
- **Section 3** outlines the specialist EIAR topics to be addressed and how the assessments will be presented; any key issues identified at this time in respect of each of these topics and the methodology proposed to be adopted for each.
- **Appendix A** outlines the draft layout of the EIAR.

1.1 Site Location and Context

The site is located at Fassaroe which is on the western side of Bray to the west of the N11 as shown on **Figure 1-1** below.

Figure 1-1: General Site Location



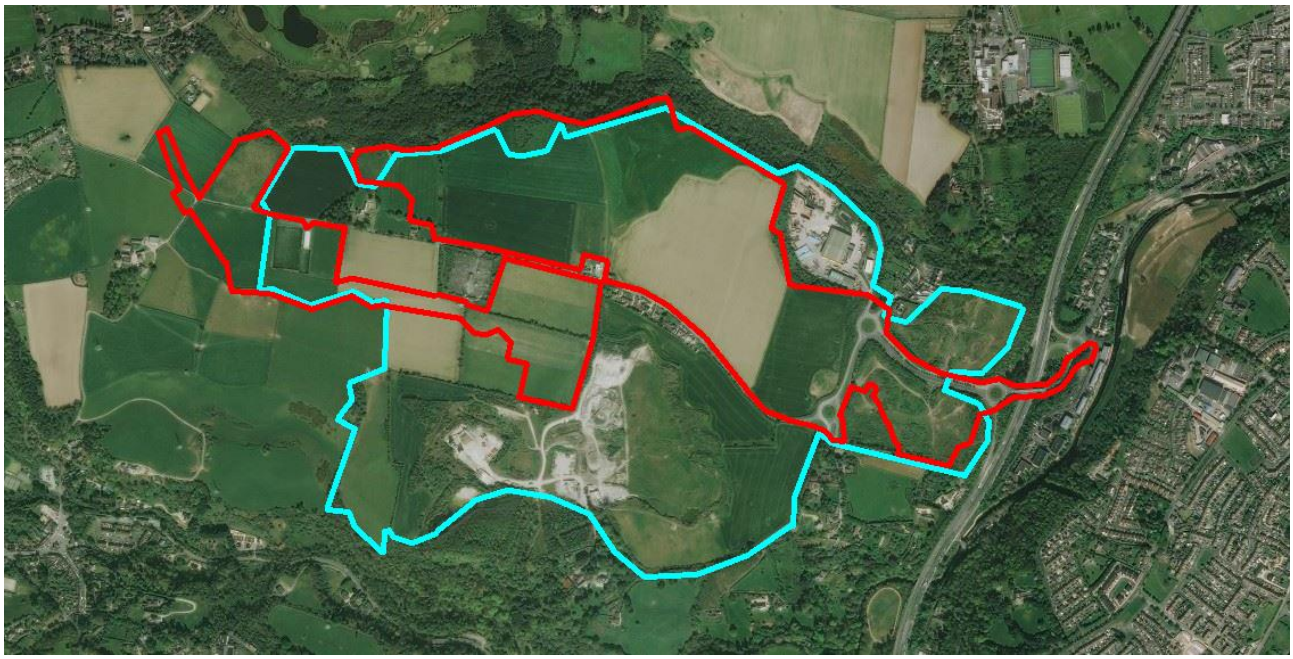
The application site is part of a larger designated development area zoned primarily for residential, open space, employment and community and education uses. The lands also comprise a designated Neighbourhood Centre area. The lands are zoned under the Bray Municipal District (MD) LAP 2018 and are to be developed in accordance with an Action Area Plan to be agreed with Wicklow County Council. The LAP identifies two overall phases of development for Fassaroe. The current proposed application comprises the first stage of the 'Phase 1' development. It incorporates most of the infrastructural requirements of Phase 1 and approximately half of the identified housing element of Phase 1. The current proposed application is referred to as Phase 1(a).

The extent of the overall Fassaroe Action Area Plan area covers circa 150 hectares to the west of the existing built-up area of Bray. The overall zoned development lands in Fassaroe are bounded by the N11 to the east, Ballyman Glen to the north, the Cookstown River to the south and by field boundaries to the west. Further west is the Ballyman Road which links to Enniskerry to the southwest. The existing edge of the built-up area of Bray environs is located immediately to the east of the N11.

Transport Infrastructure Ireland is currently progressing planning and design proposals for upgrade works to the N11/M11 for a 22km length of the N11 from Junction 4 (M50) to Junction 14 (Kilmacanogue). Statutory approval will be sought for the preferred scheme following completion of the public consultation phase.

Figure 1-2 identifies the overall extent of the zoned lands at Fassaroe (blue outline) as well as the general extent of the current proposed development site within it (red outline).

Figure 1-2: Overall Zoned Lands at Fassaroe and Proposed Application Site



The overall Fassaroe development area is made up primarily of existing agricultural and quarry lands along with some clusters of private dwellings and a waste management facility.

The Fassaroe area is currently accessed from the N11 from the Junction 6 interchange. This also comprises of a bridge across the N11 which links to the built-up area of Bray at Dargle Road. The road access into the lands from Junction 6 was previously upgraded to accommodate development at Fassaroe on the basis of a previous industrial development permission which was not subsequently implemented. There is a roundabout providing access to Thornhill Road which links to the Old Connaught area to the north. There are a number of residences located along this road. This roundabout also provides access to an existing Greenstar Waste Management facility on the north-eastern quadrant of the overall Fassaroe development lands. A second roundabout to the south provides access to Kilbride Lane and Berryfield Lane along which again are a number of residences. Berryfield Lane runs east west through the overall Fassaroe development lands and links to Ballyman Road. Parts of this lane are in private ownership which are closed on occasion to through traffic.

Generally, the lands between Berryfield Lane and Ballyman Glen are agricultural. There are 4 No. historic landfill sites previously operated by Wicklow County Council between the early 1970s and mid-1990s which are covered and currently in use for agricultural purposes. These sites had historically been quarried for sand and gravel. The Greenstar facility is also located on an area which was previously quarried.

Lands to the south of Berryfield Lane comprise of agricultural and quarry uses primarily as well as an ESB electricity sub-station set centrally within the lands. There is also an existing football club / pitch on the southern side of Berryfield Lane, adjacent to which is a fifth area of historic landfill previously used by WCC which is also now covered and in use for agriculture.

Ballyman Glen which forms the northern boundary of the overall Fassaroe development lands comprises an SAC. The features of interest in the SAC are petrifying springs with tufa formation (Cratoneurion) [7220] and alkaline fens [7230]. These features interact to create a wet woodland habitat which includes different species of orchids and sedges. Overall, the vegetation at this site is well developed.

There are a number of sites of Archaeology / Architectural Heritage significance in the area. The following National Monuments are within the site boundary:

- WI007-026002- A granite cross known as St. Valery's Cross. There were excavations carried out here in 2002 which failed to reveal anything of significance.
- WI007-026003- A second cross was previously found next to St. Valery's Cross, but the current location of this is unknown.

Along with this, there are 2 no. Protected Structures in Fassaroe to the south east of site, roughly 300m from the south eastern boundary, close to Junction 6 off the N11. These are country houses (Ref. No. 03-32 and Ref. No. 03-34) were built in the early 1800s and are both attributed to the architect Sir Richard Morrison.

The proposed development lands are within the administrative area of Wicklow County Council. The northern boundary of the lands is marked by a river valley and straddles the border with County Dublin and the administrative edge of Dún Laoghaire Rathdown County Council. The Dún Laoghaire Golf Club is located on the elevated lands beyond the valley to the north as well as the Old Connaught area of Bray. Enniskerry is located nearby to the south west of the lands, across an area of open fields. Powerscourt Demense is situated further south west, beyond Enniskerry.

1.2 The Application Site

The application site consists of an irregular area of land and encompasses fields primarily to the north of Berryfield Lane with the Ballyman Glen adjacent to much of the northern site boundary. The site does extend partly to the south of Berryfield Lane also. To the south of the Lane, the application site includes an area of land between the existing ESB substation to the west and a row of private dwellings to the east. Quarry lands currently operated by Roadstone are adjacent to the south and east. This southern portion of the application site extends west to include the proposed road which will link to the Ballyman Road. The application site also extends to the east to Dargle Road, allowing for the provision of a pedestrian / cycle link from the proposed development to Bray. The site primarily comprises lands which are currently used as agricultural fields, including hedgerow boundaries. Towards the western extent of the lands, the site encompasses the Enniskerry Youth Club amateur football club facility. The historic landfills in the area are also included within the application site.

1.3 Project Description

The proposed development will comprise of:

- Road link connecting N11 to Ballyman Road.
- Pedestrian / cycle connection across the N11 connecting to Dargle Road.
- Remediation of 5 no. historic landfill sites in line with Certificates of Authorisation issued by the EPA in 2019.
- 18.5ha of District Park / Active Open Space.

- Approximately 750 sq.m. creche.
- 1,084 no. residential units; comprising of 487 no. houses and 597 no. apartments.
- Retail unit / kiosk in district park.
- Demolition of an existing dwelling at Berryfield Lane.

Along with these elements, the application will also include these associated works:

- Rerouting and undergrounding of overhead ESB lines (110kV and 38kV lines).
- Site development / ground works on future development areas.
- Water supply, foul and surface water drainage proposals.
- Provisions for public bus service within the proposed layout.
- Provision of interim bus services by the developer.

1.3.1 Road Link to Connect N11 to Ballyman Road

Under the Bray MD LAP 2018, the development of the lands at Fassaroe are subject to the provision of a new link road from the N11 to the Ballyman Road. Part of this overall road link connection from the N11 to Ballyman Road is already permitted under a housing permission for 12 No. houses at Monastery, off Ballyman Road (Wicklow Co Ref. 17/15 / ABP Reference Pl 27.248914). The junction with Ballyman Road and 280m of the access road were permitted as part of that permission and are currently under construction. The proposed new development at Fassaroe subject of this EIA Scoping Report provides for the full extent of the link road from the N11 through to the connection point with the previously permitted road under Reg. Ref. 17/15.

This proposed road link incorporates some existing roadway at the eastern side of the Fassaroe lands and runs through existing large open agricultural fields thereafter. It also passes through part of one of the historic landfill sites. The roadworks here combined with the landfill remediation as authorised by the EPA require a modest amount of waste removal along with a cap and gas management strategy.

1.3.2 Pedestrian / Cycle Connection Across the N11 to Connect to Upper Dargle Road

Several options were considered in relation to this bridge including widening of the existing road bridge across the N11. It is proposed to provide a separate bridge immediately south of the existing road bridge. The bridge will extend from the roundabout to the west down to the La Vallee roundabout to the east of the existing junction. The bridge will comprise a main span of approximately 45m across the N11 which would accommodate future widening of the N11 by an extra lane in each direction, which is expected to be included in the M11 upgrade works.

1.3.3 Remediation of 5 no. Historic Landfill Areas

As noted above, there are 5 no. historic landfill sites which were previously operated by Wicklow County Council within the Fassaroe area from the early 1970s to the mid-1990s. These lie within and adjacent to the proposed development areas.

In accordance with the requirements of the Waste Management Act 1996, 4 No. of these sites are classified as Historic Unlicensed Waste Disposal sites which require Certificates of Authorisation from the EPA for their remediation. One of the sites, though operated by Wicklow County Council, does not fall under the certification requirements of the Waste Management Act due to its age. In any event applications were made by Wicklow County Council to the EPA for the remediation of the 4 sites. The Environmental Risk Assessment for the applications had regard to the presence and need for remediation of all 5 sites. In November 2019, the EPA issued final Certificates of Authorisation for the remediation of the 4 no. sites.

In addition to approval under the Waste Management Act, approval for the remediation works is also required under the Planning and Development Acts. While responsibility for remediation of the landfill sites rests with Wicklow County Council, given that their remediation is necessary in advance of development being undertaken in the area, it is appropriate that planning permission for their remediation be sought under this comprehensive development application. The Developer has agreed this approach with Wicklow County Council. Planning permission is therefore now sought for the remediation of all 5 no. sites as per the remediation proposals authorised by the EPA in the Certificates of Authorisation. The remediation measures include:

- A Landfill Capping System.
- Landfill Gas Management System.
- Leachate Interception.
- Surface Water Drainage.
- Excavation and Disposal (in localised areas to address existing slope slippage works and to accommodate a road proposal in one area).

Three of the landfill sites will be landscaped and form part of the passive open space provisions proposed under the current application. One will be simply grassed. It will be subject of more detailed landscaping proposals as part of future development proposals. The main east west link road through the site will traverse the final landfill site and will be capped and grassed on either side.

1.3.4 18.5 ha of District Park / Active Open Space

The application will comprise of 18.5ha of District Park / Active Open Space.

3.1ha of open space has previously been delivered by the Developer as a football pitch for Enniskerry Youth Club.

15.4 ha of District Park is proposed. 3.1ha of this will be Active Open Space accommodating primarily playing pitches with some changing facilities. This area lies to the south of Berryfield Lane. To the north of Berryfield Lane the Park will be landscaped to serve primarily passive activities but will also accommodate pockets of active recreation areas (approx. 1ha).

The main area of passive Park sites incorporates two of the areas of historic landfills. The landscaping elements will be placed on top of the engineered cap requirements. A third landfill site will also be set out as passive landscaped open space under the current application.

A series of ponds are proposed within this area of the park which will serve both aesthetic amenity, biodiversity and surface water drainage functions. This area of the park will be crossed by the proposed link road through the overall Fassaroe lands. The landscaping design as well as the road design in this area will be such as to ensure the entire District Park both functions and visually presents as a single park.

Additional public and communal open space provision is proposed within the residential areas. The distribution and layout of these spaces provide for visual and physical connections to the District Park insofar as reasonably practical.

1.3.5 Creche (approx. 750 sq.m.)

A creche of 750sq.m. is proposed to be delivered as part of the Phase 1(a) development. This is proposed to be located at the western end of the Community and Education zoned lands adjacent to the proposed District Park. This is a centrally located location which also allows the creche to benefit from the amenities of the public park both visually and also allowing easy and safe physical access. It will also be immediately adjacent to the school complex (on the lands zoned for Community and Education use under the LAP) in the long term.

The proposed design and layout of the creche will allow for future extension to serve increasing demand should it arise as the future population grows.

1.3.6 1,084 Residential Units of Which 487 no. Are Houses and 597 no. Are Apartments

The proposed application incorporates a total of 1,084 no. residential units. This comprises of 487 no. houses and 597 no. apartments.

Of the 597 no. apartments proposed the unit breakdown will be as follows:

Apt Type	No. Units	% of Apartments
1 Bed	89	15%
2 Bed	418	70%
3 Bed	90	15%
Total Apts	597	

Of the 487 no. houses proposed the breakdown of units will be as follows:

House Type	No. Units	% of Houses
3 Bed (+ study)	97	20%
4 Bed	195	40%
5 Bed	195	40%
Total Houses	487	

These result in an overall unit size breakdown as follows

Unit Type	No. Units	% of Units
1 Bed	89	8%
2 Bed	418	39%
3 Bed / 3 bed + study)	187	17%
4 Bed	195	18%
5 Bed	195	18%
Total Units	1,084	

1.3.7 Retail Unit / Kiosk in District Park

The Fassaroe Neighbourhood Centre will not form part of the Phase 1(a) application.

It is considered that the number of residential units proposed within the Phase 1(a) application will not deliver a sufficient level of population capable of sustaining on its own the scale of retail provision identified for the Neighbourhood Centre in both the County Development Plan and the Bray MD LAP.

It is estimated that at least 1,400 residential units or above would be required to support such a scale of development.

Combined with the concerns expressed by Wicklow County Council and An Bord Pleanála in respect of the retail proposals for a previous application at Fassaroe (Reg. Ref. 16/999), it is submitted that the Neighbourhood Centre at Fassaroe will more appropriately be delivered as part of a future Phase1(b) development.

In order to provide some element of local retail provision within Fassaroe in the short term however, it is proposed to provide a retail unit /kiosk at the edge of the Public Park adjacent to the main access road through the site. This will be of a scale akin to a traditional local shop.

1.3.8 Demolition of Existing Dwelling at Berryfield Lane

There is an existing single storey dwelling on the northern side of Berryfield Lane which will be demolished to accommodate the District Park and to enhance the connectivity between the passive and active parts of the park. This dwelling is of no particular architectural or historical significance.

1.3.9 Rerouting and Undergrounding of Overhead ESB Lines (110kV and 38kV Lines)

There are existing 110kV and 38kV overhead ESB lines crossing the lands, in and out of the ESB substation on Berryfield Lane. These will be undergrounded as part of the application proposals. They will run within proposed new roadways.

1.3.10 Site Development / Ground Works on Future Development Areas

The full road connection from the N11 through to Ballyman Road will be constructed prior to the occupation of any dwellings within the development. Given the nature and scale of this road and the proposed residential development itself combined with the local topography of the site, it is expected that there will be excess soil material generated that will be required for reuse within the immediate development areas proposed under the currently proposed development.

There will, however, be a need for fill material with the wider lands in the ownership of Cosgrave Property Group at Fassaroe to facilitate the longer term development of those areas. In the interests of a sustainable approach to development, the currently proposed development there will include some site development works on areas of land which will need to be filled for future development. None of these areas will have significant depths of fill but will result in slightly altered land profiles.

1.3.11 Water Supply, Foul and Surface Water Drainage Proposals

The applicant has been in discussions with Irish Water in respect of the current proposals and has agreement in principle for the servicing of these lands.

Water supply to serve the immediate needs of the development will be from an existing public main crossing the lands with temporary storage provided on site. On completion of the Ballyman Reservoirs, the lands at Fassaroe will be served by these.

The nearest existing foul water connection to the proposed Fassaroe development is located close to the Berryfield Lane Roundabout at the western end of Fassaroe Lane. This sewer line was constructed by the Cosgrave Group in anticipation of a previously proposed business park development and it caters for the entire development lands.

The new surface water drainage network to serve the Phase 1(a) development lands will be provided within the alignment of the proposed roads network with spurs into individual development areas. Soakaway areas will be provided throughout the development in order to retain infiltration rates as close to existing pre-development conditions as possible (to minimise potential impact on the features of the Ballyman Glen SAC). The only areas of the development proposals where surface water will be intercepted and not recharged to groundwater will be where the landfill sites are remediated with an engineered cap which includes a non-permeable membrane. The overall reduction in groundwater recharge rate as a result of the capping system is calculated at 11%. Surface water intercepted from these areas will be captured in the surface water network.

Attenuation for surface water run-off will also be provided in the form of landscaped ponds in the main proposed Park and also at the eastern side of the Fassaroe lands close to the N11.

1.3.12 Provisions for Public Bus Services Within The Proposed Layout

The Bray and Environs Transport Study 2019 prepared by the National Transportation Authority (NTA) in consultation with Wicklow County Council, Dun Laoghaire Rathdown County Council and TII confirms that the Fassaroe development lands will be served by public bus. Provision is made within the road layout for access through the site by public bus.

The Developer also proposes to provide a private bus service connecting to Bray DART station to serve the initial occupancy phases of development in the event that there is a delay in the commencement of the public bus service.

1.4 Indicative Phasing of Residential Development

An indicative 3 stage phasing has been proposed for the development. The first phase will include 469 no. units on lands within the eastern portion of the site, closest to Bray. The second phase will be more central within the site and will provide 329 no units and the creche. The final stage will constitute the western extents of the proposed units and will include 286 no. units.

Planning permission is sought for 10 years. It is anticipated that the development will be completed within 8 years but a 10-year permission is sought to allow for some flexibility in delivery of the development. The expected implementation programme is as follows:

- Compliance with conditions / procurement: Year 1
- Site Development Works, Distributor Road Construction, ESB Diversions: Year 2
- First phase of residential development: Years 2 – 4
- Second phase of residential development: Years 4 – 6
- Third phase of residential development: Years 6 – 8

1.5 Construction

1.5.1 Sequencing of Works

Given the size and scale of the proposal, it is necessary for the development to be implemented in a number of stages. Given the extent of infrastructural works required at the site to facilitate development, much of this needs to be undertaken from the outset in advance of and in parallel with the residential development. Undertaking the roadworks and the landfill remediation works in tandem also helps to achieve a good materials balance at the site, with excess soils material generated through road construction being utilised for landfill cap material and / or fill on areas of the site requiring localised reprofiling.

The general sequencing / phasing of construction works at the site will be as follows:

- Secure site boundaries with temporary fencing.
- Establish contractors compound(s).
- Commence construction of proposed new main access road from eastern side of site to western side of development areas, as far as ESB substation (including provision for rerouted 38kV ESB lines) – including all associated roadside landscaping, drainage and utilities.
- Commence construction of new structures for rerouted ESB lines.
- Commence land fill remediation works at Landfill Sites 1, 2 and 3c (including provision for rerouted 38kV ESB lines).
- Commence construction of First Phase of Residential Development
- Continue construction of western end of distributor road to Ballyman Road (including works to and remediation of landfill Site Nos. 3A and 3B).
- Complete remediation of Landfill Site Nos. 1, 2 and 3c and set out as Passive Park
- Complete ESB diversion works and decommission existing.

- Complete remediation of Landfill Site No. 3A and 3B.
- Complete construction of distributor road.
- Complete construction of First Phase of Residential Development
- Undertake Second Phase of Residential Development including creche
- Undertake Third Phase of Residential Development.

1.5.2 Site Entrance and Access

Access to the lands are from the N11. The road access into these lands has already been partially upgraded on the eastern side. This roads infrastructure was previously constructed as part of a permitted commercial development which was not subsequently constructed. These constructed roads and roundabouts, now referred to as Fassaroe Avenue form part of the application site. The new main access road through the overall lands will connect into this. It will take a route to the north of Berryfield Lane as it runs through the main development area. At the western side of the development lands the new access road will cross to the south of Berryfield Lane immediately to the east of the existing ESB substation. From Fassaroe Avenue to the ESB substation the new access road will be referred to as Berryfield Avenue. From the sub-station it will run east west to the south of the pitches before crossing Berryfield Lane again as it heads north to join with Ballyman Road at a new access point.

The access road through the site will be one of the first parts of the development to be constructed to open up access to the development areas. The road will be constructed in two rolling phases from east to west. The first phase will comprise Berryfield Avenue from the east of the site as far as the ESB substation. This will provide all necessary access for the initial phases of construction and will also facilitate the timely diversion of the various ESB lines. The construction of the western part of the access road, Ballyman Link Road, will form a continuous process which will ensure that the road is fully operational by the time of occupancy of the first houses at Fassaroe.

All construction traffic will access the lands from the N11. The access from the new access road to Ballyman Road will not be opened until prior to the occupation of the initial phases of the development. Even when opened during the later stages of construction, construction traffic will not be permitted to access the site from the west.

Local access for existing residents will be retained along Berryfield Lane for the duration of construction. Access will be maintained to Berryfield Lane from both the east and west throughout the construction period. It is noted that Berryfield Lane is not formally a through road but is regularly used by local traffic as such. During construction of the new distributor road at the two points where it crosses Berryfield Lane there will be some interruptions to local access. In these periods the through route along Berryfield Lane will be restricted when the crossing points are under construction. This may cause some temporary inconvenience to residents, ESB workers and users of the pitches as they may be required to follow detoured routes for a period of time.

1.5.3 Construction Compound

A contractor's site compound will be established at the site and the working area fenced off to provide a secure site. Due to the scale of development and the phased approach to development this compound will move positions throughout the construction period.

The construction compound will accommodate a site office and staff welfare facilities (including a canteen, drying room, toilets and first aid) as well as storage areas for materials, waste areas and plant and machinery. All surplus plant and materials shall be stored in this location when not in use and will be secured here at night when the site is not operational.

An electricity connection will be provided to the site at the outset. However, it will also be necessary on occasions to use diesel generators. A fuel storage area will be provided at the site compound.

Temporary portable toilet facilities will be provided within the compound. These units will be maintained, and the waste collected therein will be disposed of using an appropriately licensed contractor.

2 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

2.1 Screening

The requirement for Environmental Impact Assessment (EIA) in Ireland was initially introduced by European Directive 85/337/EEC and amended in 1997, 2003 and 2009. These were codified by Directive 2011/92/EU which has in turn been further amended by Directive 2014/52/EU. The Directive requires the assessment of the effects of certain public and private projects on the environment.

These Directives have been transposed into law in Ireland through a variety of legislation, including the Planning and Development Act 2000 as amended and the Regulations made thereunder as well as a variety of European Communities (Environmental Impact Assessment) Regulations / European Union (Environmental Impact Assessment) Regulations from 1989 to 2019. The Planning and Development and EIA Regulations specify the developments for which EIA will be required and the information which must be provided in an Environmental Impact Assessment Report (EIAR) prepared in connection with the proposed development.

The proposal has been screened by reference to the Planning and Development Act 2000 (as amended) and the Planning and Development Regulations 2001-2019. Schedule 5 Part 2 Item 10 of the Planning and Development Regulations relate to Infrastructure Projects.

Class 10(b)(ii) refers to:

"Construction of more than 500 dwelling units."

Class 10(b)(iv)

"Urban development which would involve an area greater than 2 hectares in the case of a business district, 10 hectares in the case of other parts of a built-up area and 20 hectares elsewhere."

The development comprises of more than 500 units and the site area is in excess of 20 hectares. A mandatory EIA is therefore required for this development.

2.2 Scoping

Scoping is now being carried out to identify matters that should be covered in the EIAR for this proposed development.

The main purpose of the EIA scoping study is to:

- Identify environmental aspects that may be impacted by the development during the construction or operation of the proposed scheme and which should therefore be addressed in more detail as part of the EIA;
- Consider the potential likely and significant impact on these environmental aspects and determine whether any may be partially or wholly omitted from the EIA (scoped out). This ensures that resources and time are focused on the key issues where potential for significant impacts is likely;
- Identify mitigation and enhancement measures at an early stage in the design process, thereby minimising the need for subsequent design amendments and ensuring that environmental protection and sustainability are key factors in the project design;
- Outline proposed methodologies for undertaking the EIAR;
- Outline the likely contents of the NIS; and
- Form a basis of common reference for consultation about the scope and methodology for the EIAR.

Having regard to the Environmental Protection Agency's 2017 document *'Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports'* scoping must be focused on issues and impacts which are:

- Environmentally based;
- Likely to occur; and
- Significant and adverse.

The process of scoping involves assessing the possible impacts of the projects and the alternatives that can be addressed, and deciding which impacts are likely and significant. An initial scoping of possible impacts has identified those impacts thought to be potentially significant, those thought to not be significant and those whose significance is unclear. Those considered to not be significant are eliminated; those in the uncertain category are added to the initial category of other potentially significant impacts.

It must, however, be emphasised that the process of scoping for an EIAR is on-going and iterative, which continues throughout the EIA process and through the design, construction and monitoring phases. This allows the flexibility to address any new issues which emerge during the course of project development and impact assessment, for example the discovery of potential additional impacts arising from information gathered during detailed baseline studies.

The Environmental Protection Agency's 2003 document *'Advice Notes on Current Practice in the preparation of Environmental Impact Statements',* 2015 document *'Draft Advice Notes for Preparing Environmental Impact Statements'* and 2017 document *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* provide useful preliminary information that may be of assistance to all parties during scoping, particularly for project types and topics.

These Advice Notes have condensed the comprehensive list of project types, and development thresholds where relevant (except roads) which are subject to Environmental Impact Assessment, as per Schedule 5 of the Planning and Development Regulations, 2001-2019. These project types comprise a number of related generic development types with similar development and/or operational characteristics.

In particular, Project Type Number 28 relates to, among other things, *'Urban Development'* which would include development of the scale of the proposed development. Under the heading of *'Environmental Effects'*, Project Type 28 lists the typical significant impacts likely to affect the following environmental sub-headings. These have been referenced in the scoping of each of the specialist assessments as presented in section 3 of this report below.

- **Human Beings**
  - Amenity;
  - Accommodation;
  - Employment;
  - Health and safety;
  - Traffic congestion.

- **Fauna**
  - Loss and disturbance of habitats;
  - Food chain impacts;
  - Introduction of vermin and pests.

- **Flora**
  - Site preparation impacts (loss of habitat);
  - Emission impacts (aquatic);
  - Tramping impacts (terrestrial);
  - Eutrophication (terrestrial vegetation).

- **Soil (and Geology)**
- **Water**
  - Supply capacity;
  - Effluent Disposal capacity;
  - Water table effects.
- **Air**
  - Atmospheric emissions;
  - Odours;
  - Noise.
- **Climate**
- **The Landscape**
  - Visual impacts due to the introduction of new structures;
  - Visual impacts due to access roads;
  - Visual impacts due to telecommunications/power lines;
  - Lighting;
  - Change of character due to intensification of use;
  - Parking;
  - Waste handling areas;
  - Litter;
  - Impact of removal of site vegetation;
  - Impact of landscaping proposals.
- **Material Assets**
  - Impacts on roads;
  - Impacts on water supply;
  - Impacts on power;
  - Impacts on telecommunications network;
  - Waste disposal requirements.
- **Cultural Heritage**
  - On-site heritage;
  - Features/artefacts along access or other infrastructural routes.
- **The Interaction of the Foregoing**

  The following guidance documents are to be consulted in the preparation of the EIAR for the proposed development:

  - EIA Directive (2011/92/EU) and as subsequently amended;
  - Planning and Development Act 2000 (as amended);
  - Planning and Development Regulations 2001-2019;
  - Draft Guidelines on the Information to be contained in Environmental Impact Assessment Report (EPA 2017);
  - Advice Notes on Current Practice in the preparation of Environmental Impact Statements (EPA 2003) as updated by the EPA;
  - Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 2017);

- Eastern and Midland Regional Spatial and Economic Strategy 2019 – 2031;
- Wicklow County Development Plan 2016 – 2022;
- Bray Municipal District Local Area Plan 2018 - 2024; and
- Specific guidance, legislation and standards relevant to each environmental topic area are recorded in the relevant environmental chapters of this EIAR.

2.3 Consultation

Consultation is an important part of the Environmental Impact Assessment process. Consultation provides an opportunity to:

- Identify concerns and measures about the project and uses these to inform the preparation of the EIAR;
- Incorporate mitigating measures where possible into the design of the project in early stages;
- Encourage participation in decisions yet to be made;
- Take into consideration concerns during the decision-making process and make the decision and conditions on the decision accordingly.

This scoping document will be issued to various Prescribed Bodies in respect of whose function the proposed development or subject site may have potential relevance or interest. The opinions of these Bodies are sought in respect of the nature of the development, what assessments should be carried out during the Environmental Impact Assessment process and how they should be carried out.

Having regard to Article 213 of the Planning and Development Regulations 2001-2019, the following are deemed to be the appropriate bodies for consultation based on the nature and extent of the proposed development:

a) Department of Culture, Heritage and the Gaeltacht – the National Monuments Service and the National Parks and Wildlife Service
b) Environmental Protection Agency
c) Irish Water
d) Heritage Council
e) Inland Fisheries Ireland
f) Office of Public Works
g) An Taisce
h) The National Transport Authority
i) Eastern and Midland Regional Assembly
j) Transport Infrastructure Ireland
k) Córas Iompair Éireann
l) Dún Laoghaire-Rathdown County Council
m) Waterways Ireland
n) Wicklow County Council

3 SPECIALIST EIAR TOPICS - SCOPING

3.1 Introduction

The objective of this section is to set out the scope the likely environmental impacts to be assessed in the EIAR with reference to the following environmental factors:

- Population and Human Health;
- Biodiversity (Flora and Fauna);
- Soils, Geology and Hydrogeology;
- Water Services, Hydrology and Flood Risk;
- Air Quality;
- Noise and Vibration;
- Landscape and Visual Impact;
- Archaeological, Architectural and Cultural Heritage;
- Traffic Impact Assessment; and
- Interactions and Cumulative Impacts

3.2 Presentation of Specialist Assessments

The specialist assessments will be undertaken and presented in the EIAR with reference to the following format:

1) The Receiving Environment (Baseline Situation)

This section will comprise a dynamic description of the specific environment into which the proposal will fit, taking account of other developments likely to occur. The particular aspects of the environment are discussed in terms of their context, character, significance and sensitivity.

2) The Characteristics of the Proposal

This section will comprise a projection of the specific *'load'* on the particular aspects of the environment considered, which the proposal would be likely to generate during the construction and operational phases.

3) The Potential Impact of the Proposal

a) The potential impact of the proposal will comprise a general description of the possible types of impacts which proposals of this kind would be likely to produce during the construction and operational phases.

b) This includes a consideration of the *'Do Nothing'* scenario. This scenario describes the environment as it would be in the future if no development of any kind is carried out.

c) As the proposed development will form the first phase of development of the larger Action Area Plan development lands, each specialist section will consider the impacts of the Phase One development in itself but also the cumulative impacts of all future development on the overall Action Area Plan lands.

4) Remedial or Reductive Measures

A description of any specific remedial or reductive measures considered necessary and practicable resulting from the assessment of potential impacts described at (3)(a) above during the construction and operational phases.

5) The Predicted Impact of the Proposal

a) An assessment of the specific direct and indirect impacts of the proposal arrived at by adding to the receiving environment (as in (1) above), the loading of the proposal (as in (2) above) and the remedial or reductive measures (as in (4) above). The predicted impacts are discussed having regard to their character, magnitude, duration, consequences, and significance during the construction and operational phases.

b) A *'Worst Case'* scenario is also considered. This scenario arises where a development, or its mitigation measure(s), substantially fails.

c) The residual cumulative impact following mitigation of the proposed development along with the overall Action Area Plan will be assessed and considered.

6) Monitoring

This section will comprise a description of any post development monitoring of effects on the environment which might be necessary, covering the monitoring methods, and the organisations responsible for their implementation.

7) Reinstatement

Where required, a description of reinstatement measures and the organisations responsible for their implementation.

3.3 Identifying the Baseline / Receiving Environment

The spatial extent of the study area / receiving environment for environmental assessment purposes will vary between different environmental topics as the development has different potential geographic zones of influence for potential environmental effects on various types of receptors and on resources. Resources consist of items such as land, habitats, water resources, access routes, and community facilities. Receptors consist of human beings, and the social and economic systems within which they operate and depend upon.

The EPA 'Draft Guidelines on The Information to be Contained in Environmental Impact Assessment Reports' (August 2017) sets out a useful methodology for describing the baseline environment and data for use in an EIAR. This approach is set out in **Table 3.2** below and will be followed in the EIAR.

Table 3.1: EIAR Baseline / Receiving Environment Description Approach

Context	Describe the location, magnitude spatial extent and trends of the environmental factors
Character	Indicate the distinguishing aspects of the environment under consideration
Significance	What quality, value or designation is assigned to this aspect of the existing environment?
Sensitivity	How sensitive is this aspect of the environment to change?

3.4 Identifying Impacts

The likely significant effects (including direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative) of each stage of the proposed development on the environment resulting from the following will be addressed:

- The construction and operation of the proposed development;
- The potential use or loss of natural resources; and
- The potential emission of pollutants, the creation of nuisances and waste.

Impacts can be identified by considering (1) all aspects of the project, (2) the receiving environment, and (3) systematically identifying the potential for interactions between them.

3.5 Scope of Specialist Assessments

The scope and extent of environmental aspects proposed to be assessed in the EIA are set out below. As the project design is refined and as environmental assessments progress the extent and scope of impact assessment will vary as necessary to ensure a robust assessment is undertaken.

3.5.1 Population and Human Health

3.5.1.1 Key Issues

The proposed development comprising of 1,084 No. residential units will result in a significant local population increase. The EIAR will consider what are the key characteristics of the existing resident population and how will these be impacted and altered by the new population arising from the proposed development.

The new resident population also has potential to impact on local working and visiting populations which will be considered.

The new population will generate increased local demand for amenities and community services including education, childcare and recreation facilities. The development will itself also deliver a significant new amenity feature in the form of a district park for both the resulting new population and the wider existing Bray population. A social and community audit of the Bray area will be undertaken to identify existing services. The EIAR will assess impacts on existing services, implications for the existing population utilising these services and the implications for the new residents with reference to access to suitable services.

The development is proposed on largely greenfield lands at the edge of the existing built up area of Bray. There are clusters of existing dwellings in the area. The proposed development will alter the character of the area in which these dwellings are located. The EIAR will consider the impacts on these dwellings.

The closest education facility to the site is St. Gerard's School on Thornhill Road to the north. The potential for impact to same will be considered in terms of accessibility and demand for school places.

The EIAR will consider implications for the closest nearby recreational activities the Enniskerry Youth Club Football Club and the Bray Clay Pigeon Club which operate from lands at Fassaroe.

The proposed development will include a small local retail outlet only. It is proposed that the Neighbourhood Centre planned for the overall Fassaroe area will be delivered with a later phase of development when a sufficient on-site population is achieved to sustain the neighbourhood Centre without adverse impacts on Bray town centre. The EIAR will assess this proposed approach to retail provision with reference to potential impact on Bray town centre while also ensuring the delivery of services to the new Fassaroe population at an appropriate time.

The proposed development comprises the remediation of historic landfill sites which will have a positive environmental impact. The development also introduces a new resident population in close proximity to the remediated sites. The EIAR will consider the remediation proposals and the protection measures incorporated to ensure protection of human health.

The construction phase of the development will have considerable duration and involves some significant infrastructural work. The EIAR will consider the impacts in terms of employment generation as well as inconvenience or nuisance for the existing local resident and working population as well as the future population of the proposed development itself.

3.5.1.2 Methodology

This assessment will be carried out by way of a combination of desk-based studies and site visits and will be undertaken in accordance with the *Draft Advice Notes for Preparing Environmental Impact Statements* (EPA, 2015) and the *Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2015), as well as the *Advice Notes on Current Practice in the preparation of*

Environmental Impact Statements (EPA 2003), and *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA 2002).

Demographic characteristics of the area will be ascertained from the Census of Population data and other statistics released by the Central Statistics Office (CSO). The most recent census carried out by the CSO is the 2016 Census. The 2016 Census results will be compared against the results of the 2011 Census of Population as appropriate.

Identification of sensitive communities and land uses in the vicinity of the site will be undertaken by a mix of site visits, review of digital mapping, aerial photography and development Plan and local area plan mapping.

In addition, relevant national, regional and local planning policies for the area will be examined, including the Bray Environs MD Local Area Plan 2016 and the Wicklow County Development Plan 2016 – 2022.

The focus of the chapter will be on establishing the potential for impact on sensitive communities in the area, including the resident, working and visiting community. Land use will be considered in addressing impacts on the resident, working and visiting communities. In this regard, any particular sensitive land uses will be identified and considered in this assessment. Each section will set out the detail of the existing environment, the characteristics of the development that could have socio-economic impacts, the consequences of such impacts, and mitigation measures where considered necessary.

The human health section will cross reference the findings of other specialist EIAR topics most specifically air quality and noise and vibration. Health and safety aspects of the construction stage in particular with reference to remediation of the historic landfill sites will also be considered.

3.5.2 Biodiversity (Flora and Fauna)

3.5.2.1 Key Issues

The EIA and associated Appropriate Assessment process will identify Natura 2000 sites within the area of influence of the proposed development, i.e. Special Areas of Conservation (SAC) designated under the EC Habitats Directive (Council Directive 92/43/EEC) and Special Protection Area designated under the EC Birds Directive (Directive 2009/147 EC).

The application site lies immediately to the south of the Ballyman Glen SAC and pNHA. The qualifying interests of the SAC are petrifying springs and alkaline fens. These features are dependent on groundwater. An Appropriate Assessment Screening Report and a Natura Impact Statement will also be undertaken and submitted with the planning application.

The EIAR will cross reference the Natura Impact Statement to be prepared for the development which will consider the implications for the development on the SAC. The groundwater regime can potentially be affected by the development through alterations to the rate of groundwater recharge and also by way of groundwater quality improvements due to landfill remediation.

ESB diversion works will potentially require new tower infrastructure within wet woodland area of the SAC. This will be quantified and assessed with mitigation measures specified as necessary.

There are a number of other Natura 2000 sites and NHAs within 15km of the site. The AA screening report will consider potential for impact on all Natura 2000 site and the NIS will assess impacts on those for which the proposed development could impact on. The EIAR will cross-reference the findings of same.

The EIA will also identify and consider any Nature Reserves and Refuges for Fauna or Flora, designated under the Wildlife Acts of 1976 and 2000.

Two of the historic landfill sites to be remediated are immediately adjacent to woodland and scrub associated with Ballyman Glen. The remediation works (which will include stability works where there is potential slippage of the landfill sites towards the Glen) will impinge slightly on the edge of the wet woodland. The direct impacts to same will be quantified and assessed.

The subject site comprises primarily of agricultural land and improved grassland. There are limited hedgerows or trees within the application site. The impact on habitats and any features of significance will be assessed and mitigated as necessary. The EIA will identify any habitats listed on Annex I of the Habitats Directive.

The site and surrounds will be assessed for Species listed on Annexes II and IV of the Habitats Directive, species protected under the Wildlife Acts including protected flora and Red data book species. Of note at this subject site this will include identification of potential bat and badger activity and impacts. Potential for deer and otter will also be considered.

The County Brook (Fassaroe Stream) runs through Ballyman Glen. Much of the application site drains to this stream and surface water runoff from the development will continue to drain to same. The potential for impact on water quality of the stream (from run-off and groundwater flow) will be considered along with the impacts and implications for aquatic ecology and fisheries.

The potential for use of the subject site by winter and breeding birds will be identified and considered whether the development has potential to impact thereon. Particular regard will be had to Birds listed on Annex I of the EC Birds Directive. The habitat assessment will identify any habitats which are important for birds (breeding or feeding).

3.5.2.2 Methodology

The methodology for assessing impacts on Biodiversity / Flora and Fauna will comprise of a mixture of desk top study as well as site visits. Initially we will undertake desk top study and consultation to determine the key existing terrestrial ecology, water quality, aquatic ecology and fisheries (including amenity) value of the affected area. Thereafter we will undertake walkover surveys of the study area to assess terrestrial habitats, identify any likely mammal activity. We will also undertake baseline biological water quality surveys along the County Brook (Fassaroe Stream).

The assessment was carried out in accordance with the following guidelines and documents:

- EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements, Environmental Protection Agency;
- EPA (2003) Advice Notes on current practice in the preparation of Environmental Impact Statements. Environmental Protection Agency;
- EPA (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements. Environmental Protection Agency;
- EPA (2015) Draft Advice Notes for Preparing Environmental Impact Statements. Environmental Protection Agency;
- Interpretation Manual of European Union Habitats. Version EUR 27. European Commission 2007;
- The Status of EU Protected Habitats and Species in Ireland. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland NPWS (2008);
- TII publications, Guidelines for the Assessment of Ecological Impacts of National Road Schemes;
- CIEEM (2016) Chartered Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment.

Sources of information that will be used to inform the assessment include amongst others:

- The National Parks and Wildlife Service (NPWS) natural heritage database (www.npws.ie) for details of designated sites of nature conservation interest in the study area;
- The National Biodiversity Data Centre (NBDC) species database (www.biodiversityireland.ie) to obtain historical species records in the study area;
- National Biodiversity Plan and any relevant County Biodiversity Plan;
- Water Framework Directive (WFD) and River Basin Management site: http://www.wfdireland.ie/;
- Geological Survey of Ireland online mapping: http://www.gsi.ie/mapping.htm;

- EPA ENVision Mapping: http://maps.epa.ie/InternetMapViewer/mapviewer.aspx;
- A review of Ordnance Survey maps and ortho-photography;
- A wide range of guidelines and best practice published by the OPW regarding the potential environmental impacts of drainage on the aquatic environment with particular reference to:
    - Environmental Management Protocols April 2011; and
    - Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance) April 2011.

Ordnance Survey (OS) maps and ortho-photography will be used to inform the field survey work by identifying any habitats present that may be of ecological interest, and to identify adjacent habitats of potential ecological value, along with any connecting habitats, or ecological corridors, that may be present. Bat and badger and protected species surveys will be undertaken as part of the field work.

Biological surveys (Benthic macroinvertebrate sampling) and fishery habitat assessments will be undertaken in the County Brook (Fassaroe Stream).

Consultation with IFI, the NPWS and Wicklow County Council will be undertaken as part of this current EIA scoping exercise.

In order to assess impacts it may be necessary to obtain hydrological and hydrogeological data. In particular, impact on groundwater levels and quality may impact on features of Ballyman Glen.

The EIA will assess cumulative impacts with other plans or projects if applicable. Where negative impacts are identified, suitable mitigation measures should be detailed if appropriate.

3.5.3 Soils, Geology, and Hydrogeology

3.5.3.1 Key Issues

The EIA will set out the baseline characteristics of the soil, geology, and hydrogeology of the subject site and its environs. In this regard it is noted that the overburden deposits at the application site and surrounds are dominated by sand and gravel, reflected in the large number of historic pits within and adjacent to the site. The EIA will consider the quality, drainage characteristics, and range of agricultural uses of soil around the subject site. It will identify quarries in the vicinity, and the potential implications (if any) for existing activities and extractable reserves.

There are no geological heritage sites, historic mines or important geological features within the site or its immediate environs.

The most significant geological / hydrogeological issue at the site is the presence of historic landfill sites; the previously worked gravel pits were used for the disposal of waste. A detailed assessment has already been undertaken as part of an Environmental Risk Assessment to delineate the extent of the waste and associated leachate and landfill gas, which form the baseline contaminated land conditions of the site. This was undertaken to inform a previous planning application at the site and an application for Certificates of Authorisation to the Environmental Protection Agency. Arising from those assessments, a number of design measures to remediate the landfill sites and their associated impacts were presented to the EPA and were granted formal approval in 2019 by the EPA under Certificates of Authorisation. The current application seeks planning approval for the remediation measures as already approved by the EPA. The ERA undertaken for the landfill remediation will form an appendix to the EIAR and will be cross-referenced as appropriate.

Other potential impacts on soils and geology are associated with the construction phase with large-scale earthworks required for the development. The EIA will consider the extent of topsoil and subsoil cover and the potential use of this material on-site or requirement to remove it off-site as waste for disposal or recovery. The EIA will also consider whether the appropriate measures are incorporated into the design to achieve a good materials balance and minimise / eliminate the generation of excess material for disposal off-site.

The aquifers underlying the area have been classified as locally important and poor. The area is serviced by mains water, and no drinking water wells were identified within the site or its immediate environs. No significant concerns regarding drinking water then arise.

Important groundwater springs which deposit calcium carbonate have been identified along the Ballyman Glen, which has been designated a Special Area of Conservation and proposed Natural Heritage Area. These springs are dependent on the local groundwater flows through limestone gravels. The contamination of the groundwater from the landfill leachate may currently be impacting on the springs. The EIAR will consider whether the landfill remedial measures will reduce the volume of leachate generated, and hence improve the groundwater quality discharging to these streams.

The key civil engineering works during construction will involve the excavation of material for foundations, disturbance of topsoil and subsoil, and deliveries of imported engineering fill, crushed stone, concrete, reinforcement and other construction materials. Other construction activities will include site storage of cement and concrete materials, oils, and fuels. The operational stage of the development also present a risk to groundwater quality through leakage of hydrocarbons from vehicles using the development. The EIAR process will identify appropriate mitigation measures to be put in place to manage the risk of ground and groundwater contamination during both construction and operation. These measures will seek to avoid or minimise potential effects in the main through the implementation of the best practice construction methods and adherence to all relevant legislation. Due cognisance will also be paid to the 'good practice' guidance documents for construction work including (but not limited to) 'Environmental good practice on site' CIRIA (2011) and CIRIA (2012).

3.5.3.2 Methodology

This assessment will be undertaken having regard to the publication '*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*' by the Institute of Geologists of Ireland, 2013. In order to assess the site, a desk-based study of publicly available information on the regional soils and geology will be conducted. The sources of information to be used will include amongst others:

- Geology of Kildare-Wicklow, Geological Survey of Ireland (GSI), 1994;
- Geological Survey of Ireland 6-inch to 1 mile 1850's field mapping sheets (unpublished);
- Areas of Scientific Interest in County Wicklow, An Foras Forbartha Teoranta, December 1976.
- Soils Association of Ireland and their Land Use Potential, M. J. Gardiner and T. Radford, National Soil Survey of Ireland, 1980;
- Directory of Active Quarries, Pits, and Mines in Ireland, GSI 2014;
- Memoir of Localities of Minerals of Economic Importance and Metalliferous Mines in Ireland, The Mining Heritage Society of Ireland, 1998;
- Soil Infiltration Test Reports, Geoenvironmental Environmental Consultants, March 2015;
- Cosgrave Property Development Fassaroe Historic Landfill – Environmental Risk Assessment, Atkins, 15 June 2010;
- Warehouses & Ancillary Offices Geotechnical Interpretative Report, Atkins, October 2002;
- Proposed Development at La Vallee, Fassaroe Geotechnical Investigation, Glover Site Investigations Ltd, September 2001;
- N11 Fassaroe Interchange Preliminary Geotechnical Investigation, Glover Site Investigations Ltd, May 2000;
- Fassaroe Development – Geotechnical Interpretative Report Proposed Overbridge at M11 Interchange, Atkins McCarthy, 21 June 2001;
- Fassaroe Historic Landfill Environmental Risk Assessment, RPS, 03 June 2016;
- Fassaroe Historic Landfill Gas Management Strategy, RPS, August 2016;
- Fassaroe Historic Landfill Remediation Report, RPS, August 2016;
- Closed Landfill Certificates of Authorisation (Certificate Authorisation Nos. H0474-02, H0475-01, H0476-01 and H0477-02) for historic landfill sites at Fassaroe, Bray, Co. Wicklow – Issued by the Environmental Protection Agency; and
- GSI online datasets - http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple

In addition, a site walkover survey will be undertaken to confirm the local topography, soil and bedrock types. This will include a walkover survey of the site and windscreen survey of the surrounding area.

3.5.4 Water Services, Hydrology and Flood Risk

3.5.4.1 Key Issues

The EIA will set out the baseline characteristics of the water services currently available in the area, as well as the natural drainage which currently occurs as a result of local topography and soil soakage. Along with this, sensitive receptors will also be examined, including existing watercourses and designated sites.

The Fassaroe area is currently serviced by a limited network of water supply, and foul and storm drainage pipes. These are planned to be added to, notably by the recently permitted Irish Water reservoirs at Ballyman. The EIA will examine the extents and capacities of the existing and proposed infrastructure. Along with this, the suitability of the proposed additions to these networks will be considered in the context of the increased demand which will occur as a result of the population growth provided within the proposed development.

The hydrology of the area is currently defined by three watercourses. The Cookstown / Glencullen River to the south, the County Brook / Fassaroe Stream to the north and the Dargle River into which both flow. The Dargle River in turn flows north easterly and enters the Irish Sea at Bray. Water currently discharges off the development lands in northerly, easterly and southerly flows, depending on variances in the local topography. The EIA will examine what impacts the proposed development will have upon this natural system. These impacts will be considered for both the construction and operational stages of the development.

There is no record of the area being prone to flooding at any point. The natural topography of the area generally prevents the watercourses from flooding their surroundings, and the elevation and inland location of the site prevents rain or coastal flooding from occurring. The watercourses surrounding the site culminate in the Dargle River flowing into the Irish Sea at Bray. The outline proposal for the area includes a number of ponds within the areas of public open space. The EIA will examine the increased flood risk, if any, caused as a result of the overall development on both the development lands and other areas which could be affected, including Bray.

3.5.4.2 Methodology

The methodology for assessing impacts on water and hydrology will comprise a mixture of desk top analysis as well as site assessments. These will be carried out according to the methodology specified in the following guidance documents:

- Environmental Protection Agency (EPA) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2017).
- European Commission Guidance on the preparation of Environmental Impact Assessment Report (2017).

The following sources of information will be consulted to establish the baseline environment:

- Office of Public Works flood mapping data (www.floodmaps.ie);
- *The Planning and Flood Risk Management, Guidelines for Planning* Authorities (Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), 2009;
- The Geological Survey of Ireland (GSI) well card and groundwater records for the area with reference to hydrology and hydrogeology;
- Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (CIRIA 532, 2001);
- Base maps – Ordnance Survey of Ireland;

- CFRAM PFRA Maps (OPW); and
- Geological Survey of Ireland (GSI) maps of superficial deposits.

A Flood Risk Assessment will be prepared to fully examine the potential impacts of the proposed development, and this will help inform the assessments carried out in the EIA.

3.5.5 Air Quality

3.5.5.1 Key Issues

The air quality in the area is quite good at the moment, given the rural character of the area. The key sensitive receptors in the immediate vicinity are the amenity facilities and clusters of dwellings within Fassaroe, as well as those in the wider surrounding area. There is potential for the development to have an impact on these during construction through a number of sources. The emission of fugitive dust may arise from construction works and activities. The movement of heavy construction vehicles, plant and machinery is likely to result in fuel emissions and fine particulate matter such as PM10. The works to the landfill sites may give rise to odours and gases. The EIA will examine the risks posed from these sources and, where applicable, assess any mitigation measures which may help minimise any impacts. These mitigation measures

Most of these impacts are temporary and will only occur during the construction of the development. Once completed, the development will change local traffic patterns as a result of the creation of a new road network in the area. The Environmental Protection Agency (EPA) measures the levels of a number of atmospheric pollutants. The pollutants of most concern are those whose main source is traffic such as particulate matter and nitrogen dioxide. The EIA will examine the long-term implications of these traffic changes and the effects they may have on local air quality.

The proposed gas management strategy for the landfill remediation will also be assessed with reference to implications for air quality on the remediated lands which will not be utilised as open space areas and for nearby residential development.

3.5.5.2 Methodology

The methodology for assessing the impacts on air quality will be carried out by means of a desktop review of available EPA information along with site visits. A baseline will be established using existing air quality data from the EPA monitoring network and will also determine the spatial and temporal trends. This assessment will be prepared in accordance with the relevant standards, including:

- Guidelines on the Information to be Contained in Environmental Impact Assessments (EPA, 2002);
- The National Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011);
- Directives 2008/50/EC (relating to limit values for values sulphur dioxide, nitrogen and oxides of nitrogen, particulate matter in ambient air);
- Directive 2008/50/EC (relating to limit values for benzene and carbon monoxide in ambient air);
- UK Highway Agency, Design Manual for Roads and Bridges (DMRB)
- Government of Ireland, Design Manual for Urban Roads and Streets (DMURS)

The findings of this analysis will be complied into an Air Quality and Climate Assessment which will be submitted as part of the supporting documentation of the planning application.

3.5.6 Noise and Vibration

3.5.6.1 Key Issues

The EIA will set out the baseline characteristics for noise and vibration sources in the area. The primary among these will be traffic movements in the area. The N11, in particular, as well as Ballyman Road and Berryfield Lane, are the main sources of traffic-generated noise and vibrations. Along with this, the ESB substation close to the centre of the development lands adds to local ambient noise levels. Lastly, the Roadstone operated quarry to the south can also give rise to noise and vibrations.

During construction, there will be additional noise and vibrations in the area associated with the use of plant and machinery on-site, and movements of heavy vehicles to and from the site. Once completed, there will be a new road network provided within the development which will influence the long-term baseline for the area. The EIA will examine the extent of noise and vibrations generated from construction works, and the long-term impacts of additional traffic on the proposed road network. These impacts can be mitigated and controlled by establishing working hours for the construction activities and through the inclusion of sound barriers where necessary. The EIA will also explore the suitability and necessity of these mitigation measures.

The existing residential clusters and amenity facilities such as the football pitches in the Fassaroe area and St. Gerard's school to the north are considered to be the key sensitive receptors for noise and vibration impacts. The EIA will examine the impacts of the current baseline environment on these receptors, and the likely changes in these impacts as a result of the proposed development, both during construction and after completion.

3.5.6.2 Methodology

A Noise and Vibration Assessment will be carried out to establish the existing and future noise vibration levels associated with the proposed development during both the construction and operational phases. This assessment will examine the impacts of vehicles and operation of machinery during construction as well as the long-term impacts of residential traffic. The assessment will be carried out in accordance with the following guidelines;

- National Roads Authority (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes;
- National Roads Authority (2014) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes;
- ISO1996-1_2003 Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedure;
- EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities;
- BS 5228-1:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites;
- UK Department of Transport, Welsh Office (1988) Calculation of Road Traffic Noise Document
- EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements, Environmental Protection Agency;
- EPA (2003) Advice Notes on current practice in the preparation of Environmental Impact Statements. Environmental Protection Agency;
- EPA (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements. Environmental Protection Agency; and
- EPA (2015) Draft Advice Notes for Preparing Environmental Impact Statements. Environmental Protection Agency.

In establishing baseline noise levels, measurements (daytime and night-time) will be taken in the vicinity of the proposed development. This survey will be carried out at the nearest noise sensitive locations to the development and it is proposed to carry out measurements for 15-minute periods on a cyclical basis.

BS 5228-1:2009+A1:2014 "*Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise"*, will be used to examine likely construction noise levels during the construction stage of the proposed development. This will take account of noise emissions from construction plant and machinery likely to be used during construction.

Noise modelling software will be used to predict the impact of the proposed road alignment (which will be the main operational stage potential noise generator) on noise sensitive receptors. The implications of any noise being generated by the ESB substation on proposed new housing within the scheme will also be assessed.

There are various vibration guidelines to protect individuals and properties during operational and construction stages of a development. Common practice in Ireland has been to use guidance from these internationally recognised standards, which address vibration standards in two forms, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. The generally accepted criteria used in assessing vibration levels are:

- Vibration that would be likely to lead to complaints (BS6472: 1992 Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)); and
- Vibration levels that would be likely to lead to structural damage (BS7385: Part 2 1990: Evaluation and Measurement for Vibration in Buildings - Guide to Damage Levels from Ground-Borne Vibration).

In the case of nominally continuous sources of vibration, such as traffic, vibration is perceptible at a peak particle velocity of 0.5 mm/s or greater. The operational stages of the proposed development will be assessed against this vibration level. During the construction stage of the proposed development, vibration levels are likely to be higher and associated with single events or events of short duration. For example, piling or rock breaking, which are two of the primary sources of vibration during construction, and are typically tolerated at vibration levels up to 2.5 mm/s due to its temporary nature/short duration. This limit provides for protection against vibration nuisance.

3.5.7 Landscape and Visual Impact

3.5.7.1 Key Issues

The development area currently comprises rural greenfield sites with a mix of developments scattered throughout. These developments include clusters of residences, the ESB substation, the football club, and the Greenstar facility to the north east. As a baseline, it is clear the proposed development will significantly change the more rural character currently in the area. The EIA will examine whether this change can be considered positive, neutral or negative.

The EIA will consider the key existing landscape and visual components. These will include the presence of the quarry to the south of the development lands which constitutes a disturbance in the natural topography of the area. Along with this, designated views and prospects, such as those looking from Ballyman Road and the Enniskerry area towards the Sugarloaf Mountains will also be examined.

As the proposal comprises the development of predominantly rural lands, it will result in a significant change in the visual character of the area. The EIA will examine the extent of potential visibility of the development upon completion, and the overall acceptability of these views onto the development. This sense of visual intrusion will be dependent on the overall design and layout of the proposed development, and as such, these will also be taken into account.

The proposed development will include a landscaping strategy which will help enhance the visual amenity of the area for future residents. This landscaping may also help embed the development into the surrounding landscape, thus mitigating the potential for adverse visual impacts. The EIA will consider any such landscaping and mitigation measures as appropriate.

3.5.7.2 Methodology

A Landscape and Visual Impact Assessment will be carried out in order to assess the impact of the proposed development. This assessment will be carried out in accordance with the Landscape Institute Guidelines for Landscape and Visual Impact Assessment (3rd Edition, 2013), and will include:

- Site survey to determine the character of the site and its surrounding environs.
- Site analysis to determine views in to and out of the site along with Zone of Theoretical Visibility (ZTV) mapping.
- An assessment of the proposed development through analysis of architectural layout plans and sections to determine the impacting features.
- Preparation of photomontages of the proposed development and cumulative development of the entire Action Area Plan lands.
- Evaluating the impact on the landscape in accordance with EPA guidelines.

3.5.8 Archaeological, Architectural and Cultural Heritage

3.5.8.1 Key Issues

There are 2 no. recorded National Monuments within the site boundary, as outlined in **Section 1.1** above. The first of these is St. Valery's Cross (WI007-026002), which is located close to the previously developed roads and roundabouts near the N11. The second is another cross which was previously recorded as being next to St. Valery's Cross, but the current location is unknown. Excavations carried out in the area in 2002 did not find anything of any significance. There are also a number of other heritage assets located in the surrounding area. The EIA will therefore consider the potential for any significant findings to occur during construction, and the measures to be taken if such an event occurs.

There are no other archaeological or architectural heritage designations within the site.

3.5.8.2 Methodology

The Archaeological, Architectural and Cultural Heritage components of the study will comprise a review and evaluation of selected sites of archaeological, architectural and historical potential within, and in the immediate environs of, the proposed development area. The work will consist of the results of a paper survey and field inspection.

3.5.8.2.1 Paper Survey

As part of a documentary / cartographic search, the following principal sources will be examined from which a list of sites and areas of Cultural Heritage interest / potential will be compiled:

- Record of Monuments and Places – Co. Wicklow (RMP).
- Archives of the Archaeological Survey of Ireland.
- Records of the National Museum of Ireland.
- Annual Archaeological Excavation Bulletin.
- Stereoscopic photographic coverage carried out by the Geological Survey of Ireland.
- NIAH Survey of the Architectural Heritage of County Wicklow (NIAH).
- Documentary and cartographic sources in Wicklow County Library.
- Eastern and Midland Regional Spatial and Economic Strategy 2019 – 2031.
- Wicklow County Development Plan 2016-2022 (WCDP).
- Bray Municipal District Local Area Plan 2018 - 2024.

3.5.8.2.2 Field Inspection

From the preceding paper survey, a list of cultural heritage sites / sites of cultural heritage potential will be compiled for inspection. The subject lands and a 300m area surrounding the boundaries of such lands will be assessed for the presence of archaeological monuments by reference to map and aerial photographic sources by site walkover.

It is not proposed to undertake invasive site investigations for the purposes of archaeological assessment at this time. It is proposed that pre-construction investigations would be undertaken following receipt of planning permission and monitoring and / or other mitigation measures would be agreed with the Department of Culture, Heritage and Gaeltacht prior to the commencement of the development.

3.5.9 Traffic Impact Assessment

3.5.9.1 Key Issues

The proposed development constitutes Phase 1(a) of the development of Fassaroe as set out in the Bray Municipal District Local Area Plan. As part of the wider development of the area, the LAP outlines the need for a link road through the lands to connect the N11 and Ballyman Road. The proposed development includes this link road, which will also serve as the primary road from which the development will be accessed. Given the development includes a large number of residential units, there will be an increase in traffic movements associated with this. The EIA will therefore consider the impacts of the proposed development on the traffic and transportation networks in the immediate and wider areas.

The Bray Environs Transport Study provides for a public service bus link between the development site, Bray town centre, and the Bray DART station. It is proposed to include a private interim bus service for the development until such time as the public bus service becomes available.

In other to accommodate multiple modes of transport, the development includes a proposal for a new pedestrian / cycle bridge across the N11 to provide a suitable alternative means of access to Bray town.

In the short-term, there will be construction related traffic movements to the site. The frequency and nature of these will be examined in the EIA, along with the routes proposed for different vehicles, and the impacts these may have on the surrounding road network.

3.5.9.2 Methodology

A Traffic and Transport Assessment will be carried out and included within the supporting documents for the planning application. This will describe and examine the existing transport infrastructure in the area. Along with this, baseline traffic flow figures will be established. The assessment will also estimate the volume of traffic generated by the proposed development during both the construction and operational phases and its distribution onto the local road network. These estimations will take different modal splits into account. Consideration will be given to transport proposals and objectives outlined within the Bray Municipal District Local Area Plan 2018 - 2024, the Bray Environs Transport Study, the Wicklow County Development Plan 2016-2022, and the Greater Dublin Area Transport Strategy 2016-2035. Where necessary, the assessment will make recommendations to mitigate traffic and transportation impacts.

The traffic modelling which will be undertaken will assess movements for 650 no. units in a +4 year scenario, and 1,084 no. units in a +9 year scenario. This staggered modelling will reflect the envisaged phasing of construction for the proposed development. The modelling will also consider and assess, as appropriate, traffic management options at Junction 6 of the N11 / M11, examining implications on merge improvements and public transport prioritisation.

3.5.10 Interactions and Cumulative Impacts

3.5.10.1 Key Issues

The EIA will consider and identify other noteworthy developments, if any, in the surrounding area. The potential impacts of any such developments will be examined, and the risk for cumulative impacts in conjunction with the proposal will also be considered. Any such cumulative impacts will be particularly scrutinised if a risk is posed to a sensitive receptor or designated site such as the Ballyman Glen SAC.

One of the various impacts or mitigation measures outlined above may result in a secondary impact on another topic. As such, the EIA will also examine the interactions between the various impacts outlined above. Any such interrelated impacts will be considered to assess the receptor which would be affected, and the acceptability of any such impact.

3.5.10.2 Methodology

A desktop study will be undertaken to identify developments in the vicinity surrounding the application site. This study will consider applications for development which have been submitted to both Wicklow County Council and Dún Laoghaire Rathdown County Council, as well as An Bord Pleanála. The EIA will also consider both public and private developments.

These developments will be examined to assess their potential to give rise to cumulative impacts in conjunction with the proposed development, including any secondary impacts which could arise due to the interrelationship of any of the impacts outlined above. The interactions of impacts will be identified within a table and examined to conclude the magnitude of such interactions.

3.6 Overall Content of the EIAR

The EIAR will explore all of the above topics in detail. As part of this, the structure of the document will be laid out in three volumes;

- **Volume I: Non-Technical Summary** – this volume will outline and summarise the main content of the EIAR
- **Volume II: Environmental Impact Assessment Report** – this is the main volume of the document where the overall description and context of the development will be set out before each of the topics outlined above are examined.
- **Volume III**: **Technical Appendices** – the volume will contain the technical data, specialist documentation and other reports that informed the overall report.

A more detailed summary of the content and layout of the EIAR can be seen in **Appendix A** of this report.

3.7 Illustrative Material to be Contained in the EIAR

At this stage, it is intended that illustrative material for the EIAR will consist of pertinent drawings, maps, diagrams, and photographs / photomontages as appropriate; sufficient to articulate the proposed scheme and to document specific environmental aspects. This material will be complementary to the full drawing package which will be submitted in accordance with the Planning and Development Regulations 2001-2019 as part of the overall application package.

Appendix A
Draft Layout of the EIAR

APPENDIX A – DRAFT LAYOUT OF THE EIAR

The structure of the EIAR is laid out the in the preface of each volume for clarity. It consists of three volumes as follows

Volume I: Non-Technical Summary

A non-technical summary of the information contained in Volume II.

Volume II: Environmental Impact Assessment Report

This is the main volume of the EIAR. It provides information on the location and scale of the proposed development, details on design and impacts on the environment (both positive and negative) as a result of the proposed development. Part A will contain the following chapters;

Chapter 1 Introduction

Chapter 2 Project Description

Chapter 3 Planning and Development Context

Each of the environmental aspects as listed below are examined in terms of the existing or baseline environment, identification of potential construction and operational stage impacts and where necessary proposed mitigation measures are identified. The interaction of the environmental aspects with each other is also examined. Part B of Volume II of the EIR relates to the environmental aspects considered as follows;

Chapter 4 Population and Human Health

Chapter 5 Biodiversity (Flora and Fauna)

Chapter 6 Soils, Geology and Hydrogeology

Chapter 7 Water Services, Hydrology and Flood Risk

Chapter 8 Air Quality

Chapter 9 Noise and Vibration

Chapter 10 Landscape and Visual Impact

Chapter 11 Archaeological, Architectural and Cultural Heritage

Chapter 12 Traffic Impact Assessment

Chapter 13 Interactions and Cumulative Impacts

Volume III: Technical Appendices

Volume 3 contains specialists' technical data and other related reports including photomontages.

APPENDIX 1B

Copies of EIA Scoping Letters to Prescribed Bodies

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Our ref: CP19001

Date: 12 March 2020

Córas Iompair Éireann
Heuston Station
St. John's Road West
Dublin 8

Dear Sirs,

Re: Strategic Housing Development at Fassaroe, Bray, Co. Wicklow

RPS Group, acting as agent for Cosgrave Property Group, intends to engage in pre-application consultation with An Bord Pleanála for a proposed Strategic Housing Development on lands at Fassaroe, Bray, Co. Wicklow. This proposal will be subject to Environmental Impact Assessment (EIA).

The proposed development will include a number of elements. The main works within the proposal is the construction of 1,084 no. residential units with a mix of houses and apartments. Along with this, the development will include a road link between the N11 and Ballyman Road, and a pedestrian / cycle connection across the N11 to Dargle Road. The wider development area includes 5 no. historic landfill sites, and remediation works are proposed for these locations. The proposal also includes the creation of a district park / active open space amounting to 18.5ha, with a retail unit / kiosk in the district park. Part of this open space will utilise some of the remediated landfill sites. A creche with an area of roughly 750 sq.m. will also be provided within the development.

The development will also require associated and ancillary works which include the rerouting and undergrounding of 110kV and 38kV overhead ESB lines, ground works on future development areas and the provision of water services. Furthermore, the layout of the development will allow for the provision of public bus services, with an interim service provided by the developer. As part of the overall proposal, an existing dwelling on Berryfield Lane would be demolished.

Strategic Housing Developments (SHDs) are defined under the Planning and Development (Housing) and Residential Tenancies Act 2016 and the Planning and Development (Strategic Housing Development) Regulations 2017. This definition includes the development of 100 or more houses on lands zoned for residential use or a mixture of residential and other uses. Given the proposal includes the construction of 1,084 residential units, it is clear the development constitutes a Strategic Housing Development. The SHD process comprises of three mandatory stages;

- **Stage 1 – Consultation** with the local Planning Authority under Section 247 of the Planning and Development Act, 2000, as amended.
- **Stage 2 – Pre-application consultation** with An Bord Pleanála under Section 6 of the Planning and Development (Housing) and Residential Tenancies Act, 2016.

- **Stage 3 – Planning application** to be submitted directly to An Bord Pleanála.

This development is currently moving into Stage 2 of the process. The result of this pre-application consultation Stage will be an Opinion from An Bord Pleanála regarding the acceptability of the development. The legislation allows for this to be one of two Opinions;

a) The documents submitted under Stage 2 constitute a reasonable basis for an application to be submitted under Stage 3

or

b) The proposal requires further consideration and amendment in order to constitute a reasonable basis for an application to be submitted under Stage 3

Given the size, scale and nature of the development, the application will be subject to Environmental Impact Assessment (EIA). As part of the overall EIA process for this proposal, an EIA Scoping Report has been prepared with respect of the proposed development. This Scoping Report outlines the information which is proposed to be included in the Environmental Impact Assessment Report (EIAR) which will be submitted with the finalised Stage 3 planning application. Please find this report enclosed.

This Scoping Report also serves as discussion prompt as we are now seeking opinions for issues to be examined within the EIAR. Given the timeline for the application, we would appreciate any opinions or feedback on the issues outlined in the Scoping Report by **April 17th**.

Any queries or submissions relating to this can be sent digitally to luke.martin@rpsgroup.com or as a hard copy to our offices at;

RPS Group
Inishmore
Ballincollig
Co. Cork
P31 KR68

Yours sincerely,
for RPS Group

Luke Martin
Planner
luke.martin@rpsgroup.com

Our ref: CP19001

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Date: 12 March 2020

The Minister for Agriculture, Food and the Marine
Agriculture House
Kildare Street
Dublin 2
D02 WK12

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Yours sincerely,
for RPS Group

Luke Martin
Planner
luke.martin@rpsgroup.com

Our ref: CP19001

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Date: 12 March 2020

The Minister for Communications, Climate Action and Environment
29-31 Adelaide Road
Dublin
D02 X285

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Yours sincerely,
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Planner
luke.martin@rpsgroup.com

Our ref: CP19001

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Date: 12 March 2020

The Minister for Culture, Heritage and the Gaeltacht
C/O The Manager
Development Applications Unit
Department of Culture, Heritage and the Gaeltacht
Newtown Road
Wexford
Y35 AP90

Dear Sirs,

Re: Strategic Housing Development at Fassaroe, Bray, Co. Wicklow

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Yours sincerely,
for RPS Group

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Innishmore, Ballincollig
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Date: 12 March 2020

The Minister for Housing, Planning and Local Government
Custom House
Dublin 1
C01 W6X0

Dear Sirs,

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Date: 12 March 2020

Planning Section
Eastern & Midland Regional Assembly
3rd Floor North
Ballymun Civic Centre
Main Street
Ballymun
Dublin 9

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Innishmore, Ballincollig
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Date: 12 March 2020

Environment Protection Agency
PO 3000
Johnstown Castle Estate
Co. Wexford

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Our ref: CP19001

Date: 12 March 2020

The Heritage Council
Áras na hOidreachta
Church Lane
Kilkenny

Dear Sirs,

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Inland Fisheries Ireland
3044 Lake Drive
City West
Dublin 24

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Irish Water
Colville House
24-26 Talbot Street
Dublin 1

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Date: 12 March 2020

The Manager
National Transport Authority
Floor 3
Block 6/7
Irish Life Centre
Dublin 1

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Date: 12 March 2020

Office of Public Works
Head Office
Jonathan Swift Street
Trim
Co. Meath
C15 NX36

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RPS Group
Inishmore
Ballincollig
Co. Cork
P31 KR68

Yours sincerely,
for RPS Group

Luke Martin
Planner
luke.martin@rpsgroup.com

Our ref: CP19001

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Date: 12 March 2020

An Taisce Advocacy
The Tailors' Hall
Brick Lane
Dublin 8
D08 X2A3

Dear Sirs,

Re: Strategic Housing Development at Fassaroe, Bray, Co. Wicklow

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Yours sincerely,
for RPS Group

Luke Martin
Planner
luke.martin@rpsgroup.com

Innishmore, Ballincollig
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T +353 21 466 5900

Our ref: CP19001

Date: 12 March 2020

Transport Infrastructure Ireland
Parkgate Business Centre
Parkgate Street
Dublin 8

Dear Sirs,

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Yours sincerely,
for RPS Group

Luke Martin
Planner
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Our ref: CP19001

Date: 12 March 2020

Planning Department
Dún Laoghaire-Rathdown County Council
County Hall
Marine Road
Dún Laoghaire
A96 K6C9

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Our ref: CP19001

Date: 12 March 2020

Planning Department
Wicklow County Council
County Buildings
Whitegates
Wicklow Town
A67 FW96

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APPENDIX 1C

Copies of EIA Scoping Responses from Prescribed Bodies

Roinn Cumarsáide, Gníomhaithe ar son na hAeráide & Comhshaoil
Department of Communications, Climate Action & Environment

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Luke Martin
Planner
RPS Groups
Inishmore
Ballincollig
Co. Cork
P31 KR68

30 March 2020

Re: Strategic Housing Development at Fassaroe, Bray, Co. Wicklow

Your Ref: CP19001
Our Ref: 20/71

Geological Survey Ireland (GSI) is the national earth science agency and has datasets on Bedrock Geology, Quaternary Geology, Geological Heritage Sites, Mineral deposits, Groundwater Resources and the Irish Seabed. These comprise maps, reports and extensive databases that include mineral occurrences, bedrock/mineral exploration groundwater/site investigation boreholes, karst features, wells and springs. Please see our website for data availability and we recommend using these various data sets, when undergoing the EIAR, planning and scoping processes. Geological Survey Ireland should be referenced to as such and should any data or geological maps be used, they should be attributed correctly to Geological Survey Ireland.

Dear Luke,

Thank you for your correspondence and accompanying EIS scoping report which was received by Geological Survey Ireland on 13 March 2020. To aid the completion of the EIAR by RPS, Geological Survey Ireland (a division of Department of Communications, Climate Action and Environment) would like to make the following comments:

Geoheritage

Geological Survey Ireland (GSI) is in partnership with the National Parks and Wildlife Service (NPWS, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs) to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Irish Geoheritage Programme (IGH) of GSI, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGS), as adopted under the National Heritage Plan are now included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer. The audit for Co. Wicklow was completed in 2014. The full report details are available here Report.

We would like to draw your attention to the following CGS site – Enniskerry Delta, a full report on which is available to view and download here Report. **Please note that the proposed development lies entirely within the boundary of this CGS**.

The Enniskerry Delta includes a large accumulation of sands and gravels which has been quarried extensively historically. It is also known as the 'Fassaroe Delta'. The feature is a high, striking example of a dry sand and

gravel ridge, and stands proud of the surrounding landscape. This is an excellent example of a deglacial, ice marginal, meltwater-deposited feature.

GSI would also bring your attention, section - 10.3 Natural Heritage and Landscape, subsection 10.3.5 'Soils and Geology' of the Wicklow Development Plan 2016-2022 and outlined sections below for your information.

> NH26 Protect and enhance 'County Geological Sites' (Schedule 10.10 and Map 10.10 of this plan) from inappropriate development at or in the vicinity of a site, such that would adversely affect their existence, or value.
>
> NH27 To consult with the Geological Survey of Ireland as is deemed necessary, when dealing with any proposals for major developments, which will entail 'significant' ground excavation, such as quarrying, road cuttings, tunnels, major drainage works, and foundations for industrial or large buildings and complexes.
>
> NH28 To facilitate public access to County Geological Heritage Sites, on the principle of "agreed access" subject to appropriate measures being put in place to ensure public health and safety and subject to the requirements of Article 6 of the Habitats Directive.

Source: Wicklow Development Plan 2016-2022

The proposed development area lies within the boundary of the CGS site which is listed as site 24, schedule 10.10 and spatially represented map 10.10 in the Wicklow Development Plan.

Please contact Clare Glanville (Clare.Glanville@gsi.ie) for further information and possible mitigation measures if applicable.

Natural Resources (Minerals/Aggregates)

Geological Survey Ireland is of the view that the sustainable development of our natural resources should be an integral part of all development plans from a national to regional to local level to ensure that the materials required for our society are available when required. Geological Survey Ireland highlights the consideration of mineral resources and potential resources as a material asset which should be explicitly recognised within the environmental assessment process. Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer. **Our Aggregates Potential Map records granular aggregate potential as 'very high potential' in the vicinity of the proposed Development and consideration to aggregate potential sterilisation should be included as part of the EIAR and planning process.**

Groundwater

Groundwater is important as a source of drinking water, and it supports river flows, lake levels and ecosystems. It contains natural substances dissolved from the soils and rocks that it flows through, and can also be contaminated by human actions on the land surface. As a clean, but vulnerable, resource, groundwater needs to be understood, managed and protected. Through our Groundwater Programme, Geological Survey Ireland provides advice and maps to members of the public, consultancies and public bodies about groundwater quality, quantity and distribution.

Geological Survey Ireland monitors groundwater nationwide by characterising aquifers, investigating karst landscapes and landforms and by helping to protect public and group scheme water supplies. With regard to Flood Risk Management, there is a need to identify areas for integrated constructed wetlands. We recommend using the GSI's National Aquifer and Recharge maps on our Map viewer to this end.

Geohazards

Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides are the most prevalent of these hazards. Geological Survey Ireland has information available on past landslides for viewing as a layer on our Map Viewer. Geological Survey Ireland also engages in national projects such as Landslide Susceptibility Mapping and GWFlood Groundwater Flooding. We recommend that geohazards be taken into consideration, especially when developing areas where these risks and susceptibility are prevalent, and we encourage the use of our data when doing so.

Geotechnical Database Resources

Geological Survey Ireland continues to populate and develop our national geotechnical database and viewer with site investigation data submitted voluntarily by industry. The current database holding is over 7500 reports with 134,000 boreholes; 31,000 of which are digitised which can be accessed through downloads from our Geotechnical Map Viewer. We would strongly recommend that this database be consulted as part of any baseline geological assessment of the proposed development as it can provide invaluable baseline data for the region or vicinity of the proposed development area. This information may be beneficial and cost saving for any site-specific investigations that may be designed as part of the development.

Other Comments

Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. The data would be added to GSI's national database of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to Beatriz Mozo, Geological Mapping Unit, at Beatriz.Mozo@gsi.ie, 01-678 2795.

I hope that these comments are of assistance and we look forward to receiving a copy of the EIAR report in due course. If we can be of any further help, please do not hesitate to contact me Emily Murray-Farrugia (EmilyMurray.Farrugia@dccae.gov.ie) or my colleague, IGH Programme Lead, Dr. Clare Glanville (clare.glanville@dccae.gov.ie)

Yours sincerely

Emily Murray Farrugia
Planning and Geoheritage Programmes

Mr Luke Martin
RPS Group
Inishmore
Ballincollig
Co. Cork
P31 KR68

Údarás Náisiúnta Iompair
National Transport Authority

17th April, 2020

RE: EIAR Scoping for SHD at Fassaroe

Dear Mr Martin,

The National Transport Authority (the "NTA") welcome the opportunity to submit our views on the issues to be considered in the Environmental Impact Assessment Report (EIAR) for the proposed SHD at Fassaroe, Co. Wicklow. These views are informed by the Transport Strategy for the Greater Dublin Area (the "Transport Strategy") and the Bray and Environs Transport Study (the "Bray study").

The issuing of this correspondence is provided as best practice guidance only and does not prejudice NTA's statutory right to make any observations following the examination of any valid planning application referred.

1. Context

Fassaroe is a challenging location for large-scale residential development due to its severance from Bray to the east by the M11, and its lack of continuity to urban development to the north. It is an isolated site which does not lend itself readily to servicing by non-car modes of transport. Its topography also leads to challenges in making walking and cycling attractive. It is within this context that the NTA have engaged with the applicant, Wicklow County Council (WCC) and Transport Infrastructure Ireland (TII) over the last number of years in order to derive an approach for the development of Fassaroe which would be consistent with the Transport Strategy. This engagement culminated in the publication, by the NTA, of the Bray Study in 2019. Our recommendations, set out below, are based on the policies and principles of these documents, both of which should form the basis for the transport and land use planning elements of this application and EIAR.

It should be noted that the NTA is available for pre-planning consultation only via liaison with WCC.

2. NTA Comments on Planning Application File Reference 16/999

The main points in the NTA's submissions on the previous application for a large-scale development on the subject site may be summarised as follows:

- The existing Fassaroe Masterplan should be reviewed and that review should be accompanied by a comprehensive transport plan;
- The residential aspect of the proposed development was supported on the condition that appropriate provision is made for mitigation measures to address the impact on the national road network in accordance with the requirements of the *Spatial Planning and National Roads Guidelines*; and

- That permission should not be granted for the office component of the proposed development, pending the completion of a comprehensive transport plan for the overall Fassaroe area.

3. Bray and Environs Transport Study

Following the decision of An Bord Pleanála to refuse permission for planning application 16/999, NTA, TII, WCC and Dún Laoghaire Rathdown County Council (DLRCC) undertook to prepare a land use and transport study for the N/M11 Corridor. The Bray Study comprised a strategic examination of the land use proposals of WCC and DLRCC along the N/M11 corridor and sought to devise a suite of transport infrastructure and service proposals which would enable the development areas in the corridor to perform in a manner consistent with the Transport Strategy. In relation to Fassaroe, the study set out an approach to facilitating a level of development approximately commensurate with planning application 16/999 as follows:

Table 3.1 – Transport Requirements for Phase 1 of Fassaroe

Infrastructure or Service	Delivery Process	Work Commenced	Completed to a Standard to be Taken in Charge
Fassaroe Development Roads	Part of Planning Application	Prior to Occupation of any dwellings	Prior to Occupation of any dwellings
N11 Cycle and Pedestrian Bridge	Part of Planning Application	Prior to Occupation of any dwellings	Prior to Occupation of any dwellings
Traffic Management Measures at Fassaroe Interchange arising from the development	Wicklow County Council Traffic Management System Framework to be agreed with TII within 2 months of the agreement of the Bray Study .	Prior to Occupation of any dwellings	Prior to Occupation of any dwellings
New bus services in line with demand	Part of Planning Application with agreement of NTA	Phased introduction as dwellings are completed	n/a
Bus Priority on Upper Dargle Road including the approach to Sunnybank Junction	In conjunction with Phase 1(a) development	Prior to occupation of any dwellings	n/a – WCC Scheme
Bus priority on Dublin Road – Castle Street	Prior to occupation of 50% of Development	Prior to occupation of 100% of Development	n/a – WCC / NTA Scheme

In addition to the above, it was recommended that any application for the development of the Fassaroe lands demonstrates the following:

a) That the proposed development provides fully for walking and cycling trips to all local services within Fassaroe;
b) That the applicant will provide a bus service to Bray DART station in advance of demand justifying public investment as part of the expansion of the bus network under BusConnects;
c) That the applicant has fully assessed a requirement for a bus service to Bride's Glen or Cherrywood Luas and provides same if demand is deemed sufficient in advance of demand

justifying public investment as part of the expansion of the bus network under BusConnects; and

d) That the applicant demonstrates how demand for travel to schools from Fassaroe can be accommodated without undue recourse to the private car.

Further phases of the build out of these lands were recommended to be governed by a separate implementation and monitoring plan to be developed by Wicklow County Council with input from the NTA and TII. Whereby such a plan has been agreed with all agencies, the full build-out of Fassaroe could proceed on that basis. As the proposed SHD application provides for a quantum of development significantly in excess of that in the previous application, the NTA would expect that this implementation and monitoring plan is agreed with all parties in advance of an application being lodged and that it would be submitted as part of the application to An Bord Pleanála.

4. Key Transport Issues for the EIAR

It is assumed that, as part of the EIAR, the applicant will undertake a full Transport Assessment (TA) for the proposed development addressing all forecast travel demand by all modes within Fassaroe; between Fassaroe and Bray; and between Fassaroe and all other destinations. The NTA is of the view that this should incorporate the following:

a) A demonstration that the mode share for all trip purposes from the proposed development is in line with National policy. The mode shares that emerged as part of the Bray Study should be regarded by the applicant as a baseline and efforts should be made to achieve lower rates of car use;

b) A demonstration that the proposed development will not have adverse impacts on the carrying capacity of the N/M11 in its current configuration and as configured after the J4-J14 Upgrade scheme. This should be agreed with Wicklow County Council in consultation with TII in advance of an application being lodged, taking account of the transport requirements included in Table 3.1 above;

c) The full extent of physical works required to facilitate the sustainable operation of the proposed development and the mechanism for their delivery, including the financial implications for all relevant parties, in particular -
    - The manner in which public transport priority will be provided between Fassaroe and Bray DART Station, by agreement with the NTA and Wicklow County Council;

d) The full extent of public transport services required to facilitate the sustainable operation of the proposed development and the mechanism for their delivery, including their direct provision by the applicant by agreement with the NTA;

e) The manner in which public transport services proposed to serve Fassaroe would link with, and complement, those set out in the BusConnects Metropolitan Bus Network Review;

f) The manner in which pedestrians and cyclists travelling to Bray town centre, Bray DART Station and the proposed Dublin Road Core Bus Corridor will be catered for safely;

g) A comprehensive assessment of the cumulative impact of the proposed development with any further phases within Fassaroe; the full build-out of Old Conna; Woodbrook; Bray Golf Club; Cherrywood and a reasonable estimate of the potential development of the lands at Rathmichael in the longer term, as provided for by the Bray Study;

h) All roads and junctions must be designed in accordance with the NTA's National Cycle Manual and Permeability: A Best Practice Guide;

i) A Mobility Management Plan should be included covering all aspects of travel demand generated by the proposed development, demonstrating how car use will be minimised; and

j) All aspects of the assessment, as set out above, will be required to be undertaken for each phase of the proposed development, as appropriate.

5. Additional Considerations

It is further recommended that the submissions of the NTA and TII on planning application file reference 16/999 are reviewed alongside the detailed assessment of traffic and transport issues undertaken in the assessment of that application by An Bord Pleanála.

The NTA would also like to emphasise that the requirements of official Government policy in relation to the protection of the strategic function of the N/M11 must be met in order for the NTA to be satisfied that the proposed development is consistent with the Transport Strategy.

6. Summary

In summary, the NTA recommends the following be incorporated into the application and EIAR:

- The full recommendations of the Bray and Environs Transport Study, in particular
    - The Traffic Management System Framework to be agreed between TII and WCC for the development of c.650 units;
    - Implementation and Monitoring Plan for the development of Fassaroe beyond c. 650 units; and
- A comprehensive Transport Assessment covering all aspects of travel demand for each phase of the proposed development.

In the context of the collaboration already undertaken in relation to the development of the subject lands, NTA will forward a copy of these observations to Wicklow County Council and TII.

I trust that the views and recommendations of the NTA are taken into account in the preparation of this planning application and accompanying EIAR.

Yours sincerely

Michael MacAree

_____

Michael MacAree.
Head of Strategic Planning

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Luke Martin
Planner
RPS Group
Innishmore
Ballincollig
Co. Cork
P31 KR68

Dáta|Date	Ár dTag|Our Ref.
17 April, 2020	TI20-109196

Re: EIAR Scoping in relation to Proposed Strategic Housing Development at Fassaroe, Bray, Co. Wicklow

Dear Mr. Martin,

I acknowledge receipt of your email of 12 March, 2020, to my colleague Vincent O'Malley in TII's Environmental Policy and Compliance Section. Your query has been forwarded to TII Land Use Planning for response.

TII has previously advised RPS Group that all referrals and correspondence concerning planning related issues should be sent to the Land Use Planning Unit, Transport Infrastructure Ireland, Parkgate Business Centre, Parkgate St., Dublin 8, D08 DK10. Correspondence can also be referred electronically to landuseplanning@tii.ie.

TII recommends that you update your contacts/referrals records to reflect correspondence requirements in the interests of facilitating the Authority in responding promptly to any correspondence forwarded by RPS.

In relation to the EIAR Scoping referral, TII wishes to advise that it is not in a position to engage directly with planning applicants in respect to proposed developments. The Authority will endeavour to consider and respond to planning applications referred to it given its status and duties as a statutory consultee under the Planning Acts. The approach to be adopted by the Authority in making such submissions or comments will seek to uphold official policy and guidelines as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities (DoECLG, 2012). Regard should also be had to other relevant guidance available at www.tii.ie. It is expected that Wicklow County Council will similarly abide by the provisions of official policy in the first instance and An Bord Pleanála in the event of a Strategic Housing Development Application.

The issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid planning application referred.

1. **Recent Planning History**

TII would highlight that An Bord Pleanála determined to refuse permission for a previous development of the subject lands in November, 2017, under case reference. Pl27.248705 (Wicklow County Council planning file ref. 16/999 refers). A revised application will have to consider and address the reasons for refusal cited by the Board.

Próiseálann BIÉ sonraí pearsanta a sholáthraítear dó i gcomhréir lena Fhógra ar Chosaint Sonraí atá ar fáil ag www.tii.ie.
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2. Official Policy Context

The M/N11 corridor is a strategic road corridor of national significance providing access to the south east of the country, in addition to providing access to international markets for freight and tourist traffic through Rosslare Euro-port. The national primary road corridor is identified as part of the TEN-T Comprehensive Network. Such a designation has repercussions and action requirements for policies and objectives which should be considered in the preparation of an EIAR. The international dimension is reflected in the Eastern and Midland Assembly Regional Spatial and Economic Strategy (EMRA RSES) Regional Policy Objective RPO 8.16.

> RPO 8.16: *Support the improvement and protection of the TEN-T network to strengthen access routes to Ireland's ports, including investment in the ongoing development of the N11/M11 to improve connectivity to Rosslare and improvements to the Dublin-Wexford Rail line.*

More generally, the EMRA RSES also includes Regional Policy Objective 'RPO 8.11' which outlines the objective to support the improvement, and protection, of the EU TEN-T network...

Project Ireland 2040|National Development Plan, 2018 – 2027, outlines the investment priority to ensure that the existing extensive transport networks, which have been greatly enhanced over the last two decades, are maintained to a high level to ensure quality levels of service, accessibility and connectivity to transport users. Government also includes the objective to maintain the strategic capacity and safety of the national roads network, including planning for future capacity enhancements, in National Strategic Outcome 2 of the National Planning Framework.

The foregoing policy provisions have all been adopted in the intervening time since the last planning application was submitted to Wicklow County Council on the subject site and ultimately determined by An Bord Pleanála. The above should be reflected in the preparation of EIAR and any revised application.

3. The Bray and Environs Transport Study (2019)

Although not a party to the above appeal to An Bord Pleanála, TII collaborated with the NTA and Wicklow County Council on the preparation of the NTA's Bray and Environs Transport Study (2019).

The study was undertaken to identify a strategy to facilitate the land use objectives of Wicklow County Council and Dun Laoghaire – Rathdown County Council in relation to Bray, including Fassaroe, as provided for in statutory regional, county and local plans.

Development proposals prepared in relation to Fassaroe, Bray, should take full cognisance of and demonstrate adherence with the NTA Bray and Environs Transport Study (2019).

The Transport Study identifies a number of transport interventions required to facilitate development of Phase 1 of Fassaroe comprising 650 residential units and appropriate residential support facilities.

The required transport interventions include the agreement of a Wicklow County Council Traffic Management System Framework. The Council has not as yet finalised this Traffic Management System Framework for agreement with the Authority.

Development proposals in advance of such a framework being prepared and agreed have the potential to significantly impact on the safety and operation of the M/N11 strategic national road network and associated junctions in the vicinity. TII would therefore welcome Wicklow County Council finalising and agreeing the required Traffic Management System Framework, prior to the submission of any SHD application, in accordance with the requirements of the agreed Bray and Environs Transport Study.

In summary, there is a requirement at local policy level as well as regional and national policy to ensure that the strategic function of the M/N11 is safeguarded. Demonstration of the agreed completion and adherence

to the Transport Requirements for Phase 1 of Fassaroe included in the Bray and Environs Transport Study (2019) should be clearly provided for in any revised application. In TII's opinion, this includes Wicklow County Councils requirement to prepare and agree a Traffic Management System Framework which has not been finalised to date. TII has met with the Council on this matter and remains available to liaise with the Council and the NTA to assist in progressing this requirement.

4. Development Proposals above that provided for in Fassaroe Phase 1

The EIAR Scoping referral outlines proposals for the development of 1,084 residential units. The Bray and Environs Transport Study (2019) provides the pathway to the development of Fassaroe Phase 1 comprising 650 residential units and appropriate residential support facilities.

The Bray and Environs Transport Study sets out that further development, i.e. in excess of 650 residential units and appropriate residential support facilities, is recommended to be subject to the development of an implementation plan by Wicklow County Council in collaboration with NTA and TII.

TII is of the opinion that development above 650 residential units and appropriate residential support facilities is not provided for in the agreed Bray and Environs Transport Study (2019) in advance of the development of an implementation plan by Wicklow County Council in collaboration with NTA and TII. TII is not aware that the Council has undertaken such an implementation plan.

Similar to the advice above, TII is available to liaise with the Council and the NTA to assist in progressing this requirement, although it should be noted that no recent approach has been made to TII in relation to this matter.

Again, there is a requirement at local policy level as well as regional and national policy to ensure that the strategic function of the M/N11 is safeguarded. Demonstration of adherence to the Transport Requirements for Phase 1 of Fassaroe included in the Bray and Environs Transport Study (2019) should be clearly provided for in any revised application.

5. General EIAR Scoping Recommendations

In relation to general EIAR Scoping on the proposed Strategic Housing Development at Fassaroe, Bray, Co. Wicklow, TII has reviewed the EIAR Scoping document that accompanied your e.mail and provides the following further general observations for your consideration.

The developer should have regard, *inter alia*, to the following;

- Consultations should be had with the relevant Local Authority/National Roads Design Office with regard to locations of existing and future national road schemes;
    - In particular, regard should be had to N11 – M11 TEN-T Corridor Study. The M11 from Junction 4 M50 to Kilmacanogue Scheme is included as a Scheme in Pre-Appraisal/Early Planning in Project Ireland 2040|National Development Plan, 2018 – 2027,
- Consultations should be had with the relevant Local Authority/National Transport Authority with regard to locations of existing and future light rail schemes,
- The Authority would be specifically concerned as to potential significant impacts the development would have on the national road network (and junctions with national roads) in the proximity of the proposed development, i.e. existing M/N11. There are significant capacity issues which pertain to the M/N11 at this location.
- It would be required that a Traffic and Transport Assessment be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. The Authority's Traffic and Transport Assessment Guidelines (2014) should be referred to in relation to proposed development with potential impacts on the national road network. Having regard

to the nature of the proposed development and location, the TTA should be undertaken in accordance with the TII Traffic and Transport Assessment Guidelines (2014);
    - A mobility management plan should accompany the transport assessment,
    - Modal share targets (pre. and post light rail) should be outlined and how any PT modal share is accommodated in advance of light rail,
    - What measures that are proposed to reduce car dependency should be outlined,
    - Detailed phasing proposals of development with associated transport infrastructure provision is required,
    - Consider and address cumulative impacts of other development and impacts on limited national road capacity,
    - The traffic and transport assessment should consider all road users,
    - Mitigation measures should be aligned with phasing of road infrastructure improvements and required public transport interventions; all clearly outlined,
    - Demonstrate compliance with the requirements of the Bray and Environs Transport Study (2019).
- The developer should assess visual impacts from existing national roads.
- The developer should have regard to any EIS/EIAR and all conditions and/or modifications imposed by An Bord Pleanála regarding road schemes in the area. The developer should in particular have regard to any potential cumulative impacts.
- The developer, in conducting EIAR, should have regard to the TII Publications (formerly NRA DMRB and the NRA Manual of Contract Documents for Road Works).
- The developer, in conducting EIAR, should have regard to TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006).
- The EIAR should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (1st Rev., National Roads Authority, 2004)).
- The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required.
- In the interests of maintaining the safety and standard of the national road network, the EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network. Any works to the national road network are required to be undertaken in accordance with standards outlined in TII Publications. Structures crossing national roads, such as a pedestrian footbridge, are subject to separate approvals/agreements and TII Technical Acceptance in advance of development. Additionally, such works should not compromise future road improvement proposals at this location.
- TII recommends review of the Authority's observations submitted in relation to Wicklow County Council planning application ref. 16/999.
- The Board decision and associated Inspectors Report in relation to file ref. 16/999, An Bord Pleanála case ref. Pl27.248705, should be reviewed.

Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practise.

I hope that the above comments are of use in your scoping process.

In the interests of clarity, the issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid planning application referred.

In the context of the collaboration already undertaken in relation to the development of the subject lands, TII will forward a copy of these observations to Wicklow County Council and the National Transport Authority. A copy will also be forwarded to the Strategic Housing Unit of An Bord Pleanála.

Yours sincerely,

_____

Tara Spain
Head of Land Use Planning

From: Morgan O'Reilly <Morgan.OReilly@housing.gov.ie>
Sent: Wednesday 18 March 2020 15:04
To: Luke Martin
Cc: qcsofficer
Subject: Strategic Housing Development EIA Scoping

CAUTION: This email originated from outside of RPS.

Hi Luke,

Following on from our discussion earlier, and in response to your query of 12 March, under section 30 of the Planning and Development Act 2000, as amended, the Minister for Housing, Planning and Local Government is specifically precluded from exercising power or control in relation to any particular case with which a planning authority or An Bord Pleanála is or may be concerned. As a consequence, it would be inappropriate for the Minister to comment on the EIA Scoping report, received by the Department in softcopy on 13 March.

We will be noting your correspondence, of course, and we thank you for your efforts in seeking our opinion. We would also ask you to ensure that all other relevant prescribed bodies are contacted in relation to this pre-application consultation phase.

Kind regards
Morgan

Morgan O Reilly
EU and International Planning Regulation, Planning Division

An Roinn Tithíochta, Pleanála agus Rialtais Áitiúil
Department of Housing, Planning and Local Government

Teach an Chustaim, Baile Átha Cliath 1. D01 W6X0
Custom House, Custom House Quay, Dublin D01 W6X0

T (+353) 1 8882710

www.tithiocht.gov.ie www.housing.gov.ie

****
Is faoi rún agus chun úsáide an té nó an aonán atá luaite leis, a sheoltar an ríomhphost seo agus aon comhad atá nasctha leis. Má bhfuair tú an ríomhphost seo trí earráid, déan teagmháil le bhainisteoir an chórais.

Deimhnítear leis an bhfo-nóta seo freisin go bhfuil an teachtaireacht ríomhphoist seo scuabtha le bogearraí frithvíorais chun víorais ríomhaire a aimsiú.

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APPENDIX 2A

Confirmation of Agreement from NTA to Public Transport Access Strategy

Subject: FW: NTA Feedback - Fassaroe PTAS

From: David Clements [mailto:David.Clements@nationaltransport.ie]
Sent: 17 January 2022 13:16
To: Michael Flynn
Cc: Michael MacAree
Subject: NTA Feedback - Fassaroe PTAS

Hi Michael,

We reviewed the PTAS for Fassaroe and have the following comments:

- NTA are satisfied with the overall approach to bringing bus services through Fassaroe;
- For Phase 1, this can be achieved either by diverting the 185 (L15) as proposed, or more amenably, by the provision of an additional service to meet demand from Fassaroe specifically without running services on to Enniskerry;
- The applicant / WCC will be required to identify a turning / layover area in Fassaroe for 2 buses for Phase 1. This will need to be expanded in later phases as additional services and higher frequencies come on stream;
- For later phases, the NTA is satisfied that the approach proposed is broadly consistent with the Bray and Environs Transport Study and, in the context of the emerging Transport Strategy Park & Ride proposals for Fassaroe, can deliver the public transport services required;
- The above is based on the condition that other measures as agreed previously by NTA, TII and WCC (titled N11 Junction 6 Traffic Management Framework Agreement) are in place which will encourage the use of sustainable transport modes and protect the capacity of the N11;
- The above comments relate to the Public Transport elements of the application only and the NTA reserves the right to submit observations and recommendations on all other aspects of any planning application which may come forward for development at Fassaroe, as they relate to impacts on transportation.

I have told Peter Foley of Atkins that our feedback has been sent to WCC and that if another meeting is required, we can attend.

Regards,
David

Tá eolas sa teachtaireacht leictreonach seo a d'fhéadfadh bheith príobháideach nó faoi rún agus b'fhéidir go mbeadh ábhar rúnda nó pribhléideach ann. Is le h-aghaidh an duine/na ndaoine nó le h-aghaidh an aonáin atá ainmnithe thuas agus le haghaidh an duine/na ndaoine sin amháin atá an t-eolas. Tá cosc ar rochtain don teachtaireacht leictreonach seo do aon duine eile. Murab ionann tusa agus an té a bhfuil an teachtaireacht ceaptha dó bíodh a fhios agat nach gceadaítear nochtadh, cóipeáil, scaipeadh nó úsáid an eolais agus/nó an chomhaid seo agus b'fhéidir d'fhéadfadh bheith mídhleathach.
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APPENDIX 2B

Construction Environmental Management Plan

ATKINS

Member of the SNC-Lavalin Group

Fassaroe Phase 1 Strategic Housing Development

Construction Environmental Management Plan

Cosgrave Property Group

April 2022

Notice

This document and its contents have been prepared and are intended solely as information for Cosgrave Property Group and use in relation to the proposed Fassaroe Phase 1 Strategic Housing Development.

WS Atkins Ireland Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 79 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 0	Draft for Comment	KL	KL			01/09/2021
Rev 1	Planning	KL/AMC	JL	DL	PF	06/04/2022

Client signoff

Client	Cosgrave Property Group
Project	Fassaroe Phase 1 Strategic Housing Development
Job number	5186693
Client signature / date	

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List of Acronyms

The following list of abbreviations have been used within this document;

- ABP - An Bord Pleanála
- AOD - Above Ordnance Datum
- BRE - Building Research Establishment
- C&D - Construction and Demolition
- CEMP - Construction Environmental Management Plan
- ECoW- Ecological Clerk of Works
- EIAR – Environmental Impact Assessment Report
- EPA - Environmental Protection Agency
- ERP – Emergency Response Plan
- GSI - Geological Survey of Ireland
- HEMP - Handover Environmental Management Plan
- IFI - Inland Fisheries Ireland
- mBGL - meters below ground level
- NIS - Natura Impact Statement
- NPWS - National Parks and Wildlife Services
- PSCS - Project Supervisor for the Construction Stage
- PSDP - Project Supervisor for the Design Process
- SAC - Special Area of Conservation
- SPA – Special Protection Area
- SuDS - Sustainable Drainage System
- WCC – Wicklow County Council

1. Introduction

1.1. Overview

This Construction Environmental Management Plan (hereafter referred to as CEMP) has been prepared by WS Atkins Ireland Ltd. (Atkins) on behalf of Cosgrave Property Group (the applicant) as part of the supporting documents required for a planning application for a proposed residential development at Fassaroe, Bray Co. Wicklow.

Cosgrave Property Group are applying to An Bord Pleanála (ABP) for permission for a Strategic Housing Development comprising of the construction of 650no. residential units comprising a mix of apartments and houses along with a neighbourhood centre, a crèche, a district park, local parks, the diversion and rerouting of ESB electricity lines, a distributor road connecting to Ballyman Road, a new pedestrian / cycle route across the N11 connecting to Dargle Road, historic landfill remediation works, landscaping works, parking facilities, ancillary services and facilities and associated site development works, on predominantly agricultural lands in the administrative areas of Wicklow County Council. The proposed development is situated on a ca. 80.16 hectares (ha) parcel of land, to the west of Bray Town Centre. The proposed maximum height of the apartment blocks will be ca. 5no. storeys. The site location is presented in Figure 1.1.

The proposed Phase 1 lands are the subject of this Strategic Housing Development (SHD) application to ABP and are hereafter also referred to as 'the Site', or the 'proposed development'. A detailed development description and further details are presented as part of the planning documents and drawings submitted for this planning application.

1.2. Purpose of CEMP

The purpose of this CEMP is to provide recommended measures to avoid, minimise and control adverse environmental impacts associated with the construction of the proposed project. The CEMP will document the commitment to safeguarding the environment through the identification, avoidance and mitigation of the potential negative environmental impacts which are associated with the proposed development.

The works Contractor will undertake the works in accordance with the provisions of the CEMP. This may be added to, to address other detailed construction matters. The CEMP will be updated by the Contractor to address any subsequent planning conditions relevant to the proposed development.

The CEMP aims to define good practice as well as specific actions required to implement mitigation requirements as identified in the following environmental reports and documents reviewed by Atkins:

- Atkins, 2022 Fassaroe Planning Application Flood Risk Assessment;
- Atkins, 2022 Resource and Waste Management Plan;
- RPS 2018 Fassaroe Historic Landfills Environmental Risk Assessment (Volume 3 Part 3 of the EIAR);
- RPS 2022 Gas Management Strategy Fassaroe Historical Landfill (Included in the Remediation Strategy Report);
- RPS 2022 Fassaroe Phase 1 Development Remediation Strategy Report (Volume 3 Part 3 of the EIAR);
- RPS, 2022 Japanese Knotweed Management Plan;
- RPS, 2022. Fassaroe Phase 1 Strategic Housing Development Environmental Impact Assessment Report - Volume 1 EIAR Document;
- RPS, 2022. Fassaroe Phase 1 Strategic Housing Development Environmental Impact Assessment Report - Volume 2 EIAR Document; and,
- RPS, 2022. Fassaroe Phase 1 Strategic Housing Development Screening for Appropriate Assessment and Natura Impact Statement (NIS).

The party responsible for the preparation of the CEMP is likely to change over the lifecycle of a project. In the absence of Irish guidelines, the relevant UK guidelines (LA 120 Environmental management, March 2020) in relation to the preparation of CEMPs has been applied to this document.

1.3. Structure

This CEMP has been structured as follows:

- **Section 1** outlines the purpose of the CEMP and introduces the proposed development/project;
- **Section 2** describes in detail the proposed development/project;
- **Section 3** outlines the minimum standards, legislation and guidance required of the Contractor during the development of the CEMP;
- **Section 4** identifies the relevant roles and responsibilities for developing, implementing, maintaining and monitoring environmental management;
- **Section 5** sets out the mechanisms through which environmental requirements would be managed;
- **Section 6** sets out the general requirements to of the CEMP.
- **Section 7** provides a summary of minimum requirements that should be implemented by the Contractor; and
- **Section 8** sets out the procedures for the Emergency Response Plan.

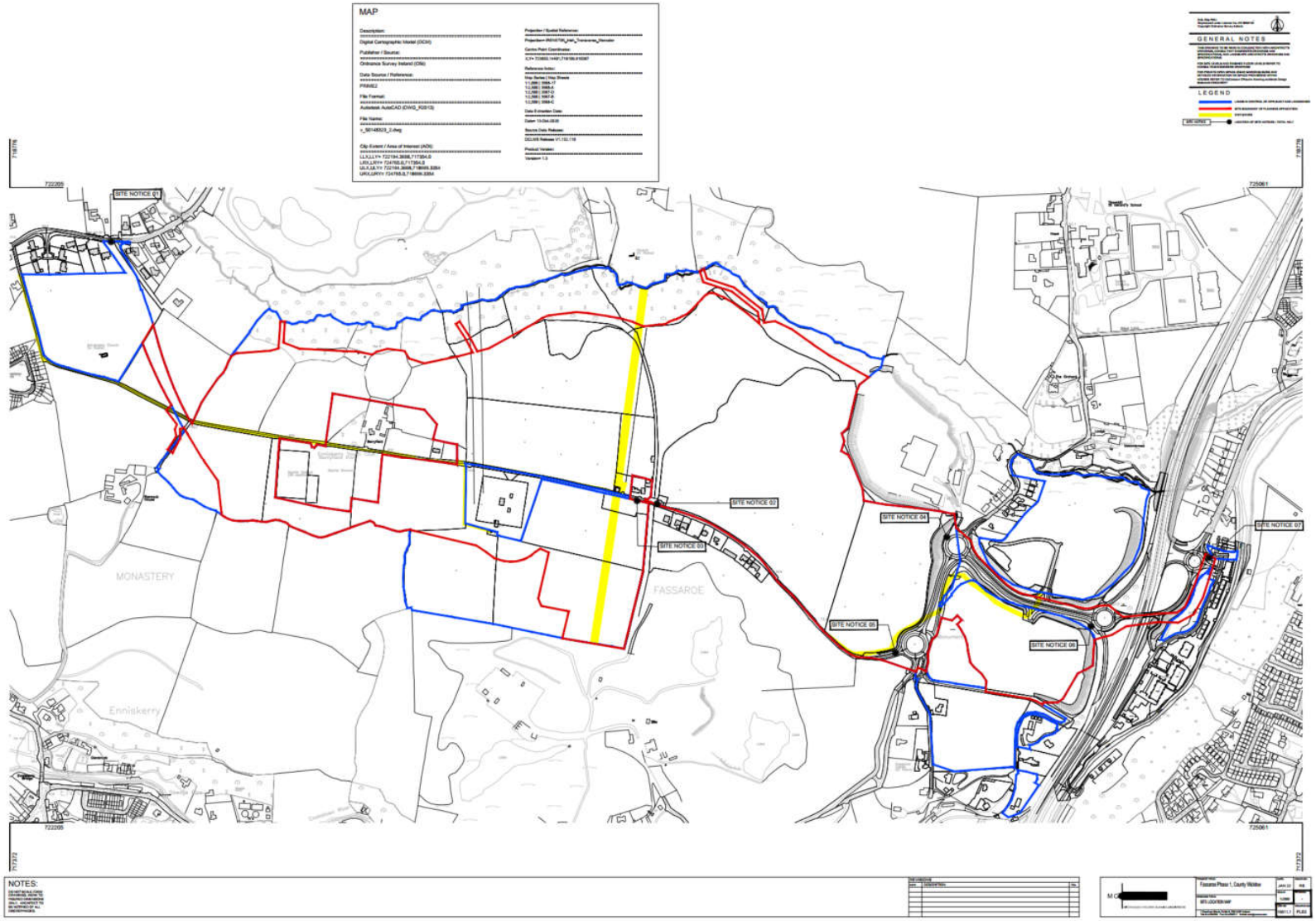

Figure 1.1 - Site Location

2. The Proposed Development

2.1. Site History & Surrounding Land Use

The proposed development site is located within predominantly agricultural lands, a combination of arable crops, vegetable crops and grassland, in Fassaroe to the west of Bray, Co. Wicklow as shown on Figure 1.1. There are 5no. historic landfill locations within the development, known as Site 1, Site 2, Site 3A, Site 3B and Site 3C which were used from the early-1970s to the early-1990s. The landfill operations ceased in the early 1990s, where the landfills were sequentially covered in topsoil and returned to agricultural use. The historic landfill areas are now very overgrown with grass and other rough vegetation present with no waste noted on the surface.

Four of the landfills (Site 2, Site 3A, Site 3B and Site 3C) are now authorised under Certificates of Authorisation (CoA) granted by the Environmental Protection Agency (EPA) to Wicklow County Council in November 2019. The fifth site, Site 1 does not fall under the CoA requirements. However, its remediation is being treated in the same manner as that authorised for the other 4no. landfills sites.

While Sites 2, 3A, 3B and 3C are located in lands owned by Cosgrave Property Group, Wicklow County Council as the CoA holder, is responsible for the remediation and ongoing monitoring of these sites and for ensuring the conditions of the Certificates of Authorisation are complied with.

As per RPS (2022) Historic Landfill Remediation Strategy Report *'agreement has therefore been obtained by Cosgrave Property Group from Wicklow County Council to include the capping of the landfills within the proposed Phase 1 development as it is acknowledged that the remediation of the sites in accordance with the Certificates of Authorisation is intrinsically linked to the future use of the sites post-development'.*

The proposed development site is zoned within a number of land use zoning objectives as per the development plan as follows:

- *PU Public Utility: To maintain lands providing services infrastructure;*
- *NC Neighbourhood Centre: To protect, provide for, and improve a mix of neighbourhood centre services and facilities, which provide for the day-to-day needs of the local community;*
- *Community & Education: To provide for civic, community and educational facilities;*
- *AOS Active Open Space: To protect and enhance existing and provide for new active open space;*
- *OS1 Open Space: To protect and enhance existing and provide for recreational open space;*
- *OS2 Open Space: To protect and enhance existing open, undeveloped lands;*
- *E1 Employment: To provide for the development of enterprise and employment;* and,
- *R-HD New Residential-High Density: To protect, provide and improve residential amenities in a high density format.*

There are 3no. existing Irish Water watermains located within the boundary of the proposed development site, as follows:

- 33" watermain running north south through the centre of the site;
- 24" watermain also running generally north south through the eastern side the site; and,
- 800mm dia interconnector watermain crossing from west to east along Berryfield Lane between the existing 33" and 24" watermains.

The land form generally falls from ca. 100mOD in the west to ca. 30mOD to the east of the site. The site is bounded to the east by the N11, to north east by Greenstar recycling centre, to the north by woodland / scrubland and Ballyman Glen, to the south by agricultural lands and a Roadstone quarry to the south east and the west by agricultural lands and residential dwellings.

2.2. Proposed Development

The proposed development site is located in predominantly agricultural lands in Fassaroe to the west of Bray, Co. Wicklow. The various elements of the application include:

- Road link (2.4km) connecting N11 to Ballyman Road (with westerly connection to Ballyman Road already in place).
- Pedestrian / cycle route including bridge across the N11 to Dargle Road Upper.
- 15.3ha of District Park / Active Open Space.
- 650 no. residential units comprising 241 no. houses and 409 no. apartments.
- 3 No. pocket park areas comprising a total of 0.43ha.

- 733sq.m approx. crèche with capacity for approx. 138 no. childcare spaces.
- Retail unit / kiosk (108sq.m.) in district park.
- Neighbourhood Centre Phase 1 comprising:
    - 1,035sq.m. retail
    - 360sq.m. café
    - 480sq.m community concierge (serving entire Fassaroe community)
    - 414sq.m. residential ancillary uses for residents of the neighbourhood centre apartments (residents lounge 256sq.m., residents gym 90sq.m., and residents concierge 68sq.m.)
- Demolition of an existing dwelling at Berryfield Lane.
- Rerouting and undergrounding of overhead ESB lines (110kV and 38kV lines) across site and into existing ESB Substation.
- Site development / ground works on future development areas to ensure sustainable cut and fill balances across the lands
- Water supply, foul and surface water drainage proposals.
- Provisions for public bus services in line with demand towards Bray (DART and Bray bus interchange) and towards the Luas at Cherrywood / Brides Glen.
- Remediation of 5 no. historic landfill sites in line with Certificates of Authorisation issued to Wicklow County Council by the EPA in 2019.

Refer to Figure 2.1 for the proposed site layout. Further details of the proposed development and proposed site layout are included within Chapter 2 of the Environmental Impact Assessment Report (EIAR) being submitted as part of this planning application.

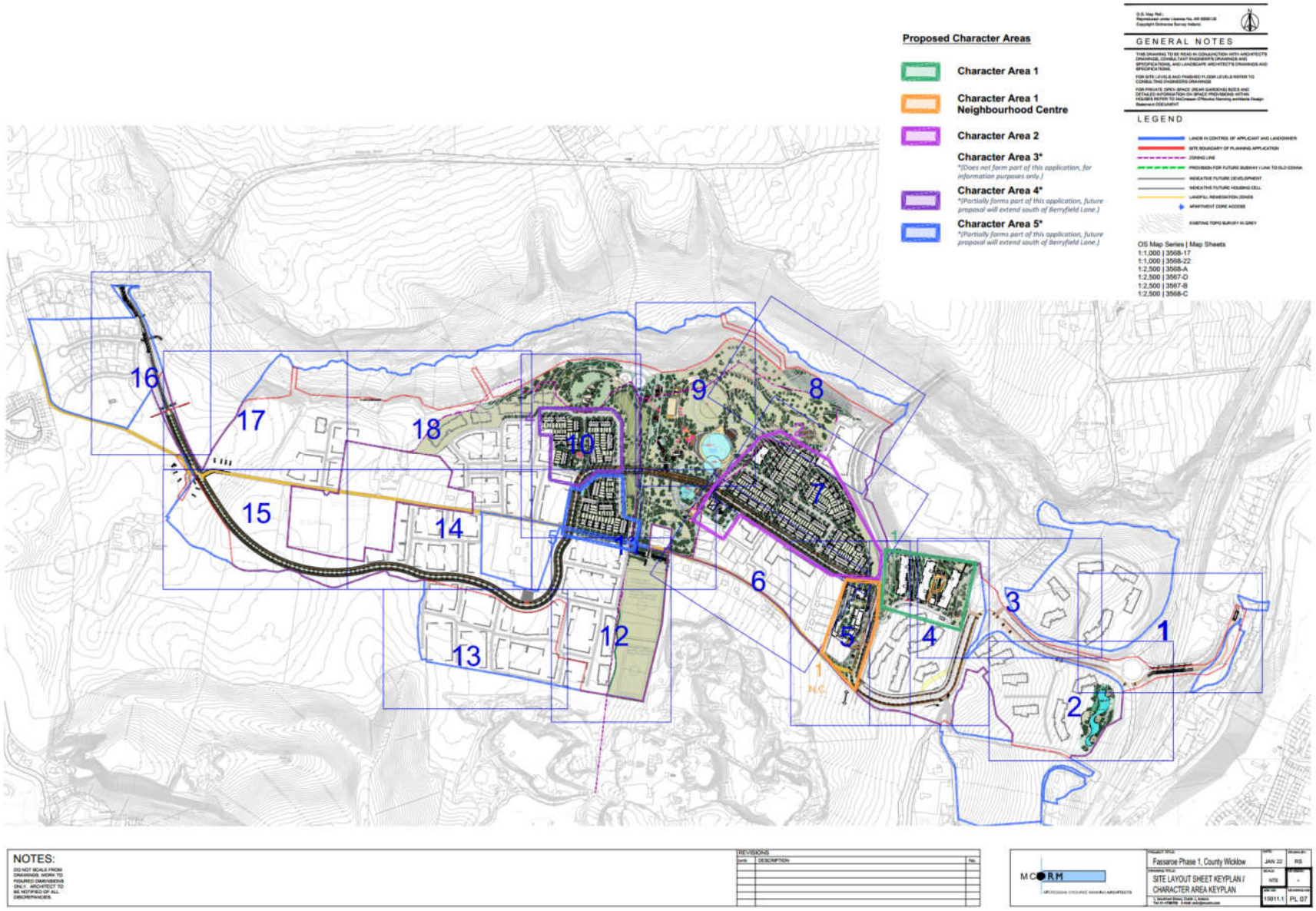

Figure 2-1 - Proposed Site Layout

An existing single storey bungalow is to be demolished as part of the proposed development. Refer to Figure 2.2.

The proposed development will be constructed in 2no. phases; Phase 1a and Phase 1b, as follows:

- Phase 1a Development will involve the following:
  - Site development works including the main spine road linking the development with the existing roads to the east towards the N11 and to the west towards Ballyman link Road;
  - Residential - 296 units consisting of 144 apartments and 152 dwellings; and,
  - District Park including remediation of landfill.
- Phase 1b Development will involve the following:
  - Neighbourhood Centre; and,
  - Residential - 354 units including 265 apartments and 89 dwellings.

The preliminary indicative construction programme is set out in Table 2.1. The construction periods are expected to overlap. A detailed construction programme will be developed once a contractor has been appointed, and construction methodologies and other factors are taken into consideration.

The general sequencing / phasing of works at the site will be as follows:

- Secure site boundaries with temporary fencing;
- Establish contractors' compound(s);
- Demolition works;
- Commence construction of proposed new main access road from the eastern side of the site to the western side of development areas, as far as the ESB substation (including provision for rerouted 38kV ESB lines) – including all associated roadside landscaping, drainage and utilities;
- Commence construction of new tower structures and underground route for rerouted twin 110kV lines, and for rerouted 38kV line;
- Commence landfill remediation works at Landfill Sites Nos. 1 & 2 (including provision for rerouted 38kV ESB lines);
- Commence construction of Phase 1a residential zone;
- Continue construction of western end of distributor road to Ballyman Road (including works to and remediation of landfill Site Nos. 3A, 3B and 3C);
- Complete remediation of Landfill Site Nos. 1 and 2 and set out as District Park;
- Construct Kiosk in Creche;
- Complete ESB diversion works and decommission existing;
- Complete remediation of Landfill Site Nos. 3A, 3B and 3C and Link Road;
- Continue / complete Phase 1a development;
- Commence Phase 1b including construction of Creche; and,
- Continue / complete Phase 1b including Neighborhood Centre.

Table 2-1 - Outline Construction Programme

Development Element	Approximate Duration	Approximate Timeline
Site Development Works, Distributor Road Construction	12 months	Q3 2022 – Q3 2023
Landfill Remediation, associated landscaping, district park, ESB Diversions	16 months	Q4 2022- Q1-2024
Phase 1a Residential	16 months	Q1 2023 – Q2 2025
Phase 1b Residential	14 months	Q1 2024 – Q2 2025
Neighbourhood Centre	12 months	Q2 2025 - Q3 2026

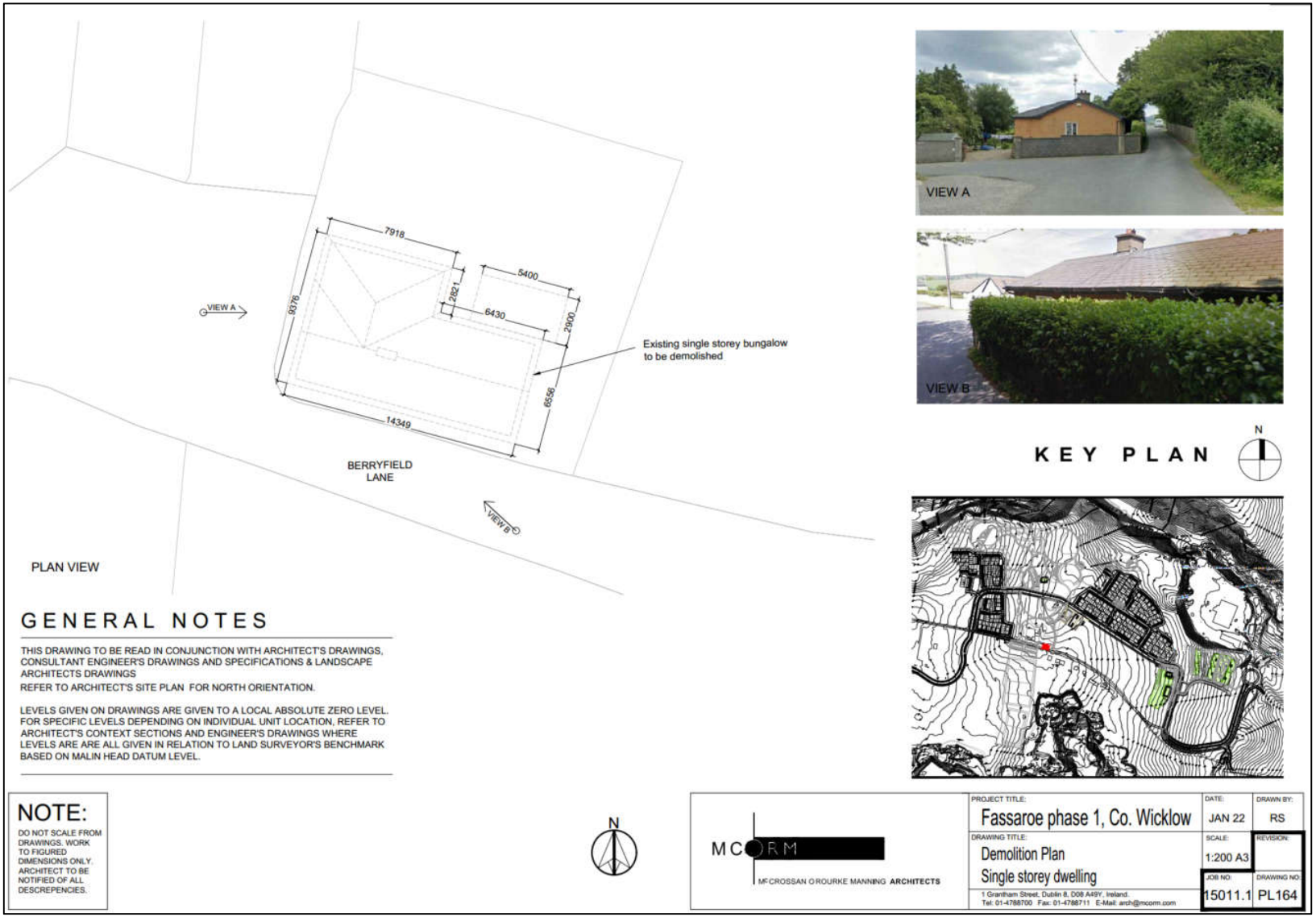

Figure 2-2 - Demolition Plan of the proposed development

2.3. Key Stages

The proposed development will involve the following key work phases:

- Tender Stage;
- Procurement and appointment of successful Tenderer(s) (hereafter referred to as The Contractor);
- Detailed Design Stage;
- Site preparatory works including the preparation of all required Detailed Safety and Health, and Environmental Management documents;
- Site mobilisation;
- Demolition Stage;
- Construction Stage;
- Completion; and,
- Operational Stage.

Details of machinery to be used on site are unknown at this time, but are likely to be standard site equipment including tracked excavators, dumpers, bulldozers etc.

2.4. Environmental Constraints

This section summarises the receiving environment along with key environmental factors (at this preliminary juncture) that should be considered during the construction phase.

2.4.1. Noise

The following is obtained from RPS (2022) EIAR Chapter 9 Noise and Vibration:

'The existing edge of the built-up area of Bray environs is located immediately to the east of the N11. Powerscourt Demesne is located c. 2km to the southwest. Dun Laoghaire Golf Club is located on elevated lands to the northwest of the site, accessed from Ballyman Road. The surrounding noise environment comprises of traffic noise from the N11 national road, Berryfield Lane and Ballyman Road, Starrus Eco Waste Transfer Facility, Roadstone Quarry and Fassaroe 110 kV substation. There are a small number of dwellings in the vicinity of the proposed development. These consist of one of dwellings along Berryfield Lane and Kilbride Lane with larger built-up areas at Monastery Grove and off Ballyman Road'.

Refer to Chapter 9 Noise and Vibration of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.2. Air Quality and Climate

The following is obtained from RPS (2022) EIAR Chapter 8 Air Quality and Climate :

'There are a number of residential clusters in the area which are most sensitive to changes in air quality in the area. These include those at Thornhill Road adjacent to the waste recovery facility in the northeast; along Kilbride Lane in the southeast; and along Berryfield Lane which runs east west through the site and connects to the Ballyman Road in the west. There are a number of small businesses located within the residential clusters at Thornhill Road and Berryfield Lane. Other key sensitive receptors in the area include the Enniskerry Football Club to the west of the development.

The key non-human receptor in the area with potential sensitivity to air quality impacts is the Ballyman Glen which is a designated as a Special Area of Conservation (SAC) (Site Code 000713). The features of interest within the site are Petrifying springs with tufa formation (Cratoneurion) and Alkaline fens. This site lies partially within and adjacent to the northern boundary of the site'.

Dust arising from the excavation and importation of soil to the proposed site, along with vehicle movement as well as emissions from construction vehicles and plant will contribute to reduced air quality. Some activities including infilling of soil, excavation of trenches, stockpiling and movement of materials, and construction vehicle movements may all contribute to generating ambient dust.

Refer to Chapter 8 Air Quality and Climate of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.3. Soils and Geology

The following is obtained from RPS (2022) EIAR Chapter 6 Soil, Geology and Hydrogeology:

'The Teagasc soil maps (GSI 2021) indicate that the soil underlying the proposed Site comprises of shallow well drained mineral (mainly basic) soils. Alluvial soils associated with the Ballyman Glen and the County Brook stream to the north of the site. The GSI quaternary sediments maps (GSI 2021) indicate that the superficial deposits beneath the site are gravels derived from limestone. Alluvium is indicated along the Ballyman Glen to the north of the site. The access road to the east of the site also crosses an area of alluvium. A number of site investigations were conducted at and near the proposed development site over the last 20 years. Based on the data from these site investigations, the thickness of overburden across the site extends to >25m bgl but becomes shallow to the east near the N11/M11 where bedrock is encountered at 5.6m. The published maps do not indicate any occurrences of landslide events within the site.

Published geology shows that the proposed Site is underlain by the Maulin formation with a small portion of the proposed Site to the south east adjacent to the N11 underlain by the Glencullen River. The development site is predominantly located within the Enniskerry Delta GHS (IGH Theme 1: IGH7). The major aquifers underlying The Site are part of the broader Enniskerry Gravels Aquifer and Wicklow Bedrock Aquifer and these have been generally classified by the GSI as a Locally Important (Ll) Aquifers. The Site is classified as having a 'High' aquifer vulnerability which indicates that the soil cover is >3.0m of high to medium permeability soil at the site, given by the cohesive and granular deposits (Gravels subsoil) which overlay the bedrock aquifer.

The site is generally underlain by topsoil, glacial till, and gravels. Bedrock is present at depths ranging from ca 6m bgl towards the east of the site to < 25m bgl to the west of the site. Bedrock generally comprises shale. 5no historic were recorded on site with waste encountered to depths of ca. 16m bgl.

There is one landslide event noted immediately east of the development site. This is recorded as an undetermined event adjacent to the River Dargle (GSI 2022) and is outside the site boundary'.

Refer to Chapter 6 Soil, Geology and Hydrogeology of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.4. Ecology

The following is obtained from RPS (2022) EIAR Chapter 5 Biodiversity:

'There are 14no. European sites within 15km of the proposed project; 8no. Special Areas of Conservation (SACs) and 4no. Special Protection Areas (SPAs). The northernmost boundary of the site is within and directly adjacent Ballyman Glen SAC (Site Code: 000713). The closest SPA to the site boundary is Wicklow Mountains SPA (NPWS Site Code: 004040), located approximately 4.2km to the west and south-west of the site.

There are 17no. proposed Natural Heritage Areas (pNHAs) within 10km of the proposed project; 8no. of which are encompassed within SACs and 9no. of which are additional sites. Ballyman Glen pNHA (Site Code: 000713) is located within and adjacent to the project site.

The nearest surface water receptor to the proposed development area is the County Brook (Fassaroe Stream) which flows through Ballyman Glen SAC, (referred to as the County Brook stream by the EPA). The County Brook is located approximately 40m north of the landfill remediation and public park proposed works at the nearest point (the proposed three surface water outfalls extend to the stream). It is noted that the County Brook (Fassaroe Stream) is not included as a qualifying interest of the Ballyman Glen SAC designation.

The proposed site is located ca. 2.6km to the west of the Irish Sea. As such, a number of protected wetland and waterbirds, including marine bird species have been recorded within the vicinity of the proposed site'. During the site walkovers a number of bird species were recorded on site, including (but not limited to); Greenfinch (Carduelis chloris), Swallow (Hirundo rustica), Buzzard (Buteo buteo) and Woodpigeon (Columba palumbus).

'Bat activity was noted throughout the study area during activity transect surveys conducted in 2014, 2019 and 2021. Species recorded include soprano pipistrelle (Pipistrellus pygmaeus), common pipistrelle (P. pipistrellus), Leisler's bat (Nyctalus leisleri), brown long-eared bat (Plecotus auritus) and whiskered bat (Myotis mysticanus). Most of the activity was of pipistrelles, which were recorded along Berryfield Lane, along hedgerows, in farmyards and around houses. No trees within the study area were being used as roost sites during the course of the surveys undertaken between 2015 and 2021.

During the course of the site surveys undertaken between 2015 and 2021, 3no. Badger setts were reported outside of the site boundary; One of the setts is a main sett, while the other two are annexe setts. Badger activity was recorded in heavy scrub in Ballyman Glen during the course of the survey undertaken in 2015. No evidence of badger was recorded within Ballyman Glen SAC during the surveys undertaken in 2016, 2019 and 2021, however, one badger dropping was recorded on the boundary of Ballyman Glen at the northern site boundary in 2019.

Badger prints were recorded within field boundaries across the proposed development area during the course of the badger survey undertaken in 2015. A lower level of badger activity signs was recorded during the course of surveys undertaken in 2016, 2019 and 2021, with evidence of activity limited to tracks and badger hair recorded at two hedge banks on the southern site boundary.

Overall, the evidence gathered during the course of the surveys undertaken between 2015 and 2021 suggest that the site forms part of the territory of the local badger population, however the level of badger activity evidence across the site was relatively low.

No evidence of otter was observed during the site survey undertaken in December 2016. However, there had been heavy rain in the week previous to the survey which may have washed evidence away. One otter spraint was recorded adjacent to a footbridge within Ballyman Glen during the course of surveys undertaken in 2021. Otters forage and commute along the County Brook and there is potential that this species may shelter within areas of scrub/woodland within Ballyman Glen.

Deer prints were observed in Ballyman Glen during the site surveys undertaken in 2016, 2019 and 2021.

No signs of pine marten were observed during the field surveys undertaken in 2016, 2019 and 2021, but it is possible that this species would use Ballyman Glen for foraging and shelter.

No signs of red squirrel were observed during the field surveys undertaken in 2016, 2019 and 2021, but it is possible that this species would use Ballyman Glen for foraging and shelter'.

During the course of the site surveys in June 2021, four stands of Japanese knotweed (*Fallopia japonica*) were recorded within the north of the site in an area of scrub and there are also stands further east within the site at its northern boundary which are located within the historic landfills. Japanese knotweed is classified as a 'high impact' invasive species and is listed in the Third Schedule European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). Butterfly Bush and Traveller's Joy were also identified within the site boundary, which are both listed as being of 'Medium Impact' but are not listed in the Third Schedule European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011).

Refer to Chapter 5 Biodiversity of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.5. Hydrology and Water Services

The following is obtained from RPS (2022) EIAR Chapter 7 Hydrology, Flood Risk and Water Services:

'The Site is located within the former Eastern River Basin District (now the Irish River Basin District), as defined under the European Communities Directive 2000/60/EC, which establishes a framework for community action in the field *of water policy – this is commonly known as the Water Framework Directive (WFD). The proposed development site is located in the Irish River Basin District and the Dargle WMU (Water Management Unit).*

There are three (3) no. watercourses within the vicinity of The Site:

- *Country Brook waterbody (IE_EA_10D010250) located along the northern boundary.*
- *Glencullen waterbody (IE_EA_10G020500) located approx. 0.61 km to the south of The Site.*
- *Dargle waterbody (IE_EA_10D010250) located approx. 0.23 km to the east of The Site.*

The northern site boundary is bordered along the County Brook River (Fassaroe Stream) (EPA Name: County Brook), which flows eastwards where it flows in to the Dargle River and flows into St. Georges Channel and into the Irish Sea. The Dargle River is a registered salmonid river under the Salmonid Regulations (S.I. 293). The Dargle River catchment forms part of the Eastern River Basin District.

The northern site boundary is bordered along the County Brook River (Fassaroe Stream) (EPA Name: County Brook), which flows eastwards where it flows in to the Dargle River and flows into St. Georges Channel and into the Irish Sea. The Dargle River is a registered salmonid river under the Salmonid Regulations (S.I. 293). The Dargle River catchment forms part of the Eastern River Basin District.

The site is underlain by thick permeable subsoil and as a result the drainage density is low and there are very few field drains in the area and no ponds or tributaries to the County Brook River (Fassaroe Stream). Emergences of springs and seepages are evident in the riparian zone along the County Brook River (Fassaroe Stream).

These springs feed the alkaline fen and tufa deposits. The spring flows which are relatively small coalesce downhill to form a more defined channel.'

Refer to Chapter 7 Hydrology, Flood Risk and Water Services of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.6. Flood Risk

A Stage 1 Flood Risk Assessment was carried out by Atkins (Atkins, 2022) and is being submitted to support this planning application. '*The Stage 1 flood risk assessment was completed in accordance with The Guidelines and the following conclusions can be drawn;*

- *'There is no historic risk of flooding within the development site.*
- *The OPW CFRAM flood extent maps studies have not been carried out in the area of the site and therefore do not show any flood risk at the site.*
- *The NIFM illustrates that fluvial flooding for the 1 in 100 year event from the County Brook is contained within the steep valley of the watercourse beyond the northern boundary of the site.*
- *On the basis of the NIFM and the topographical surveys undertaken, the site is considered to be located within Zone C, low probability of flooding.*
- *Given that the proposed development site is located in Zone C, low probability of flooding, is thus appropriate from a flood risk perspective subject to the completion of this FRA which considers other sources of flood hazard than river flooding and subject to it meeting the normal range of proper planning and sustainable development requirements.*
- *Given that the proposed development is located in Zone C and is appropriate development, consideration of the Justification Test is not required.*
- *The proposed development is not at risk of flooding from the 1% AEP event'.*

2.4.7. Landscape and Visual Impact

The following is obtained from RPS (2022) EIAR Chapter 10 Landscape and Visual Impact:

'The Fassaroe lands are located to the west of Bray and the N11. The area is mostly greenfield, but the landscape can be described as peri-urban in character, in that the farmland is interspersed with a mix of urban-generated development typical of areas surrounding an urban centre (e.g. the houses on Berryfield Lane, the quarry, waste processing plant, soccer club and substation).

The lands were zoned for development in the 1999, 2004, 2010 and 2016 (current) Wicklow County Development Plans, and the Bray Environs Local Area Plan (LAP) 2009. The current plan for the area is the Bray Municipal District Local Area Plan 2018-2024 (the 'Bray MD LAP 2018'), in which Fassaroe is identified as Action Area Plan 1 (AAP1) regarding which the LAP states (p.58): *"Fassaroe is identified as the location of major development in Bray; the growth of the settlement in accordance with regional plan targets is contingent on the delivery of the major residential and community services development at this location, there being no other suitable lands in the environs of Bray for such large scale development"*.

'The majority of the Fassaroe area is in agricultural use, with relatively large, irregularly shaped fields variously divided by hedgerows or fences. The other land uses include the quarry, the waste treatment facility, sports club and three clusters of residential and commercial use:

- *One of these, comprising several houses and two business premises, is located in the north east of the lands along Thornhill Road near the waste facility.*
- *The second is a row of houses and a business premises along Berryfield Lane at the centre of Fassaroe. The landscape has a suburban character in this area.*
- *To the south east, off Kilbride Lane which leads to the quarry, there are several large houses on extensive properties.*

There is an electrical substation in the western part of the Fassaroe lands along Berryfield Lane, and the Fassaroe lands are traversed by several power lines on both steel lattice and timber pylons'.

Refer to Chapter 10 Landscape and Visual Impacts of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.8. Archaeology and Cultural Heritage

The following is obtained from RPS (2022) EIAR Chapter 11 Archaeological, Architectural and Cultural Heritage:

'*There are 12no. previously recorded monuments, identified on the basis of the Paper Survey, located within the defined Study Area'.* One of the monuments Site CH-1 (SMR No. WI007-026 - Ecclesiastical Remains – possible) is located within the extent of the subject development lands. In addition, Site CH-1 is a National Monument and listed in the respective Record of Monuments and Places (RMP) for Counties Wicklow and Dublin, which were discovered following the publication of the RMPs in the mid-1990s. Archaeological testing was undertaken within the vicinity of these features which did not identify any subsurface features of archaeological interest or potential surrounding these features.

Refer to Chapter 11 Archaeological, Architectural and Cultural Heritage of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.9. Traffic & Transportation

The following is obtained from RPS (2022) EIAR Chapter 12 Traffic and Transportation:

There are currently limited pedestrian and cycle facilities located in the centre of the proposed site due to the underdeveloped nature of the subject site and surrounding lands. However, there are existing pedestrian and cycle facilities connecting into the site from both the N11 and the Ballyman Road on the eastern and western sides of the site, respectively. There are existing footpath facilities from the N11-Junction 6 Western Roundabout to Thornhill Road Roundabout on both sides of Fassaroe Avenue. From the Thornhill Road Roundabout there are pedestrian facilities provided on the eastern side of the road up to the existing roundabout junction with Berryfield Lane.

There is a two-way segregated cycle track provided on the southern and eastern side of Fassaroe Avenue between the N11-Junction 6 Western Roundabout to the junction of Berryfield Lane.

No pedestrian or cycling facilities exist further west on the existing roadways within the subject lands. To the east, there is a gap in the existing cycling and pedestrian facilities along the R918 overbridge over the N11 extending from the N11-Junction 6 Western Roundabout to the La Vallee roundabout on the eastern side of the N11-Junction 6 interchange. From La Vallee, pedestrian facilities resume on the Upper Dargle Road which provide onward pedestrian facilities via Dublin Road to Bray Town Centre. There are no existing segregated cycling facilities provided on Upper Dargle Road. Along this section, cyclists share the carriageway with other traffic in a low-speed (50km/h) urban environment.

Given the undeveloped green field nature of the lands at Fassaroe, the existing pedestrian and cyclist environment is limited.

Refer to Chapter 12 Traffic and Transportation of the EIAR (RPS, 2022) for further details on this particular environmental factor.

2.4.10. Population and Human Health

The following is obtained from RPS (2022) EIAR Chapter 4 Population and Human Health:

Existing residences within the area closest to the application are located at Berryfield Lane and Thornhill Road. Other nearby residences exist at Kilbride Lane and Ballyman Road. The most recent Census for which local population information is available is the 2016 Census. This indicates that the population of Bray was 32,600. The labour force in the area grew by 1.1% in the period 2011 – 2016, from 15,761 to 15,927, and in the same period the amount of people at work grew by 8.2%, from 12,945 to 14,001. The number of unemployed people within the study area reduced by 890 (31.6%), from 2,816 to 1,926, in the same period.

The construction phase of the development will have impacts related to generation of dust and release of odours with potential for impact on human health. As noted in Chapter 8, Air Quality and Climate, dust dispersion across the development site and out into the wider environment from construction

activity will be determined primarily by meteorological factors including levels of rainfall, wind speed and wind direction. Based on TII guidance and the scale of the proposed development there are several residential/commercial properties located within 100 metres of the works particular along Berryfield Lane and along Thornhill Road that could potentially be affected. These properties are likely to experience a 'temporary slight adverse' dust impact during construction in the absence of additional mitigation. Additional mitigation for these properties is presented in Chapter 8 section 8.5. All other properties are located outside of the 100 metres threshold and hence, these properties will experience no adverse dust impact from the proposed construction phase.

Chapter 8 also identifies the potential for disturbance of the areas within and around the historic landfills to generate lateral or vertical pathways for the escape of landfill gas. The fugitive release of this landfill gas has the potential for the generation of odour nuisance through the release of trace gases (such as H_2S and mercaptans) within the landfill gas. The work at the landfills also has potential to development of additional pathways for landfill gas migration during construction. There are a number of existing residential properties located to the south of the Landfill Site 2 where the proposed road alignment is planned. Similarly, the Enniskerry Football Club grounds are located adjacent (c. 500 metres southwest) to the area where the proposed road cuts through Landfill Site 3B. These properties are predicted to experience a 'temporary slight adverse' impact from landfill odours in the event that any landfill gas is released during the works. Other receptors in the area will likely experience negligible impacts. Mitigation for these properties is presented in Section 8.5.2 of Chapter 8.

The construction works have potential for impact on the health of construction workers. This relates in particular to the remediation works to the historic landfill sites. While the remediation proposals for the landfill site are to cap them, thereby minimising interaction with the waste bodies themselves, there is some localised excavation works and slope stabilisation works. Contractor operatives working on or close to the historic landfills may be exposed to flammable gases (methane, hydrogen sulphide) during excavations and site clearance. In the absence of mitigation measures this could potentially have moderate to significant adverse impacts on health.

The construction stage could also give rise to windblown contaminated litter during excavation / works to the landfill sites which would have potential adverse impacts on human health.

The development incorporates the demolition of an existing dwelling at Berryfield Lane. It is possible that this building may contain asbestos which would be harmful to construction workers health.

Refer to Chapter 4 Population and Human Health of the EIAR (RPS, 2022) for further details on this particular environmental factor.

3. Legislation and Guidance

All parties, contractors and consultants working on this project shall be subject to the laws of Ireland and the various international/regional protocols and agreements to which Ireland is a party. In the event that legislation is updated the latest version shall be followed. All relevant new legislation will be followed as appropriate. This document outlines most current legislation at the date of issue. It is the responsibility of the Contractor to ensure that they are up to date with the details of the latest iterations of legislation relevant to the project throughout the duration of the contract.

The Designer should be aware of all key environmental risks and associated measures set out within this CEMP, and the final detailed design should take due cognisance of these.

The Contractor should set out the CEMP in a clear format and should address all key environmental risks and associated measures. The Contractor must be aware of and comply with the legislation and guidance set out in this document, any specific planning conditions which may be associated with the proposed development, and other relevant documentation as prescribed by the Employer and planning authority.

3.1. Legislation

It should be noted that the appointed Contractor will be required to be aware of their obligations under legislation. Such legislation, includes, but is not restricted, to:

- Planning and Development Act, 2000, as amended 2017 (S.I. No. 20 of 2017), 2018 (S.I. No. 16 of 2018), 2020 (S.I. No. 92 of 2020), 2021 (S.I. No. 18 of 2021) and 2022 (S.I. No. 75 of 2022).
- Planning and Development Regulations 2001 to 2022.
- The Birds Directive: Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC);
- The Birds Directive: Council Directive 2009/147/EC on the conservation of wild birds;
- The Habitats Directive: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora;
- The European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. 477 of 2011), as amended, 2015 (S.I. No. 355 of 2015) and 2021 (S.I. No. 388 of 2021;
- Water Framework Directive (WFD): Directive 2000/60/EC of the European Parliament and Council establishing a framework for Community Action in the field of water policy, as amended;
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009, S.I. No. 272 of 2009, as amended, 2012 (S.I. No. 327 of 2012), 2015 (S.I. No. 386 of 2015), 2019 (S.I. No. 77 of 2019);
- European Communities Environmental Objectives (Groundwater) Regulations 2010, S.I. No. 9 of 2010, as amended, 2016 (S.I. No. 366 of 2016);
- European Communities (Environmental Liability) Regulations, 2008, S.I. No. 547 of 2008, as amended, 2011 (S.I. No. 307 of 2011), 2015 (S.I. No. 293 of 2015);
- Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste, as amended 2018 (S.I. No. 851 of 2018);
- Waste Management Acts of 1996 to 2021;
- The Water Pollution Acts of 1977 & 1998;
- The Wildlife Acts 1976 to 2021;
- Water Policy Regulations 2003, S.I. No. 722 of 2003, as amended, 2005 (S.I No. 413 of 2005), 2008 (S.I No. 219 of 2008), 2010 (S.I. No. 93 of 2010) and Amendment (No. 2) Regulations, (S.I. 326 of 2010) & EU Water Policy Regulations 2014 (S.I 350 of 2014) and 2018 (S.I. No. 261 of 2018);
- Water Conservation Regulations 2008, S.I. No. 527 of 2008;
- European Communities (Drinking Water) Regulations 2014, S.I. No. 122 of 2014, as amended 2017 (S.I No. 464 of 2017) and 2020 (S.I. No. 2184 of 2020);
- Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016);

- Litter Pollution Act of 1997, as amended, 2017 (Bill 58 of 2017);
- Litter Pollution Regulations 1999, S.I. No. 359 of 1999);
- European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014), as amended 2019 (S.I. No. 233 of 2019);
- Waste Management (Facility Permit and Registration) Regulations 2007, S.I. No. 821 of 2007, as amended, 2008 (S.I. No. 86 of 2008), 2015 (S.I. No. 198 of 2015), 2019 (S.I. No. 250 of 2019);
- Waste Management (Collection Permit) Regulations 2007, S.I. No. 820 of 2007), as amended, 2015 (S.I. No. 197 of 2015), 2016 (S.I. No. 24 of 2016);
- Waste Management (Licensing) Regulations 2004 (S.I. No. 395 of 2004) as amended 2010 (S.I. No. 350 of 2010);
- Environment (Miscellaneous Provisions) Act 2011, as amended 2015;
- Waste Management (Landfill Levy) Regulations 2008, S.I. No. 199 of 2008, as amended 2009, (S.I. No. 550 of 2009), 2010 (S.I. No. 31 of 2010), 2012 (S.I. No. 221 of 2012), 2013 (S.I. No. 194 of 2013), 2015 (S.I. No. 189 of 2015), 2019 (S.I. No.182 of 2019);
- Waste Management (Hazardous Waste) Regulations, 1998, as amended, 2000 (S.I. No. 73 of 2000);
- Waste Management (Shipment of Waste) Regulations 2007, S.I. No. 419 of 2007;
- Waste Management (Movement of Hazardous Waste) Regulations, 1998 (S.I. No. 147 of 1998);
- European Communities (Shipments of Hazardous Waste Exclusively within Ireland) Regulations 2011, S.I. No 324 of 2011;
- European Communities (Transfrontier Shipment of Waste) Regulations 1994 (S.I. No. 121 of 1994);
- Waste Management (Transfrontier Shipment of Waste) Regulations 1998, as amended, 2014 (S.I. No. 861 of 2014);
- Waste Management (Tyres and Waste Tyres) Regulations 2007 (S.I. No. 664 of 2007), 2017, as amended (S.I. No. 400 of 2017) and 2018 (S.I. No. 96/2018);
- European Union Batteries and Accumulators Regulations 2014, S.I. No. 283 of 2014, as amended, 2014 (S.I. No. 349 of 2014), 2015 (S.I. No. 347 of 2015);
- Waste Management (Registration of Brokers and Dealers) Regulations 2008, SI No. 113 of 2008;
- Waste Management (Prohibition of Material Disposal by burning) Regulations 2009, S.I No. 286 of 2009, as amended 2013 (S.I. No. 504 of 2013), 2017 (S.I. No. 599 of 2017), 2019 (S.I. No. 684 of 2019) and (S.I. No. 51 of 2022);
- European Communities (Waste Directive) Regulations 2011, S.I. No. 126 of 2011, as amended 2016 (S.I. No. 315 of 2016) and (S.I. No. 323 of 2020);
- European Waste Catalogue (EWC) and Hazardous Waste List 2002, 2015 and 2018;
- Waste Management (Food Waste) Regulations 2009, S.I. No 508 of 2009, as amended, 2015 (S.I. No. 430 of 2015);
- Protection of the Environment Act 2003;
- European Union (Properties of Waste Which Render It Hazardous) Regulations 2015, S.I. No. 233 of 2015, as amended, 2018 (S.I. No. 383 of 2018);
- Air Pollution Act, 1987 (Air Quality Standards) Regulations, 1987, as amended, 2002 (S.I. No. 271 of 2002), 2011 (S.I. No. 180 of 2011), 2016 (S.I. No. 659 of 2016);
- Air Pollution Act, 1987 (Emission Limit Values for use of Asbestos) Regulations, 1990, S.I. No. 28 of 1990);
- EC (Control of Emissions of Gaseous & Particulate Pollutants from Non-Road Mobile Machinery) Regulations 2007, S.I. No.147 of 2007, as amended, 2011 (S.I. No. 263 of 2011), 2012 (S.I. No. 407 of 2012), 2013 (S.I No. 417 of 2013), 2016 (S.I. No. 2016/1628);
- The EU Regulation 2037/2000 (CFC's, HCFC's, Halons) - Ozone Depleting Substances. Control of Substances that Deplete the Ozone Layer Regulations 2006, S.I. No 281 of 2006, as amended, 2011 (S.I. No. 465 of 2011);

- EU F Gas Regulations 2006, as amended, 2014, S.I. No. 517 of 2014, 2019 (S.I. No. 367 or 2019);
- Environmental Protection Agency Act 1992 (Noise) Regulations, 1994 S.I. 174 of 1994;
- Environmental Noise Regulations 2006, S.I. No. 140 of 2006;
- European Communities (Environmental Noise) Regulations 2018 (S.I. No. 549 of 2018;
- European Communities (Noise Emission by Equipment for use Outdoors) Regulations, 2001, S.I No. 632 of 2001, as amended, 2006 (S.I No. 241 of 2006);
- European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Amendment Regulations 1996, S.I No. 359 of 1996 and 2001, S.I No. 632 of 2001);
- Local Government (Planning and Development) Act 1963 (S.I. No. 28 of 1963), as amended 1993 (S.I. No. 12 of 1993);
- Wildlife Act, 1976 (Protection of Wild Animals) Regulations, 1990, S.I. No. 112 of 1990 and Wildlife Amendment Act, 2000 (S.I. No. 38 of 2000);
- European Communities Conservation of Wild Bird Regulations 1985, S.I. No. 291 of 1985, as amended, 1986 (S.I. No. 48 of 1986), 1995 (S.I. No. 31 of 1995), 1997, (S.I. No. 210 of 1997), 1998 (S.I. No. 154 of 1998), (S.I. No. 131 of 1999), 2005 (S.I. No. 716 of 2005), 2010 (S.I. No. 65 of 2010), 2011 (S.I. No. 626 of 2011), 2012 (S.I. No. 84 of 2012), 2013 (S.I. No. 281 of 2013), 2019 (S.I. No. 178 of 2019);
- Noxious Weed Act, 1936, S.I. No. 38 of 1936;
- Noxious Weed Order, 1937, S.I. No. 103 of 1937;
- Flora (Protection) Order, 2015, S.I. No 356 of 2015;
- The Forestry Act, 1946, S.I. No. 13 of 1946, as amended, 2009 (S.I. No. 40 of 2009) & Forestry Act, 2014, S.I. No. 31 of 2014;
- Forestry Regulations, S.I. No. 191 of 2017, as amended 2020 (S.I. No. 32 of 2020);
- The National Monuments Act 1930, S.I. No. 2 of 1930, as amended, 2004 (S.I. No. 22 of 2004);
- European Union (Environmental Impact Assessment and Habitats) (Section 181 of the Planning and Development Act 2000) Regulations, 2013 (S.I. No. 403 of 2013), 2015 (S.I. No. 301 of 2015), 2019 (S.I. No. 418 of 2019); and,
- European Union (Environmental Impact Assessment and Habitats) (Environmental Impact Assessment) Regulations, 2018, S.I. No. 296 of 2018.

3.2. Industry Guidance

The Contractor should take due consideration of, and incorporate best practice guidance, including but not limited to the following:

- BS 5837/2012. Trees in relation to design, demolition and construction;
- BS 3998; 2010. Tree Work. Recommendations;
- CIRIA (2001). C532. Control of water pollution from construction sites. Guidance for consultants and contractors;
- CIRIA (2006). C648. Control of water pollution from linear construction projects. Technical Guidance;
- CIRIA (2008). C679. Invasive species management for infrastructure managers and the construction industry.;
- CIRIA (2015). C741. Environmental Good Practice on Site;
- CIRIA (2015). C753. The SuDS Manual;
- Environmental Protection Agency (2021). *'Best Practice Guidelines for the preparation of resources & waste management plans for construction & demolition projects'*
- Invasive Species Ireland (2016). Best Practice Management Guidelines. Japanese knotweed;
- NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes;
- NRA (2005). Guidelines for the Treatment of Badger Prior to the Construction of National Road Schemes;

- NRA (2008). Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes;
- NRA (2006). Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post Construction of National Road Schemes;
- NRA (2010). Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (Revision 1); and,
- Sustainability & Environmental Appraisal (March 2020) LA 120 Environmental management.

4. Project Roles and Responsivities

For the purposes of clarity, the roles and responsibilities of the project team for the proposed development should be determined at the very outset of the Construction Stages of this project. Key roles are listed below. These are typically performed by the Client, Engineer, and Contractor as presented below. Specific details will be determined upon the Detailed Design and Contract Stage.

Table 4-1 - Roles and Responsibilities

Employer	Planning Agents
The Client: Cosgrave Property Group Email: mcosgrave@cosgravegroup.com Contact: Michael Cosgrave	The Planner: RPS Tel: (01) 488 2900 Contact: Maria Lombard
Employers Representative	**Design Team**
Tel: to be confirmed Contact: to be confirmed	Atkins Tel: (01) 810 8000 Contact: Peter Foley
Project Supervisor for the Design Process (PSDP)	**Environmental Team**
Tel: to be confirmed Contact: to be confirmed	RPS Tel: (01) 488 2900 Contact: Maria Lombard
Project Supervisor Construction Stage (PSCS)	**Contractor**
The Contractor: to be confirmed Tel: to be confirmed Contact: to be confirmed	The Contractor: to be confirmed Tel: to be confirmed Contact: to be confirmed

4.1. The Client/Employer

Cosgrave Property Group will be responsible for ensuring that competent parties are appointed to undertake the construction of the proposed development and that sufficient resources are made available to facilitate the appropriate management of all potential risks to the environment.

4.2. Environmental Manager

An Environmental Manager will be appointed by the Contractor to ensure that the CEMP is effectively implemented. The Environmental Manager will be a suitably qualified, competent and experienced professional that would perform the necessary tasks, review environmental procedures and consult with the members of the construction team and stakeholders as required. The Environmental Manager will be responsible for:

- Ensuring that the CEMP and all relevant documents such as environmental control plans are developed, implemented and maintained on site;
- Updated the CEMP to address any subsequent planning conditions relevant to the proposed development.
- Ensuring compliance with the Conditions of the Planning Permission and any other relevant permits/ consents required;
- Ensuring the mitigation measures set out in the EIAR, NIS and any other statutory approvals as well as in the CEMP are implemented;
- Ensuring that construction occurs in accordance with the relevant environmental requirements and that such compliance is adequately recorded and documented;

- Conducting regular environmental inspections and compiling an environmental compliance report on a monthly basis;
- Attending site and stakeholder meetings as required;
- Keeping up-to-date with relevant environmental best practice and legislative changes;
- Ensuring all staff have undertaken adequate environmental inductions, awareness briefings and training;
- Dealing with environmental complaints; and
- Managing and responding to environmental incidents and ensuring that all incidents are recorded and reported in an appropriate manner.

4.3. Construction Director

The Construction Director will be responsible for the overall execution and organisation of all environmental related activities, as appropriate. Some responsibilities of the Construction Director will comprise the following:

- Overall responsibility for the implementation of the CEMP;
- Allocating the correct resources in order to ensure the successful implementation of the CEMP; and,
- Assisting in the management review of the CEMP for suitability and effectiveness.

4.4. Construction Manager

The Construction Manager is directly responsible to the Construction Director in assisting with the successful execution of the Proposed Development. The responsibilities of the construction manager in respect of the CEMP comprise the following:

- To report to the Construction Director on the on-going performance and development of the CEMP;
- To discharge his/her responsibilities as per the CEMP; and,
- To support and augment the Construction Management Team (CMT) through the provision of adequate resources and facilities for the duration of the implementation of the CEMP.

5. Environmental Management Procedures

5.1. General

The Contractor will be required to have a recognised environmental management system such as ISO 14001:2015 or be able to demonstrate that they are actively working towards implementing such a system.

The works Contractor will undertake the works in accordance with the provisions of the CEMP. The CEMP will be updated by the Contractor to address any subsequent planning conditions relevant to the proposed development and will be reviewed by the Employer and/or the Employer's Representative. The Contractor will review and update the CEMP as appropriate and shall issue an updated CEMP. A record of the review and any recommendations will also provide (for review and approval by the Employer and/or the Employer's Representative) Environmental Control Plans (ECPs), which will be maintained and updated in accordance with the CEMP. ECPs will include (if applicable), but will not be restricted to:

- Air Quality Control Plan;
- Construction Noise and Vibration Control Plan;
- Pollution Prevention, Soil Erosion and Sedimentation Control Plan
- Water Resources and Energy Use Control Plan;
- Ecological Control Plan;
- Landscape and Visual Control Plan;
- Light Pollution Control Plan;
- Archaeological and Cultural Control Plan;
- Traffic Management Control Plan; and,
- Contamination Land Control Plan.

Guidance on the development of such Control Plans is located in Section 7 of this document.

5.2. Environmental Policy

Contractors shall have an environmental policy dated and signed by the most senior person in the company. The policy shall:

- Be appropriate to the nature, scale and environmental impacts of the organisations activities, products and services;
- Include a commitment to continual improvement in environmental performance;
- Include a commitment to comply with all applicable legislation and with other requirements to which the organisation subscribes which relate to its environmental aspects;
- Provide a framework for setting and reviewing objectives and targets;
- Be documented, implemented and maintained;
- Be communicated to all persons working for or on behalf of the organisation; and
- Be available to the public.

5.3. Environmental Aspects

Contractors are expected to use a qualitative approach to identify and evaluate potential environmental aspects along with any controls to prevent or mitigate environmental damage. A simple risk matrix (as follows) facilitates quick reference and assignment of risk levels for each environmental aspect, based on the following general risk classifications:

- Extreme/serious risk;
- High risk;
- Moderate risk; and,
- Low risk.

All environmental aspects rated as High or Extreme/Serious will be classified as significant and will require control or mitigation measures to manage the risk. All environmental aspects covered by a legal requirement, for example an Environmental Permit condition will also be classified as significant even if the risk is low or moderate.

An example of a Qualitative Risk Matrix is presented below.

Table 5.1 – Example of Qualitative Risk Matrix

					Probability				
Severity	**People**	**Assets**	**Environment**	**Reputation**	**Impossible / Rare**	**Improbable / Possible**	**Probable / Likely**	**Very Likely / Often**	**Certainty/ Frequent**
Catastrophic	Multiple fatalities or permanent total disabilities	Extensive damage	Massive effects	International impact				Extreme / Serious Risk	
Severe / Major	Single fatality or permanent total disability	Major damage	Major effect	National impact		High Risk			
Critical / Moderate	Major injury or health effects	Local damage	Localized effect	Considerable impact					
Marginal / Minor	Minor injury or health effects	Minor damage	Minor effect	Minor impact		Moderate Risk			
Negligible / Insignificant	Slight injury or health effects	Slight damage	Slight effect	Slight impact	Low Risk				

The Contractor shall record the results of the qualitative risk analysis in an Aspects and Impacts Register (Table 5.2).

Table 5.2 – Example of Aspects and Impacts Register

Environmental Aspect	Environmental Impact	Risk Rating	Control / Mitigation Measures	Risk Rating After Control
Use of fuel storage tanks on site	Potential contamination of water and land	High Risk	Double skinned tank, bunding, location on hard standing, emergency spill procedure and equipment and training	Moderate Risk

5.4. Training, Awareness and Competence

The Contractor (and their sub-contractors) will be selected with due consideration of relevant qualifications and experience. The Contractor will be required to employ construction staff with appropriate skills, qualifications and experience appropriate to the needs of the works to be carried out during construction.

A site induction will be provided to all construction staff before they commence work on site. Where appropriate, the Contractor will identify specific training needs for the construction workforce and will ensure that appropriate training requirements are fulfilled. A baseline level of environmental awareness will be established though the site induction programme. Site inductions will cover the following as a minimum:

- Introduction to the Environmental Manager;
- The requirements of the CEMP and consequences of non-compliance;
- The requirements of due diligence and duty of care;

- Identification of environmental constraints and potential impacts of the work;
- Procedures associated with incident notification and reporting including procedures for dealing with damage to the environment; and,
- The benefits of improved environmental and sustainability performance; and the potential consequences of departure from specified procedures, work instructions and method statements.

5.5. Meetings

The Environmental Manager will be responsible for arranging and holding monthly meetings with the Employer and/or the Employer's Representative. The Environmental Manager would develop and distribute minutes on monthly meetings accordingly.

5.6. Monitoring and Inspections

For the duration of the contract, the environmental performance of the Contractor will be monitored through site inspections and audits. The programme for monitoring, inspections and audits shall be specified in the contract. The Contractor shall develop, implement and maintain an Environmental Inspections and Monitoring Plan.

Record of all inspections carried out should be recorded and all actions should be closed out in a reasonable time. If additional monitoring and inspections are required due to any subsequent planning conditions, these will be added to the CEMP.

5.6.1. Monitoring

Mitigation and monitoring will be carried out so that construction activities are undertaken in a manner that does not give rise to significant negative effects. Suitable monitoring programmes will need to be developed, implemented, documented and assessed in accordance with the specification outlined in the CEMP. The CEMP takes account of all relevant mitigation measures and monitoring requirements as set out in the EIAR, NIS and any other statutory approvals.

The results of all environmental monitoring activities would be reviewed by the Environmental Manager on an ongoing basis to enable trends or exceedance of criteria to be identified and corrective actions to be implemented as necessary. The CEMP takes account of all relevant monitoring requirements as set out in the EIAR, NIS and any other statutory approvals.

5.6.2. Inspections

Inspections of construction activities will be carried out by the Environmental Manager on a daily basis to ensure all necessary environmental measures relevant to the construction activities are being effectively implanted by construction staff, ensuring legal and contractual conformity. Furthermore, the CEMP takes account of all relevant inspection requirements as set out in the EIAR, NIS and any other statutory approvals.

5.6.2.1. Daily Inspections:

The daily inspections should include, but not be limited to, checking that:

- The site boundary is marked out and respected;
- All waste is appropriately stored and segregated;
- Waste skips are covered to prevent wind-blown litter;
- Drip trays are in place for all stored equipment and plant;
- All chemicals/fuels are stored with appropriate containment/bunds/cover;
- Construction noise is within permitted limits and does not create a nuisance;
- Dust does not create a nuisance; and
- Fencing/hoarding is secure.

5.6.2.2. Weekly Inspections

The inspections should include, but not be limited to confirming that:

- Daily checklists have been completed;
- Waste storage areas have been checked and there is no build-up of waste materials;
- Spill kits have been checked and contain all relevant materials;
- The performance of all pollution control equipment has been checked and the equipment is working effectively;
- Noise reduction/monitoring equipment has been checked and is operating effectively;

- Septic tanks are not overfull/discharging; and
- Special control measures identified in Permit/Planning Conditions, the EIAR, NIS and any other statutory approvals are adhered to.

5.7. Nonconformity and Corrective and Preventative Action

The Contractor shall establish, implement and maintain procedures to deal with actual and potential non-conformities and for taking corrective and preventative action.

Non-conformities may be identified through:

- Internal contractor audits;
- Audits by the Employer and/or the Employer's Representative;
- Audits undertaken by external certification bodies;
- Audits undertaken by regulatory authorities; and
- General observations.

The Contractor procedures shall define the requirements for:

- Identifying and correcting non-conformities;
- Mitigating the environmental impacts of non-conformities;
- Investigating non-conformities including identifying root causes and implementing appropriate actions to avoid their reoccurrence;
- Evaluating the need for actions to prevent non-conformities and implementing appropriate actions designed to avoid their reoccurrence;
- Setting realistic timeframes for undertaking effective corrective and preventative actions;
- Recording the results of corrective and preventative actions taken; and
- Reviewing the effectiveness of corrective and preventative actions.

All actions identified should be appropriate to the nature and magnitude of the issue and the environmental impacts encountered.

5.8. Reporting

The Contractor will be required to submit a report, the frequency to be agreed with the Contractor and Employer and/or the Employer's Representative, to the Employer and/or the Employer's Representative for review and approval. The report shall address the following as minimum:

- Summary of compliance with the CEMP, EIAR, NIS and any other statutory approvals including identification of any non-conformances;
- Interpretation of the results of any ongoing monitoring (as required);
- Detailed description of any issues and/or non-conformances identified during inspections and/or audits;
- Record of incidents and corrective actions (including Corrective Actions Reports as appropriate);
- Synopsis of environmental complaints received/queries raised by stakeholders; and
- Records of environmental training undertaken (as appropriate).

5.9. Environmental Records

The Contractor shall maintain records of all environmental documentation including monitoring, environmental compliance, test results, method statements and plans. All records will be kept up-to-date and be made available for audits, inspections and periodical reporting. The Contractor will maintain the following environmental records (as a minimum) that will be made available for inspection to the Employer and/or the Employer's Representative and the relevant authorities if required:

- Management plans;
- Records of environmental incidents;
- Environmental reports;
- Records of environmental training;
- Register of environmental complaints;
- Corrective Action Reports;

- Environmental inspection and audit reports;
- All monitoring data;
- Waste and chemical inventories; and
- Health and Safety records.

6. General Requirements

It is the responsibility of the Contractor to ensure compliance and to avoid and/or reduce significant adverse effects that have been identified at this preliminary juncture where practicable. Where the Contractor diverts from the methodologies and working areas outlined herein and/or defined in the granted planning consent and associated conditions that may be granted, it would be the responsibility of the Contractor to obtain the relevant licenses, permits and consents for such changes.

6.1. Good Housekeeping

The Contractor will employ a 'good housekeeping' policy at all times. This will include, but not be restricted, to the following:

- 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 clear 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;
- Effective prevention of oil, grease or other objectionable matter being discharged from the 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 as far as practicable and surplus materials/soils shall be recovered or disposed of to a suitably authorised waste facility site;
- Effective prevention of infestation from pests or vermin;
- No discharge of site run-off or water discharge without agreement of the relevant authorities; and
- Maintenance of public rights of way, diversions and entry/exit areas around working areas for pedestrians and cyclists where practicable and to achieve inclusive access.

6.2. Site Compound

The exact location of the compound area will be agreed with the appointed contractor and Wicklow County Council prior to the commencement of development and will be used throughout the construction period. However the site compound is likely to be located on the site of the proposed Neighbourhood Centre as the Neighbourhood Centre will be constructed in the final stages of the development proposed. The location of the site compound should be selected to avoid any potential impacts to environmental receptors and to reduce any potential for impact on sensitive human receptors. The exact location of the site compound must be agreed with the Employers Representative and the Employer.

Site access for all personnel and visitors will be strictly controlled and all visitors will report to the site compound prior to entering the construction area. Regular inspections of the hoarding will be undertaken to ensure that the safety of any vehicles or personal are not compromised.

Storage of materials will be minimal. The site compound will also act as a storage centre for construction materials. No large materials will be stored on site until such times as they are required. At no time during the project will materials or other items be placed outside the hoarding line.

6.3. Hours of Working

6.3.1. Core Working Hours

The timing of construction activities, core working hours and the rate of progress of construction works are a balance between efficiency of construction and minimising nuisance and significant defects. The core construction working hours for the proposed development will be:

- Monday to Friday: 07:00 to 19:00; and,
- Saturdays: 07:00 to 14:00.

No working will be permitted on Sundays or Bank Holidays.

6.3.2. Start-up and shutdown

The Contractor may require a period of up to one hour before and one hour after core working hours for start-up and shutdown activities in working areas. Activities permitted may include deliveries and unloading of materials, movement of staff to their place of work, maintenance and general preparation works. The use of plant machinery likely to cause disturbance, will not be permitted outside of the core working hours.

6.3.3. Additional working hours

It may be necessary in exceptional circumstances to undertake certain activities outside of the construction core working hours. Any construction outside of the construction core working hours will be agreed by the Contractor in advance with Wicklow County Council and scheduling of such works shall have regard to nearby sensitive receptors.

In the case of work required in an emergency or which if not completed would be unsafe or harmful to workers, the public or local environment, Wicklow County Council will be informed as soon as reasonably practicable of the reasons and likely duration and timing (outside of the core working hours).

6.4. Security

Security will be the responsibility of the Contractor who will provide adequate security to prevent unauthorised entry to or from the site. The following measures may be used to prevent unauthorised access:

- Install CCTV and security systems where required;
- Consult with neighbouring properties and local crime prevention officers including Wicklow County Council and An Garda Siochana on site security matters where required;
- Prevent access to restricted areas and neighbouring properties by securing equipment on site such as ladders and scaffolding; and
- When there is no site activity, close and lock site gates and set appropriate site security provisions as required.

6.5. Hoarding and Fencing

A site boundary in the form of hoarding or fencing will be established around each of the working areas before any significant construction activities commences in that working area. The hoarding/fencing shall be a secure boundary to what can be a dangerous environment for those that have not received the proper training and are unfamiliar with construction operations.

Site hoarding also performs am important function in relation to minimising nuisance and effects including:

- Noise emissions (by providing a buffer);
- Visual impact (by screening the working areas, plant and equipment); and
- Dust minimisation (by providing a buffer).

6.6. Services and Utility

Site services shall be installed as part of the works. Working areas will be powered by mains supplies or diesel generators where an electrical supply is not available.

The Contractor will be responsible for undertaking their own surveys to establish the full extent of underground services prior to the commencement of construction to support any surveys already undertaken as part of early design work and statutory consent applications.

6.7. Lighting

- Lighting will be provided with a minimum luminosity sufficient for safety and security purposes. Where practicable, precautions will be taken to avoid shadows cast by the site hoarding on surrounding footpaths, roads and amenity areas; and,
- Motion sensor lighting and low energy consumption fittings will be installed to reduce usage and energy consumption.

6.8. Reinstatement of Working Areas on Completion

The Contractor will reinstate all working areas as work proceeds during construction. All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity and the surface of the ground restored as near as practicable to its original condition.

On completion of construction works the Contractor will ensure that all waste and potentially polluting material is removed from the site and is disposed of using appropriately authorised contractors. The Contractor shall, as appropriate, undertake visual and ecological rehabilitation of site compound and other areas no longer to be used by the Contractor. Following site clearance and rehabilitation the Employer or Employer's Representative will undertake a final inspection of the site. Any environmental issues identified during the final inspection will be raised with the Contractor. Mitigation measures and timeframes for completion will be agreed between the Contractor and the Employer's Representative in line with agreed procedures prior to final sign off.

6.9. Health and safety

The Contractor would be required to ensure all relevant health and safety, fire safety and security requirements are in place prior to the commencement of construction and in accordance with the relevant legislation requirements in addition to the specifications of Wicklow County Council.

Relevant Irish and EU health and safety legislation must be complied with at all times by all construction staff and personnel during construction. Furthermore, the Contractors would also have to ensure that all aspects of their works comply with good industry practice and all necessary consents, licenses and authorisations have been put in place for the proposed development.

7. Environmental Management and Controls

The Contractor will be required to have due regard to and incorporate any additional requirements where relevant from any planning conditions applied to this submission, the EIAR, NIS and any other statutory approvals associated with the proposed development.

7.1. Waste Management

This section identifies the potential types of waste which may arise from construction and provides guidance on the management, control and disposal of waste.

7.1.1. Risk Identification

Contractors shall undertake a qualitative waste management risk assessment or appraisal prior to the commencement of construction activities. An example assessment is shown is Table 7.1

Table 7.1 – Example of Waste Management Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark up on a site plan with the location of all adjacent housing/commercial centers, schools and educational establishments, agricultural land and other potential receptors. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for high risk activities such as waste storage areas.
02	Identify the construction activities and sources that may result in waste production and waste storage, segregation and disposal requirements.	These could include excavations, chemical and materials use etc., waste storage and bulking areas etc.
03	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage waste: 1. Prevent - Do not generate the waste in the first place. 2. Re-use – Can you re-use without treatment? 3. Recycle – Make sure that wastes are properly segregated to aid recycling. 4. Disposal with energy recovery 5. Disposal without energy recovery

7.1.2. Waste Management

Contractors should develop, implement and maintain a Resource and Waste Management Plan that is in compliance with '*Fassaroe Phase 1 Strategic Housing Development Resource and Waste Management Plan'* (Atkins, 2022), EPA (2021) *'Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects'* and Wicklow County Development Plan 2016-2022. The plan should include but not be restricted to the mitigation measures below (Table 7.2).

Table 7.2 – Waste Management Mitigation Measures

Activity	Mitigation Measures
General	An approved person, such as a site/contract/resource manager, will be given responsibility for good site practices and control, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site in accordance with EPA (2021) *'Best Practice Guidelines for the preparation of resources & waste management plans for construction & demolition projects'*. Contractors will apply the waste prevention principles of the waste management hierarchy: 1. Prevent – Do not generate the waste in the first place. 2. Re-use – Can you re-use without treatment?

Activity	Mitigation Measures
	3. Recycle – Make sure that wastes are properly segregated to aid recycling. 4. Disposal with energy recovery 5. Disposal without energy recovery The Contractor will ensure that all construction staff are trained in good waste management practice and chemical handling procedures.
Collection and Storage of Waste	Contractors will provide designated waste storage areas for the bulk storage of waste prior to removal off-site. Only appropriately authorised contractors and sites will be used for the transport and disposal of waste. The Contractor will provide adequate facilities for the collection and storage of waste material including litterbins and waste skips. Waste containers/skips/bins will be provided with nets or lids to prevent waste being carried around by scavengers or by the wind. Waste containers will not be overfilled. Appropriate measures will be employed to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers. Industrial and construction waste including redundant hazardous equipment, tyres, used oil cans/drums etc. will be separated and put into segregated bins for removal and disposal by an appropriately authorised contractor.
Waste Reduction and Sustainability	Good management and control can prevent the generation of significant amounts of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Purchase materials in the quantity required for the project to minimise unused leftovers. Purchase materials that do not use excessive amounts of packaging to minimise the quantity of used packaging for subsequent disposal/processing. Segregate and store different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal. Collect and segregate waste metals including redundant plant and equipment, metal construction materials and cans. Recycle unused chemicals or those with remaining functional capacity.
Disposal of Wastes	All waste will be disposed of at approved sites using appropriately approved contractors - The Contractor must provide copies of valid EPA Waste licences and Local Authority Waste Permits (including those relating to their subcontractors or brokers, where applicable) for collection and waste treatment/disposal/export facilities. Records of waste disposal, recycling and recovery will be maintained. The contractor will provide sufficient secure waste disposal points and regular collection for disposal. No waste will be disposed of or buried on site. Dumping of waste, including roadside dumping and filling on land not within a registered landfill area is prohibited. Works that involve onsite filling with material other than virgin excavated natural material is encouraged where material is potentially suitable. Burning any waste on site is prohibited. Divert construction, demolition and land clearing debris from landfill disposal. Redirect recyclable recovered resources back to manufacturing process. Redirect reusable materials to appropriate sites. Waste will be segregated in an onsite recycling center and those components that are recyclable sent to appropriate facilities. Consider recycling cardboard, metal, brick, acoustic tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Identify approved haulers and recyclers to handle the designated materials. All non-recyclable waste will be disposed of by an appropriately authorised waste contractor. The contractor will follow approved procedures for the classification, sampling, transport and disposal of hazardous waste.

Activity	Mitigation Measures
Storage and Stocking of Material	Temporary stockpiling of native soils and imported materials onsite will require careful management in order to prevent the release of sediment into drainage ditches and any temporarily exposed groundwater (in the event that groundwater is encountered). Stockpiled materials will not be located immediately adjacent to watercourse or onsite drainage ditches, or any temporarily exposed groundwater (in the event that groundwater is encountered). As per RPS (2022) Screening for Appropriate Assessment and Natura impact Statement: • *Top soil stripping in proximity to any watercourses shall be undertaken as much as feasible in dry weather conditions and all stockpiles will be located greater than 100m from the watercourse. Stockpiles within 200m of the watercourses will be covered.* • *Appropriate management of excess material stockpiles to prevent siltation of watercourses.* • *Temporary construction compounds will not be located close to road cuttings, watercourses or Ballyman Glen SAC or where it is likely that groundwater will be encountered.* Stockpiled materials will be covered as required to prevent it spilling over/blowing onto areas of environmental interest or semi-natural vegetation outside the agreed lands. Stockpiling of materials will be kept to an absolute minimum, and where possible, stockpiled for as short a time as possible prior to use. Any stockpiled materials will be stored in low mounds where possible. Slopes of material will be stable, and the side slopes compacted down and stabilised, with regular checks by the Contractor; The Contractor will examine the risk arising from storage areas and identify as appropriate the need for mitigation measures at the toe of slopes to reduce silt transport from areas of stockpiled material. Stockpiles of materials not suitable for onsite re-use will be removed as soon as is practicable in accordance with applicable waste management legislation. The Contractor will comply with best practice when sourcing imported materials for site works, including NRA (2006) A Guide to Landscape Treatments. Imported material will be from a reputable source who can confirm that it has been screened for potential presence of invasive species.

7.2. Air Quality, Greenhouse Gas and Odour

Construction activities have the potential to impact on air quality through the creation of dust and emissions to air from vehicles and plant, along with activities including infilling of soil, excavation of trenches, stockpiling and movement of materials may all contribute to generating ambient dust. This section identifies the potential causes of air pollution which may arise from construction and provides guidance on the management and control of emissions from site.

7.2.1. Risk Identification

Contractors shall undertake a qualitative risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.3.

Table 7.3 – Example of Air Quality Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark a site plan with the location of all adjacent housing/commercial centers, schools and educational establishments, agricultural land and other potential receptors. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for high risk activities such as material storage areas, refueling points and haul routes.
02	Identify the construction activities and sources of pollution that may	These could include excavations, concrete use, transport, materials storage, traffic management etc.

	Risk Assessment	Example Procedure
	result in emissions to air.	
03	Evaluate the risk of the construction activities resulting in emissions to air.	Assess the likelihood of an activity causing pollution. Assess the significance of the harm pollution would cause to a particular receptor. For example, the impact of dust in a populated urban area would be significantly greater than dust in an unpopulated rural area.
04	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods, covers for storage areas). 3. Protect the receptor (provide hard standing and covering for compounds/storage areas, filter, control, contain emissions, ensure appropriate environmental permits are in place). 4. Put emergency procedures in place.

7.2.2. Air Quality & Greenhouse Gas Management Plan

Contractors should develop, implement and maintain an Air Quality Management Plan. The plan should include but not be restricted to the mitigation measures below (Table 7.4).

Table 7.4 – Air Quality Mitigation Measures

Activity	Mitigation Measures
Air Quality - RPS (2022) Air Quality and Climate EIAR Chapter	*In order to mitigate dust emissions during the construction phase, a dust minimisation plan will be prepared as part of the CEMP. The dust minimisation plan will be prepared with regard to the industry guidelines such as the Building Research Establishment document entitled Control of Dust from Construction and Demolition Activities and the Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site. The dust minimisation plan should include the following mitigation measures:* • *Site roads will be regularly cleaned and maintained as appropriate. Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only.* • *Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).* • *All vehicles exiting the site will make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes will be self-contained systems that do not require discharge of the wastewater to water bodies.* • *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.* • *The transport of soils should be undertaken in covered vehicles.* • *All vehicles which present a risk of spillage of materials, while either delivering or removing materials, will be loaded in such a way as to prevent spillage on to the public road.* *If the construction contractor adheres to good working practices and the dust mitigation measures outlined above, the levels of dust generated are assessed to be minimal and are unlikely to cause an environmental nuisance. The construction contractor will be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as a 30-day average at sensitive receptors using standard Bergerhoff gauges. Where dust levels are measured to be above this guideline the mitigation measures in the area must be reviewed as part of the dust minimisation plan.*

Activity	Mitigation Measures
Odour Mitigation - RPS (2022) Air Quality and Climate EIAR Chapter	*A detailed construction methodology for the excavation works shall be prepared by the contractor and communicated to all site personnel to ensure that no confined spaces or trenches deeper than 1m are created during the excavation of waste. Where confined spaces or trenches greater than 1m are created, gas detection equipment and appropriate breathing apparatus should be used by all personnel in the vicinity of the confined space/trench.* *The works must be planned to minimise the risk of the release of odours and gases to surrounding areas including the contractor's compound and the wider community. Site operatives in the Site 3B area will be instructed to report all unusual, concentrated or significant odours on-site, so that measures may be taken to identify the source of the odour and eliminate it.* *Gas monitoring techniques will be put in place by the contractor. For nuisance odours, automated odour control systems may need to be put in place, as necessary, to periodically release a fragrance to mask or neutralise unpleasant odour. A wheel-washing facility shall be established for trucks leaving the site to minimise the transport of potentially odorous clay particles onto adjacent roads.* *A no smoking policy will be strictly enforced onsite.*
Climate Mitigation - RPS (2022) Air Quality and Climate EIAR Chapter	*Mitigation measures to minimise GHG emissions from transport during the construction phase include the following:* • *Local sourcing of construction materials such as the recycling of material won on excavations for reuse on site.* • *Implementation of the Traffic Management Plan. This will outline measures to minimise congestion and queuing, reduce distances of deliveries and eliminate unnecessary loads.* • *Reducing the idle times by providing an efficient material handling plan that minimises the waiting time for loads and unloads. Reducing idle times could save up to 10% of total emissions during construction phase.* • *Turning off engines when not in use for more than five minutes. This restriction will be enforced strictly unless the idle function is necessary for security or functionality reasons.* • *Regular maintenance of plant and equipment. Technical inspection of vehicles to ensure they will perform the most efficiently.* *Materials with a reduced environmental impact may also be incorporated into the construction design through re-use of materials or incorporation of recycled materials in place of conventional building materials. The following materials should be considered for the construction phase:* • *Ground Granulated Blast Furnace Slag (GGBS) & Pulverised Fuel Ash - Used as replacements for Portland cements to increase sustainability and carbon footprint of civil and structural works.* • *Steel - The recovery rates associated with using recycled steel are high and research exists which shows that 99% of structural steel arising from demolition sites is recycled or re-used. The carbon emissions emitted during the production of virgin steel can be higher than some other structural materials on a tonne by tonne basis, and recycled steel should be used where possible.* *As part of the Construction Environmental Management, the contractor will be required to implement an Energy Management System for the duration of the works. This Energy Management system may include such measures as:* • *The use of thermostatic controls on all space heating systems in site buildings to maintain optimum comfort at minimum energy use.* • *The use of sensors on light fittings in all site buildings and low energy lighting systems.* • *The use of adequately insulated temporary building structures for the construction compound fitted with suitable vents.* • *The use of low energy equipment and 'power saving' functions on all PCs and monitors in the site offices.* • *The use of low flow showers and tap fittings.* • *The use of solar/thermal power to heat water for the on-site welfare facilities and contamination unit (sinks and showers).*

7.3. Construction Noise and Vibration

Construction activities can produce a significant amount of noise and vibration with the potential to impact adversely on a range of receptors. This section identifies the potential causes of noise and vibration which may arise from construction and provides guidance on management and control.

7.3.1. Risk Identification

An example risk assessment is shown in Table 7.5.

Table 7.5 – Example of Noise and Vibration Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark up on a site plan the location of all nursing homes, housing/commercial centers, schools and educational establishments, agricultural land and other potential receptors. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for noisy activities or activities likely to cause vibration such as generators, compressors, haul routes and drilling.
03	Identify the construction activities that may affect the receptors identified.	These could include excavations, dewatering, traffic movements, warning sirens, use of machinery and plant etc.
04	Evaluate the risk of the construction activities impact on receptors.	Assess the likelihood of an activity causing noise pollution. Assess the significance of the noise impact on particular receptors. For example, the impact of noise from construction activities adjacent to housing would be significantly greater than the impact of noise in an uninhabited rural area.
05	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods, substitution of materials for less noisy options). 2. Control the source (modify construction methods, provide adequate baffling). 3. Protect the receptor using noise barriers, screening etc. 4. Put emergency procedures in place.

7.3.2. Noise and Vibration Management Plan

Contractors should develop, implement and maintain a Noise and Vibration Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.6).

Table 7.6 – Noise and Vibration Mitigation Measures

Activity	Mitigation Measures
Noise & Vibration - RPS (2022) Noise and Vibration EIAR Chapter	*Construction works will be temporary and limited in duration. The timing of construction activities, working hours and the rate of progress of construction works are a balance between efficiency of construction and minimising the impact on the local community and road users. Constraints will be specified in the contract documents, generally restricting working hours on the proposed development.* *The predicted noise from construction activities which may give rise to potentially significant impacts if not carefully managed. This is the case when noisy activities need to be completed in close proximity to sensitive receptors. Construction scheduling will be planned to minimise any overlap and carefully control activities when being carried out close to sensitive receptors.* *Construction working hours ('normal hours') adjacent to residential areas or sensitive noise receptors will be limited to:* • *7am - 7pm, Monday to Friday; and* • *7am - 2 pm, Saturday* • *Sunday – no working* • *Bank and Public Holidays – no working* *The proposed apartment buildings and the Neighbourhood Centre are remote from existing residences. Given the nature of the proposed apartment buildings and the Neighbourhood Centre, their construction will require a number of large concrete pours which for technical reasons require significantly longer working days. It is not unusual that such activities would require construction time-blocks of approximately 15 hours. Given the nature of construction and a range of influencing factors it is not possible to predict or programme far in advance the exact dates on which extended construction hours will be necessary. It is proposed that*

Activity	Mitigation Measures
	the developer however will provide notification to the Planning Authority a week in advance of these occurrences. *The noise predictions are based on activities being carried out close to receptors where such activities will be temporary in duration, localised and will be further mitigated by noise control measures implemented by the contractor on site.* *BS5228:2009+A1:2014 – Noise and vibration control on construction and open sites outlines a range of measures which have now become standard good practice measures that can be used to reduce the impact of construction phase noise and vibration on the nearest noise sensitive locations. These measures will be applied by the contractor where appropriate during the construction phase of the proposed development.*
Construction Noise Control - Noise & Vibration - RPS (2022) Noise and Vibration EIAR Chapter	*The contractor will engage a competent professional to monitor and provide regular reports on construction noise. The monitoring results will be reviewed and any control measures necessary to deliver on the commitments in this EIAR adopted over the course of the works.* *The contractor can exercise considerable control over noise levels by careful scheduling of works. The contractor will draft a construction method statement, prior to the commencement of works, outlining the measures to be taken during construction to avoid and mitigate construction noise.* *BS 5228 outlines several issues associated with noise effects that influence the community reaction to the noise. The duration of site operations, the hours in which specific activities are carried out, the attitude of the public to the site operator and the use of effective mitigation measures are all important considerations in managing construction noise.* *Construction noise has been modelled based on all the sources are operating simultaneously and close to the noise sensitive locations. In practical terms, the sources will be distributed throughout the construction site and in operation on a cyclical basis, depending on specific tasks.* *The contractor will implement a programme of noise management measures that will include; engagement with the community on the activities that need to be carried out, the timing and duration of such activities, commitment to specific hours of work and the use of quiet work methods such as the selection of low-noise plant and operating methods. Wicklow County Council and potentially affected residents will be kept informed of the works to be carried out and of any proposals for any work outside normal hours.* *The contractor will provide contact details on a site notice board and through contact with residents of the proposed scheduling of noisy activities, the control and monitoring measures to be taken and contact details of a responsible person to whom noise complaints can be addressed.* *Two construction activities (Construction of buildings in area 5 (Refer to EIAR) and demolition of a single dwelling on Berryfield Lane) were identified with the potential to have noise levels in excess of the noise guidance thresholds. It is proposed that a 3.6m high double skinned solid site hoarding is located along the site boundary adjacent to receptors R33 and R148. It is also proposed that existing walls will be retained along the Berryfield Lane and raised to a height of 3.6 metres using double skinned solid plywood site hoarding. Where no walls are present a 3.6 m high double skinned solid plywood barrier will be erected adjacent to receptors on Berryfield Lane in proximity to construction works. This mitigation measure can offer up to 5 – 10 dB reduction on construction noise levels.* *During the demolition works, it is proposed that a temporary noise barrier is installed adjacent to construction works.* *Specific construction good practice measures from BS5228 will be implemented by the contractor as listed below:* • *Ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order;* • *Selection of quiet plant and machinery to undertake the required work where available;* • *All major compressors will be 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use;* • *Any ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;* • *Machines in intermittent use will be shut down in the intervening periods between work;* • *Ancillary plant such as generators, compressors and pumps will be placed behind existing physical barriers, and the direction of noise emissions from plant including exhausts or engines will be placed away from sensitive locations, in order to cause minimum noise disturbance. Where*

Activity	Mitigation Measures
	possible, in potentially sensitive areas, temporary construction barriers or enclosures will be utilised around noisy plant and equipment; • *Use of temporary localised screening for specific activities as required;* • *Handling of all materials will take place in a manner which minimises noise emissions; and* • *Audible warning systems will be switched to the minimum setting required by the Health & Safety Authority.* *Further controls will be implemented during the demolition activity including:* • *Programming of works to avoid simultaneous noisy activities, (e.g., piling in two locations);* • *Retaining outer walls as barriers for as long as possible before demolition;* • *Switching off plant when not in use; and* • *Temporary acoustic barriers will be used where warranted for specific activities close to sensitive receptors to minimise noise breakout.*
Construction Vibration Control - Noise & Vibration - RPS (2022) Noise and Vibration EIAR Chapter	*Construction vibration impacts will not be significant. There may however be a risk of vibration impacts on badgers close to construction activities. In order to protect badgers from potential impacts a survey of the proposed site will be carried out within 10 months of the start of construction to identify any badger setts within 150 m of the proposed working area. If any badger setts are found the procedures set out in the TII Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes will be followed.*
Consultation and Communication - Noise & Vibration - RPS (2022) Noise and Vibration EIAR Chapter	*Mitigation in the form of timely and effective stakeholder. This will ensure that residents are kept informed of on-going and future operations. For example, local residents would be informed by letter drop of proposed works, particularly where these are due to occur outside standard working hours. The letter would include details of proposed cause, start dates and duration of works to be carried out.*

7.4. Prevention of Soil and Water Pollution and Soil Erosion

Construction activities have the potential to cause pollution to groundwater and/or soils and surface water. Soil eroded during land disturbance can wash away and contaminate storm water drains and nearby water bodies. The plan establishes a series of mitigation and management measures to control and minimise these issues if required. Water erosion potential depends on the intensity of the rainfall and/or construction discharges, the soil type and topography. This section identifies the potential causes of pollution which may arise from construction and provides guidance on the management and control.

7.4.1. Risk Identification

Contractors shall undertake a qualitative pollution risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is presented in Table 7.7.

Table 7.7 – Example of Soil and Water Pollution and Soil Erosion Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark up on a site plan with the location of all water courses, surface water features, boreholes, field drains, ecologically sensitive areas, surface and foul drainage systems and other potential receptors. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for high risk activities such as chemical/fuel storage areas, refuelling points, haul routes and wash out areas.

	Risk Assessment	Example Procedure
02	Identify sensitive receptors off site or downstream of the construction project that could potentially be affected by the works. For example, water courses, ecologically sensitive areas.	Undertake baseline assessment of groundwater and surface water quality prior to construction as required. Establish monitoring regime during construction as appropriate.
03	Identify the construction activities and sources of pollution that may affect the water receptors identified.	These could include excavations, dewatering, water course crossings, as well as general sources of pollution such as surface water runoff, chemical/fuel storage, wash down areas, fueling areas and concrete use.
04	Evaluate the risk of the construction activities polluting the identified water receptors.	Assess the likelihood of an activity causing pollution. Assess the significance of the harm pollution would cause to a particular water receptor. For example, the impact of polluting a water receptor used for potable water would be significantly greater than the pollution of a foul water system.
05	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (change location, modify construction methods, provide adequate bunding for fuel and other storage areas, install measures such as silt fences or ditches to control runoff). 3. Protect the receptor (provide hard standing for compounds/storage areas, filter, control, contain discharges, ensure appropriate environmental permits are in place). 4. Put emergency procedures in place.

7.4.2. Pollution Prevention Management Plan

Contractors should develop, implement and maintain a Pollution Prevention Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.8).

Table 7.8 – Soil and Water Mitigation Measures

Activity	Mitigation Measures
Geology and Soil – RPS (2022) Soil, Geology and Hydrogeology EIAR Chapter	*To mitigate against the impacts associated with the re-profiling of the site topography to achieve design levels, an earthworks balance has been carried out. The purpose of this was to maximise the re-use of materials within the site and minimise the need for the importation of material. Where suitable, the soil to be excavated will be re-used on site as fill. This will reduce the volume of material to be taken off site for disposal.* *Stripping of topsoil will be carried out in a controlled and carefully managed way and coordinated with the proposed staging for the development. At any given time, the extent of topsoil strip (and consequent exposure of subsoil) will be limited to the immediate vicinity of active work areas. Topsoil stockpiles will be protected for the duration of the works and will be located so as not to necessitate double handling. This will minimise deterioration in topsoil quality and minimise sediment runoff.* *The excavation of material will be minimised as much as possible to reduce the impact on soils and geology. There will be approximately 136,053m^3 of soils excavated at the site including clays and gravel aggregates.. To maximise the potential for reuse, topsoil and subsoil will be stored separately. Topsoil and any native soils that can be used for amenity purposes will be stockpiled on the proposed development area for use as required in the final landscaping of the development. While every effort will be made to put this material to beneficial use on the site, some material may not be suitable for reuse. Any unsuitable soil will be taken to a site holding a waste facility permit. Soils found to be contaminated with waste materials will be taken to a licensed waste recovery or disposal facility.* *The RPS Environmental Risk Assessment (2018) indicates that outside the landfill areas only natural soils were encountered however the risk of encountering unsuitable material outside the landfill area cannot be fully discounted. Any unsuitable material encountered outside the historic landfill areas including in close*

Activity	Mitigation Measures
	proximity to the adjacent EPA licenced facilities will be subject to further environmental testing prior to reuse onsite or transportation offsite. *Any surplus material, or materials which are deemed not suitable for onsite reuse will be managed, transported and disposed of in accordance with the requirements of the Waste Management Act 1996, as amended, and the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste.* *A project specific Detailed Resource and Waste Management Plan (RWMP) (based on the RWMP submitted as part of this planning application) will be fully implemented onsite for the duration of the project. The residual impact will be permanent slight to moderate negative.* *The design of road levels and finished floor levels has been carried out in such a way as to minimise cut/fill type earthworks operations. The duration that subsoil layers are exposed to the impacts of weather will be minimised. Disturbed subsoil layers will be stabilised as soon as practicable (e.g., backfill of service trenches, construction of road capping layers, construction of building foundations and completion of landscaping). Similar to comments regarding stripped topsoil, stockpiles of excavated subsoil material will be protected for the duration of the works. Stockpiles of subsoil material will be located separately from topsoil stockpiles.* *An existing electricity line will be diverted underground along the northern boundary of the site. The maximum depth of the proposed underground cable will be 750mm bgl. Part of the underground cable will pass through historic landfill 2. Across historic landfill 2 the underground cable will be installed in the capping layer above the low permeability capping membrane. Similarly, all underground cables required for lighting within the District Park located within the footprint of historic landfill 1 and historic landfill 2 will be installed within the capping layer and above the low permeability membrane. This will ensure that there are no preferential pathways for the movement of landfill gas or leachate created.* *It is likely, given the history of Site 1, 2, 3A, 3B and 3C that only low levels of compaction of waste occurred during filling operations. As such, with the installation of a minimum of 1.3m of cover soils above the waste and additional fill above this to make up the finished ground level, this loading will result in settlement of the landfill areas. A geogrid system will be incorporated into the capping system to reduce differential settlement.* *In addition, the earthworks programme for the Phase 1 development will include for the surcharging of Site 1, 2, 3A, 3B and 3C with clean excavated material at an early stage in the development works (once the slope stabilisation works on Site 2 have been completed and prior to installation of the capping system) so that post-capping settlement of the landfill areas is reduced as much as possible.*
Prevention of soil / bedrock contamination – RPS (2022) Soil, Geology and Hydrogeology EIAR Chapter	*The following measures will be implemented for soil handling to minimise erosion:* • *The areas stripped of topsoil and overburden will be kept to a minimum. Stripping of lands will be phased to suit the pace of development at the site.* • *Stockpiled soils will be profiled to minimise erosion from wind and rain.* • *Clean surface water runoff will be diverted around earthworks areas to minimise erosion (and the volume of silted water generated). To achieve this, shallow cut-off drains, or temporary plastic diversion barriers will be installed.* • *Stockpiles of topsoil will be kept to a maximum of 2m high to avoid anaerobic conditions and maintain fertility for reuse.* • *Vegetation of stockpiles will be promoted to minimise erosion* *The mitigation measures for prevention of soil / bedrock contamination during construction are proposed below:* • *Earthworks plant and vehicles delivering construction materials to Site will be confined to predetermined haul routes around the Site.* • *Vehicle wheel wash facilities will be installed in the vicinity of the Site entrance and road sweeping implemented as necessary in order to maintain the road network in the immediate vicinity of the Site.* • *Dust suppression measures (e.g. dampening down) will be implemented as necessary during dry periods.* • *The employment of good construction management practices will serve to minimise the risk of pollution from construction activities at the proposed development in line with the Construction Industry Research and Information Association (CIRIA) publication entitled, Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, CIRIA - C532*

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(2001) which are also detailed in Chapter 7 - Water. Specifically, with regard to soils and geology, the following will be adhered to:

- *Fuels, lubricants and hydraulic fluids for equipment used on the construction Site, as well as any solvents, oils, and paints will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice;*
- *Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the proposed development for disposal or re-cycling;*
- *Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the proposed development and properly disposed of;*
- *All Site vehicles used will be refuelled in bunded and adequately sealed and covered areas in the construction compound area.*
- *All plant and machinery will be serviced before being mobilised to Site;*
- *No plant maintenance will be completed on Site, any broken-down plant will be removed from Site to be fixed;*
- *Refuelling will be completed in a controlled manner using drip trays at all times;*
- *Mobile bowsers, tanks and drums will be stored in secure, impermeable storage areas away from open water;*
- *Fuel containers will be stored within a secondary containment system, e.g. bunds for static tanks or a drip tray for mobile stores;*
- *Containers and bunding for storage of hydrocarbons and other chemicals will have a holding capacity of 110% of the volume to be stored;*
- *Ancillary equipment such as hoses and pipes will be contained within the bund;*
- *Taps, nozzles or valves will be fitted with a lock system;*
- *Fuel and chemical stores including tanks and drums will be regularly inspected for leaks and signs of damage;*
- *Drip-trays will be used for fixed or mobile plant such as pumps and generators in order to retain oil leaks and spills;*
- *Only designated trained operators will be authorised to refuel plant on Site;*
- *Procedures and contingency plans will be set up to deal with emergency accidents or spills; and,*
- *An emergency spill kit with oil boom, absorbers etc. will be kept on-Site for use in the event of an accidental spill. A specific team of staff will be trained in the use of spill containment.*
- *Strict supervision of contractors will be adhered to in order to ensure that all plant and equipment utilised on-Site is in good working condition. Any equipment not meeting the required standard will not be permitted for use within the Site. This will minimise the risk of soils and bedrock becoming contaminated through Site activity.*
- *Highest standards of Site management will be maintained, and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the Site and surrounding environment during construction. A named person will be given the task of overseeing the pollution prevention measures agreed for the Site to ensure that they are operating safely and effectively.*
- *All Site workers will use appropriate PPE if required to clean up any potential fuel spillage onsite including gloves and dust masks to minimise contact with contaminated soil.*
- *All excavated materials will be stored away from the excavations, in an appropriate manner at a safe and stable location. The maximum height of temporary stockpiles will be 3m (and 2m for topsoil).*
- *A comprehensive monitoring and supervisory regime including monitoring of all excavations and stability assessments as required will be put in place to ensure that the proposed construction works do not constitute a risk to the stability of the Site.*

Following the implementation of the above mitigation measures the likely impact on soils and geology will be negative slight and short term.
The GSI will be notified in advance of any ground reprofiling works with regard to the Enniskerry Delta County Geological Site (CGS) and they will be given the opportunity to view and document (as required)

Activity	Mitigation Measures
	any excavated area. The residual impact on the Enniskerry Delta will be moderate negative and permanent. *In addition, the earthworks programme for the Phase 1 development will include for the surcharging of Site 1, 2, 3A, 3B and 3C with clean excavated material at an early stage in the development works (once the slope stabilisation works on Site 2 have been completed and prior to installation of the capping system) so that post-capping settlement of the landfill areas is reduced as much as possible.*
Excavation of waste – RPS (2022) Soil, Geology and Hydrogeology EIAR Chapter	*The following mitigation measures will be implemented during the excavation of waste;* • *All excavation and movement of waste should be carried out by mechanical means.* • *Strict rules and standards will be enforced regarding PPE around the works area. This will include at a minimum helmet, gloves, Tyvek suits, steel toed boots and safety glasses. Appropriate respiratory equipment will be maintained on site and there will be ongoing monitoring for gaseous hazards. The monitoring will be agreed with the contractor, but provision must be made for raising the alarm, emergency procedures and a plan for alerting those outside the work areas.* • *In addition, suitable hygiene and welfare facilities and PPE should be provided in accordance with the requirements of the Safety, Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013 to manage potential risks to construction workers.* • *The excavation of the works must be planned to minimise the risk of any material becoming airborne through the creation of dust. The contractor will have to put measures in place for dust suppression (water bowser) and have regard to weather conditions during the works to avoid run-off or severe dryness which could lead to problems with containment. The anaerobic decomposition of putrescible waste generates landfill gas which comprises methane and carbon dioxide. Gas monitoring carried out on Site 3B to date has consistently recorded methane concentrations ranging from 25.8% v/v to 70.4% v/v and carbon dioxide ranging from 17.2%v/v to 36.6%v/v. Therefore, it is expected that methane and carbon dioxide will be encountered during the Site 3B excavations. A detailed construction methodology for the excavation works will be prepared by the contractor and communicated to all site personnel to ensure that no confined spaces or trenches deeper than 1m are created during the excavation of waste. Where confined spaces or trenches greater than 1m are created, gas detection equipment and appropriate breathing apparatus should be used by all personnel in the vicinity of the confined space/trench. The works will be planned to minimise the risk of the release of odours and gases to surrounding areas including the contractor's compound and the wider community. Site operatives in the Site 3B area will be instructed to report all unusual, concentrated or significant odours on-site, so that measures may be taken to identify the source of the odour and eliminate it. Gas monitoring techniques will be put in place by the contractor. For nuisance odours, automated odour control systems may need to be put in place, as necessary, to periodically release a fragrance to mask or neutralise unpleasant odour. A wheel-washing facility shall be established for trucks leaving the site to minimise the transport of potentially odorous clay particles onto adjacent roads.* • *A no smoking policy will be strictly enforced onsite.* • *The contractor shall excavate the waste in areas as small as possible in order to limit the exposure of the waste. The contractor shall prepare an excavation plan which supports this ethos;* • *Should excessive wind conditions prevail, such that there is a risk of uncontrolled exposure to the waste with the consequences of it becoming windblown then the excavation shall cease until the weather becomes more amenable to the safe excavation of the waste. Any exposed*

Activity	Mitigation Measures
	areas of waste shall be covered with compacted clean material at the end of every working day as a minimum, in order to minimise the exposure of the waste to the winds; • *An area around the proposed excavation will be delineated which will be regarded as a safety zone beyond which the contractor's machinery is not permitted to leave unless it undergoes full decontamination. The area will be securely fenced off with access strictly controlled;* • *Only fully sealed containers shall be used for the removal of waste offsite; and* • *Prior to demobilisation, the contractor shall properly decontaminate all equipment and appropriately dispose of the decontamination water, field waste and contaminated personal protective equipment (PPE).* • *The Contractor will prepare an Asbestos Management Plan, prepared in accordance with the following guidance and regulations;* - *AGS 2012, Interim Guidance 'Site Investigation Asbestos Risk Assessment for the Protection of Site Investigation and Geotechnical Laboratory Personnel';* - *CIRIA 2014, C733 A Guide to Understanding and Managing Risks; and* - *Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010."* *Any waste for removal offsite will be tested in accordance with the EPA Guidance Document 'Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-Hazardous' (2015). It will be the Contractors responsibility to ensure that all waste soils are classified correctly and managed, transported and disposed of offsite in accordance with the requirements of the Waste Management Act 1996, as amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation. An Outline Construction and Demolition Waste Management Plan has been generated for the Site. A project specific Detailed Waste Management Plan will be fully implemented onsite for the duration of the project.*
Hydrogeology – RPS (2022) Soil, Geology and Hydrogeology EIAR Chapter	*<u>Soil Handling, Removal and Compaction</u>* *The excavated waste material will be reused on site, where applicable. However, further testing will be required should any soils be required to be removed from site. All soils removed from site will be disposed of by a licenced contractor to a licenced facility.* *Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any surface water drains. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. Stockpiles of soil/subsoil will be restricted to less than 3 metre in height.* *With regard to the imported material, it is recommended early discussions with demolition and waste recycling contractors to understand availability of compliant general fill material. This material should be chemically inert and insoluble which poses no threat to human health or the environment but offers an appropriate level of engineering capability without contributing to further contamination.* *<u>Fuel and Chemical Handling</u>* *To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas.* *A construction site compound will be established at the site and the working area fenced off to provide a secure site. Due to the scale of development and the phased approach to development this compound will move positions throughout the construction period.* *Leakages of oil from oil stores will be prevented by storing these oils in bunded tanks which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container. Drainage from the bunded area(s) shall be diverted for collection and safe disposal.* *Refuelling of construction machinery and vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in designated refuelling areas using a prescribed re-fuelling procedure. Plant nappies or absorbent mats to be place under refuelling point during all refuelling to absorb drips. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA 532, 2001) will be complied with.* *Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits; the nearby dirty water drain outlet will be blocked with an oil absorbent boom until the fuel/oil spill has been*

Activity	Mitigation Measures
	cleaned up and all oil and any contaminated material removed from the area. This contaminated material will be properly disposed of in a licensed facility. *All ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. The pouring of concrete will take place within a designated area using a geosynthetic material to prevent concrete runoff into the soil/groundwater media. Pours will not take place during forecasted heavy rainfall. Washout of concrete transporting vehicles will not take place on site. Concrete trucks will be washed out off site at the source quarry.* *To reduce the volume of cementitious water, only concrete truck chutes will be washed down on site. The concrete trucks will wash down their chutes at a designated chute wash down area in the site compound. The location of the chute washdown area will be appropriately located. The system is sealed with no overflow discharge to the drainage system.* *In the event of a spillage on site, the dirty water drains in the immediate area will temporarily be blocked and the pH levels of the water in the associated settlement ponds will be monitored and if necessary, will adjust the pH levels using CO_2 entrainment. Any spillage will be cleared immediately and deposited in the wash down area.* *In the case of drummed fuel or other chemical which may be used during construction containers will be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.*
Surface Water Run off – RPS (2022) Hydrology, Flood Risk and Water Services, EIAR Chapter	*<u>Surface Water Run-Off</u>* *As there is potential for run-off to enter current stormwater systems and indirectly discharge to a watercourse, mitigations will be put in place to manage run-off during the construction phase.* *Care will be taken to ensure that exposed soil surfaces are stable to minimise erosion and potential consequent sedimentation of surface water features and waterbodies. All exposed soil surfaces will be within the application site which limits the potential for any offsite impacts.* *Should any discharge of construction water be required during the construction phase, discharge will be to foul sewer. Pre-treatment and silt reduction measures on site will include a combination of silt fencing, settlement measures (such as silt or sediment traps,) and hydrocarbon interceptors.* *Any minor ingress of groundwater and collected rainfall in excavations will be pumped out during construction. Extensive monitoring will be adopted to ensure that the water is of sufficient quality to discharge to the sewer. The use of slit traps and an oil interceptor (if required) will be adopted if the monitoring indicates the requirements for the same with no silt or contaminated water permitted to discharge to the sewer. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavations are kept relatively dry.* *The temporary storage of soil will be carefully managed. Stockpiles will be tightly compacted to reduce runoff and graded to aid in runoff collection. This will prevent any potential negative impact on the stormwater drainage and the material will be stored away from any surface water drains. Movement of material will be minimised to reduce the degradation of soil structure and generation of dust. Excavations* *will remain open for as little time as possible before the placement of fill. This will help to minimise the potential for water ingress into excavations. Soil from works will be stored away from existing drainage features to remove any potential impact.* *Aggregate materials such as sands and gravels will be stored in clearly marked receptacles within a secure compound area to prevent contamination. Liquid materials will be stored within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications - BS8007-1987) to prevent spillage.* *Weather conditions will be considered when planning construction activities to minimise the risk of run-off from the site and the suitable distance of topsoil piles from surface water drains will be maintained.*
Fuel and Chemical Handling – RPS (2022) Hydrology, Flood Risk and Water	*To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas. Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.* *Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area or within the construction compound which will be away from surface water*

Activity	Mitigation Measures
Services, EIAR Chapter	*gullys or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA 532, 2001) will be complied with.* *Where feasible all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite.* *In the case of drummed fuel or other chemical which may be used during construction, containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.* *Emergency response procedures will be outlined in the detailed CEMP. All personnel working on the site will be suitably trained in the implementation of the procedures.*
Soil Removal and Compaction – RPS (2022) Hydrology, Flood Risk and Water Services, EIAR Chapter	*Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment. The material will be stored away from any surface water drains (see Surface Water Run-off section above). Movement of material will be minimised to reduce degradation of soil structure and generation of dust.* *Aggregate materials such as sands and gravels will be stored in clearly marked receptacles within a secure compound area to prevent contamination. Liquid materials will be stored within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications - BS8007-1987) to prevent spillage.* *All excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of potential contaminants to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be segregated and appropriately disposed of by a suitably permitted/licensed waste disposal contractor.*
Monitoring & Reinstatement: Geology and Soil – RPS (2022) Soil, Geology and Hydrogeology EIAR Chapter	<u>Soil and Geology</u> *GSI will be consulted and given the opportunity to observe the excavated areas outside of the landfill remediation works during the construction phase.* *The following monitoring measures to be implemented during the remediation and capping of the landfill sites has been identified from the RPS Remediation Strategy Report (RPS 2020).* *Capping System Construction Quality Assurance (CQA)* *CQA Plan* *As part of the design, a CQA Plan will be prepared for the installation of the capping system in accordance with the requirements of the EPA Landfill Manual: Landfill Site Design. The CQA Plan will set down the procedures for sourcing, transporting, placing, testing, repairing and protecting the capping materials prior to, during and after construction. The CQA Plan will set out the roles and responsibilities of the various parties on site and the reporting to be provided by the manufacturer, installer and CQA Monitor. This plan will help to ensure the design of the capping system is not compromised during its construction.* *CQA Supervision* *Third party supervision of the capping works by a specialist CQA consultant is required by the EPA Landfill Manual: Landfill Site Design and will be provided by a suitably qualified and experienced company. The CQA contractor will be responsible for overseeing the capping works and ensure that the main contractor adheres to the Works Requirements. A CQA validation report will be submitted to the EPA following the construction for the capping system. The CQA validation report will set out all aspects of the construction from supply through to final placement and testing.* *A quality control system will be put in place for all documentation relating to the capping works. All documentation will be kept on-site and available for inspection at all times. CQA documentation will include the following:* • *Delivery, handling and storage of materials,* • *Geomembrane panel layout and programme,*

Activity	Mitigation Measures
	• *Geocomposite panel layout and programme,* • *Monitoring programme,* • *Geomembrane seam testing,* • *Geocomposite seam testing,* • *Soil inspection, and* • *Laboratory testing results."* <u>Hydrogeology</u> *Monitoring requirements during the construction phase are detailed below:* • *Surface water run-off control: Regular inspection of surface water run-off and control of sediment (fines) will be undertaken, e.g., appropriately sized and located silt traps will be installed during the construction phase.* • *Implementation of construction mitigation measures: Regular inspection of construction mitigation measures will be undertaken, e.g., concrete pouring, refuelling etc. as part of the implementation of the CEMP for the site.*
Monitoring & Reinstatement: RPS (2022) Hydrology, Flood Risk and Water Services, EIAR Chapter	*Monitoring requirements during the construction phase are detailed below:* • *Surface water run-off control: Regular inspection of surface water run-off and control of sediment (fines) will be undertaken, e.g. appropriately sized and located silt traps will be installed during the construction phase.* • *Implementation of construction mitigation measures: Regular inspection of construction mitigation measures will be undertaken, e.g. concrete pouring, refuelling etc. as part of the implementation of the CMP for the site.*

7.5. Water Resources and Energy Use

Construction activities have the potential to use significant volumes of water and energy. This section identifies the potential impacts associated with water and energy use which may arise from construction and provides guidance on the management and control of water and energy on site.

7.5.1. Risk Identification

Contractors shall undertake a qualitative water resources and energy use assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.9.

Table 7.9 – Example of Water Resources and Energy Use Risk Assessment

	Risk Assessment	Example Procedure
01	Identify all items and activities on the construction site with high water and/or energy demands.	Mark up on a site plan with the location of all items and activities with high water and/or energy demands. This will help the planning of the overall layout of the construction site and enable the identification of efficiency opportunities.
02	Implement mitigation to eliminate or reduce water and/or energy demand.	Use the following hierarchy to promote water and energy efficiency: 1. Remove the requirement (different construction methods, substitution of materials for that require less water and/or energy). 2. Control the use (modify construction methods, monitoring, target setting, procedures, switch off, training).

7.5.2. Water Resources and Energy Use Management Plan

Contractors should develop, implement and maintain a Water Resources and Energy Use Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.10).

Table 7.10 – Water Resources and Energy Use Mitigation Measures

Activity	Mitigation Measures
General	Reduce water consumption through recovery strategies. Conserve water by maximising opportunities for infiltration runoff. Conserve water by matching water quality with its intended use and using water saving devices. Contractors will carry out regular inspections/audits of water resource and energy use. In the event of excessive water use/leaking pipes etc, immediate action will be taken to repair equipment or reassess water needs. Use an irrigation system which utilises cooling water, condensate, TSE or other wastewater. Water arising from vehicle and equipment wash-down will be treated to remove silt and reused where possible. For example wetting down roads and stockpiles. Turn out the lights at night and only light areas as required for safety and comfort (employment of lighting sensors). Ensure that the light source is the minimum intensity for the required purpose. Ensure that fittings are chosen that direct light accurately to where it is needed. Vehicles will not be allowed to idle for long periods. Machinery and generators shall be regularly maintained and operated in an efficient manner. The use of solar powered instruments/machines should be considered. Temporary site offices should be well insulated to retain heat or cool, utilise energy efficient bulbs and energy efficient cooling systems. Choose locally sourced building materials and products thereby reducing the environmental impacts from transportation. Choose rapidly renewable materials over finite raw and long cycle renewable materials. Use timber and wood, including that used in construction, from a certified sustainable source, or be postconsumer re-used timber, or similar.

7.6. Ecology – Natural Habitats, Flora and Fauna

Construction activities can have adverse impacts on natural habitats, flora and fauna. This section identifies potential adverse impacts which may arise from construction and provides guidance on management and control.

7.6.1. Risk Identification

Contractors shall undertake a qualitative ecology risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.11.

Table 7.11 – Example of Ecology Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive ecological receptors within or adjacent to the construction site.	Mark on the site plan the location of all water courses, surface water features, ecologically sensitive areas and habitats, other potential receptors including key wildlife populations. Particular attention should be paid to existing ecological features within the project area. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for high risk activities such as chemical/fuel storage areas, refueling points, haul routes and wash out areas.
02	Identify sensitive receptors off site or downstream of the construction project that could potentially be affected by the works. For example water courses, ecologically sensitive areas and habitats.	Undertake baseline assessment of water quality prior to construction if required. Establish monitoring regime during and post construction (as required).

	Risk Assessment	Example Procedure
03	Identify the construction activities and sources of pollution that may affect the water/ecological receptors identified.	These could include excavations, dewatering (if required), water course crossings, as well as general sources of pollution such as surface water runoff, fuel storage and concrete use.
04	Evaluate the risk of the construction activities polluting the identified receptors.	Assess the likelihood of an activity causing pollution, damage or harm.
05	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods, provide adequate bunding for fuel and other storage areas, install measures such as silt fences or ditches to control runoff). 3. Protect the receptor (provide hard standing for compounds/storage areas, filter, control, contain discharges, ensure appropriate environmental permits are in place). 4. Put emergency procedures in place.

7.6.2. Ecology Management Plan

Contractors should develop, implement and maintain an Ecology Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.12).

Table 7.12 – Ecology Mitigation Measures

Activity	Mitigation Measures
RPS (2022) Biodiversity EIAR Chapter	***Petrifying Springs*** *The following measures will be implemented for the storage and use of hydrocarbons on site:* • *Diesel tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled.* • *Refuelling will be carried out from these tanks or from delivery vehicles and will not be left unattended.* • *Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice - (Enterprise Ireland BPGCS005).* • *Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of.* • *Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or recycling.* • *Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction site to deal with any accidental spillage.* *It is possible that waste will be encountered during construction for the installation of utility infrastructure and the leachate could be mobilised (either vertically or horizontally). To minimise or prevent lateral migration of groundwater/leachate along utility trenches, clay plugs will be used.* ***Scrub, Mixed Broadleaved Woodland, Immature woodland, Hedgerows and Treelines*** *Woodland habitats adjacent to working areas shall be demarcated to indicate clearly that no access is permitted. Where construction activity takes place in habitats categorised as ecological features (i.e., valuable habitats, including woodland) it is important that activity is limited to the footprint of the infrastructure and immediate surrounds. Again, areas where access is restricted should be demarcated.* *Where possible, treelines, scrub, woodland and mature trees shall be avoided and retained intact. Any existing mature trees adjacent to the works or construction sites to be retained will be protected from any accidental damage during construction through use of measures such as fencing. Protective fencing barriers will be installed as outlined in Section 6.2, Barriers and Ground Protection, of BS 5837. Measures will be taken to ensure that trees and hedges being retained are incorporated into the development without being impacted upon. Protective fencing will be provided around trees and hedge vegetation being retained and this will enclose their Root Protection Areas (RPAs). The fencing will be at least 2.3m high.*

Activity	Mitigation Measures

No soil, spoil, constructional materials or rubbish will be stored or tipped, and no construction plant or vehicles will be parked within the spread of existing trees, shrubs or hedges.

Wet woodland

Works to wet woodland are limited to the installation of a surface water outfall at the north-west of the site. Woodland habitats adjacent to working areas shall be demarcated to indicate clearly that no access is permitted. Where construction activity takes place in habitats categorised as ecological features (i.e., valuable habitats) it is important that activity is limited to the footprint of the infrastructure and immediate surrounds. Again, areas where access is restricted should be demarcated.

Any existing mature trees adjacent to the works or construction sites to be retained will be protected from any accidental damage during construction through use of measures such as fencing. Protective fencing barriers will be installed as outlined in Section 6.2, Barriers and Ground Protection, of BS 5837. Measures will be taken to ensure that trees and hedges being retained are incorporated into the development without being impacted upon. Protective fencing will be provided around trees and hedge vegetation being retained and this will enclose their Root Protection Areas (RPAs). The fencing will be at least 2.3m.

Degradation of habitat

Rigorous sediment, erosion and pollution control measures have been provided for the proposed works. Good practice measures for the prevention of pollution will be employed at all times during the construction and operational period of the development.

Otter

The measures outlined for the protection of water quality below will ensure that a sufficient level of mitigation is also afforded to otter.

Badger

Badger proof fencing:

The distributer road shall be flanked to each side by badger-proof fencing from the south of the Enniskerry FC football pitch to the western end of the road. Fences should be constructed using plastic-coated chain link fencing. The wire should be stapled to timber fencing or to concrete posts for stability.

The fence must be a minimum of 1000mm in height and must also be buried to a depth of 200mm and with a return towards the direction of approach (away from the road) of 300mm. The mesh diameter must not exceed 50mm as badger may climb the standard mesh of approximately 63mm diameter.

The fence must be bent outward from the road to the base to lessen the likelihood that badgers will dig under it. A means of retaining this bend is desirable (in the form of pegging).

Badger underpass and access to each side of the route:

The potential interruption to the movement of badgers across their territory created by the routing of the road and the fencing necessary to prevent badger access at the western end of the distributer road can be alleviated by the provision of a badger underpass under the road to the west of Enniskerry FC grounds, near the junction with Berryfield Lane. All field gates close to the underpass locations must prevent badgers from exiting by way of mesh on and under the gate. The underpass should be constructed of concrete pipes (or steel and heavy duty plastic) of a diameter less than 600mm in diameter up to 1000mm. Pipes should be laid end-to-end to span the width of the road (at its widest base).

For the remainder of the road, there must be badger-proof fencing on each side of this tunnel (travelling in each direction on both sides of the road).

Where there is a drainage ditch running alongside the road, a further length of pipe or planking must be installed to allow badgers access to the underpass. A concrete slab base and a concrete slab surround prevent any badgers digging under the pipe. As well as this, fencing is more secure when attached to a totally vertical surface than if simply connected to the pipe.

The badger underpass should connect the hedgerow or drainage ditches on each side of the road to cover on the other to encourage uptake of new underpasses.

It is essential that the direction of bend of the wire is in the direction from which the badger is approaching, as to place it in the opposite direction will lead to a failure of mitigation.

Badger fence design approval must be sought from a qualified ecologist to ensure that the design and make of the fencing and other measures will be effective in preventing badger access to the route.

Specifications for badger proof fences and badger gates are as recommended in the NRA document Guidelines for the Treatment of Badgers on National Roads. Further technical details are covered in this document or by the DMRB Volume 10. Badger –proof fencing must be properly attached and buried and

Activity	Mitigation Measures

posts must not create conditions conducive to badgers climbing the fence. The buried return fence must point away from the land take of the road to work properly.

Given that mammals continue to enter onto new roads, all fencing shall be examined upon completion by an ecologist to ensure that there are no obvious gaps or opportunities for mammals to enter unto the route.

Other non-volant mammals species protected under Schedule 5 Wildlife Act 1976 (as amended): hedgehog, Pine Marten, Red Squirrel

Trees shall be checked for potential red squirrel nests or dreys and use by pine marten prior to clear felling by a suitably qualified ecologist.

Bat species

Where possible, treelines, woodland and mature trees shall be avoided and retained intact. Any existing mature trees adjacent to the works or construction sites to be retained will be protected from any accidental damage during construction through use of measures such as fencing. Protective fencing barriers will be installed as outlined in Section 6.2, Barriers and Ground Protection, of BS 5837. Measures will be taken to ensure that trees and hedges being retained are incorporated into the development without being impacted upon. Protective fencing will be provided around trees and hedge vegetation being retained and this will enclose their Root Protection Areas (RPAs). The fencing will be at least 2.3m.

Examination of trees for bats prior to felling:

The land-take of the proposed road shall be further examined to determine the potential for tree roosts prior to felling, to ensure any altered circumstances are identified prior to construction. If any trees are deemed to have high potential, these trees will be examined further either by a bat detector survey or by examination from a hoist, teleporter, tree access procedure. All bat roosts are protected and can only be removed once a licence to derogate is acquired from the National Parks and Wildlife Service by a bat specialist.

Felling should only be undertaken following acknowledgement by a bat specialist that there are no bats within the trees for removal. Trees should ideally be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per National Roads Authority guidelines (NRA 2006) and also to avoid the bird breeding seasons. Tree felling should be completed by Mid-November at the latest as bats roosting in trees are very vulnerable to disturbance during their hibernation period (November – April). Trees with Ivy (Hedera helix) cover, once felled, should be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

Buildings

Pre-construction bat surveys of the dwelling scheduled for demolition at the proposed site shall be undertaken by a suitably qualified ecologist prior to the commencement of construction to determine the presence or absence of bats. In the event that no evidence of bat usage is found during the inspection, development can commence. Should bats be found, development will be delayed and a derogation license will be required from NPWS wildlife licencing section.

Landscaping

Loss of commuting and foraging habitat at the site will be mitigated by the landscaping proposals, which include retention of hedgerows and wooded areas within and immediately adjacent to the site, which will be protected from any accidental damage during construction through use of measures such as fencing. Protective fencing barriers will be installed as outlined in Section 6.2, Barriers and Ground Protection, of BS 5837. Measures will be taken to ensure that trees and hedges being retained are incorporated into the development without being impacted upon. Protective fencing will be provided around trees and hedge

vegetation being retained and this will enclose their Root Protection Areas (RPAs). The fencing will be at least 2.3m high.

To mitigate for the loss of hedgerow and partial removal of woodland, substantial native tree planting will be established on the site. Large areas of open space will be maintained on the site, along with areas of wildflower meadow.

The planting schemes shall ensure connectivity to linear/ woodland habitats in the wider landscape. Trees that are being retained at the site shall be protected during clearance and construction works in line with current guidelines e.g. British Standard 5837:2012 and National Roads Authority 2006a.

Provision of bat boxes

A number of bat boxes are proposed for erection in proposed woodland areas to be located adjacent to Ballyman Glen at the north of the site.

Activity	Mitigation Measures
	The following bat boxes are proposed: 9x 1FF Schwegler Bat Box or Rocket Bat Boxes (which are pole mounted); *Bat boxes should be erected on trees at a height no less than 3m from the ground and with no clutter below them. It is proposed that all boxes should be in a shaded area where temperatures do not fluctuate greatly. No bat boxes shall be illuminated intentionally or unintentionally.* *Control of light pollution* *Lighting within the proposed development site shall be installed with sensitivity for local wildlife while still providing the necessary lighting for human usage. This is particularly important for bat foraging/commuting habitat at the edge retained hedgerows, treelines and woodland habitats at the site.* *The following general principles, which accord with the relevant verified measures set out in the BCT Lighting Guidelines (BCT, 2018), shall be implemented: -* • *Lighting design shall fully consider the presence of protected species. Therefore, appropriate lighting shall be used within the proposed development and adjacent areas, with more sensitive lighting regimes deployed in wildlife sensitive areas (e.g. woodland edge and hedgerows).* • *Dark buffer zones shall be used to separate habitats or features from lighting by forming a dark perimeter around them. This shall be used for habitat features noted as foraging areas for bats (Berryfield Lane, woodland edge habitats).* • *Buffer zones will be used to protect dark buffer zones and shall ensure that light levels (levels of illuminance measured in lux) within a certain distance of a feature do not exceed certain defined limits. For key bat habitat, such as treelines along Berryfield Lane and planted woodland areas at the edge of Ballyman Glen SAC), there shall be an absence of artificial illumination. The buffer zone can be further subdivided into zones of increasing illuminance limit radiating away from the feature or habitat that requires to be protected.* *Luminaire design is extremely important to achieve an appropriate lighting regime. In order to mitigate any potential impacts on bats from lighting, the following verified mitigation measures will be implemented, as set out in the most recent BCT Lighting Guidelines (BCT, 2018).* • *All luminaires used will lack UV/IR elements to reduce impact.* • *LED luminaires will be used due to the fact that they are highly directional, lower intensity, good colour rendition and dimming capability.* • *A warm white spectrum (<2700 Kelvins is recommended to reduce the blue light component of the LED spectrum).* • *Luminaires shall feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.* • *The use of specialist bollard or low-level downward directional luminaires shall be implemented in bat sensitive areas to retain darkness above.* • *Column heights shall minimise light spill. The shortest column height allowed shall be used where practicable.* • *Only luminaires with an upward light ratio of 0% and with good optical control will be used.* • *Luminaires will always be mounted on the horizontal, i.e. no upward tilt.* • *Any external security lighting will be set on motion-sensors and short (1min) timers.* • *As a last resort, accessories such as baffles, hoods or louvres will be used to reduce light spill and direct light only to where it is needed.* ***Birds*** *No scrub clearance, tree felling, or other removal of vegetation will occur during the bird breeding season from 1st March to 31st August*
RPS (2022) Japanese Knotweed Management Plan	Excavation and burial within a cell membrane is the preferred option for Japanese Knotweed management on the Fassaroe Phase 1 lands. *'General Control Measures for Japanese Knotweed Management on Fassaroe Phase One Lands* *Great care is needed to ensure that plant material (i.e. fragments of stems, leaves and roots) is not spread whilst performing the eradication measures detailed below. Effective site hygiene is essential, particularly during construction. This includes the following measures:*

Activity	Mitigation Measures
	• *Understand the possible extent of the rhizome system underground – up to 7 meters horizontally and 3 meters vertically.* • *Fence off or clearly mark infested area including the extent of the rhizome system underground.* • *Do not use machinery with tracks within an infested area, if possible.* • *Clearly identify and mark out areas where contaminated soil is to be stockpiled on site; stockpiles cannot be within 50m of any watercourse or within a flood zone.* • *Creation of entry and exit points for operators on foot and for small mobile equipment. A delineated access track to be maintained free of Japanese Knotweed should be established through the site to minimise the spread of Japanese Knotweed by permitted vehicles accessing the site.* • *Installation of a dedicated footwear & vehicular wheel brush/ wash down facility into a contained area within the site.* • *Vehicles leaving the site should be inspected for any plant material and dry brushed on to a geotextile membrane and cleaned immediately prior to leaving the contaminated area. Where dry brushing is not practicable, all machinery and vehicles on site will be washed down on to a geotextile membrane and cleaned immediately prior to leaving the contaminated area. However, due to the risk of uncontrolled run-off of water potentially containing small pieces of Knotweed, the use of a dry brush is preferred, and water should be used only where necessary. Where the use of water is unavoidable, it shall be filtered before disposal.* • *For any material entering the site, the supplier must provide an assurance that it is free of Japanese Knotweed.* • *Ensure all site users are aware of measures to be taken and alert them to the presence of the Japanese knotweed Site Management plan.* • *Erection of adequate site hygiene signage in relation to the management of non-native invasive material.* *Proposed Root Barrier Membrane Methodology:* • *Map the underground rhizomes (roots) by digging test pits in order to determine the extent of underground infestation or alternatively it can be assumed that underground infestation extends for 7m in all directions from the nearest stem and to 3m depth (NRA, 2010).* • *Calculate the volume required and excavate site, allowing for 2m depth of burial.* • *Protect the integrity of the root barrier membrane with a layer of sand and provide shutter ply supports for the edge of the cell.* • *Put approved Japanese Knotweed root barrier membrane in place, allowing enough material along the edges to eventually provide a seal.* • *Protect the root barrier membrane from tyre damage with a layer of sand.* • *Excavate the infested area (as defined above).* • *Fill the cell with the Knotweed infested soil. No other material, contaminants, or wastes should be included.* • *Make sure that dedicated vehicles are used and cleaned properly after they have been used. Haulage routes must be protected.* • *Put the surface of the root barrier membrane in place and make sure the cell is adequately sealed.* • *Protect the surface of the cell with sand and bury deep enough to prevent disruption in the future.* • *Following completion of works, monitor re-growth throughout the growing season over the next 4* *years (May-September 2023-2027, every 4-6 weeks) or until no further re-growth appears.* *The JKMP will be regularly reviewed during the lifetime of this project and updated to reflect changing conditions on site. Changes will be made subject to review and monitoring of conditions on site. Any changes will be agreed with the Planning Authority, Resident Engineer and Ecologist/ Japanese Knotweed specialist in advance through the normal communication channels'.*
Suspended Solid Pollution - RPS (2022)	*The following guidelines for erosion and sediment control are largely based on Goldman et al (1986) and are particularly important to apply in sites immediately upstream of significant salmonid habitat. They shall be applied at the subject site as follows:*

Activity	Mitigation Measures
Biodiversity EIAR Chapter	• *Sediment traps or settlement ponds should be provided for on all watercourses during construction.* • *Top soil stripping in proximity to any watercourses should be undertaken as much as feasible in dry weather conditions and all stockpiles will be located greater than 100m from the watercourse. Stockpiles within 200m of the watercourses will be covered.* • *Re-vegetate stripped areas, particularly cut and fill slopes and disturbed slopes as soon as possible. Use mulches or other organic stabilisers to minimise erosion until vegetation is established on sensitive soils.* • *Installation of silt fences along the contour at the base of a disturbed area. This will be particularly important along the lower works extent line at the northern side of the site adjacent to Ballyman Glen. Regular inspection of silt accumulation at the base and remove as appropriate.* • *Minimise runoff velocities and erosive energy by maximising the lengths of flow paths for precipitation runoff, constructing interceptor ditches and channels with low gradients to minimise secondary erosion and transport, and lining unavoidably steep interceptors or conveyance ditches with filter fabric, rock or polyethylene lining to prevent channel erosion.* • *The length and steepness of slopes should be minimised where practicable.* • *Sediment basins and traps should be installed before any major site development, remediation and grading takes place. Additional sediment traps and silt fences should be installed as such works take place to keep sediment contained on site at appropriate locations.* • *Runoff-control measures should be located in conjunction with sediment traps to divert water from planned undisturbed areas away from the traps and sediment-laden water into the traps.* • *Guidelines for minimising impacts on water quality and fisheries in relation to Construction will be implemented including, but not limited to, CIRIA C532 "Control of water pollution from construction sites - Guidance for consultants and contractors", Inland Fisheries Ireland guidelines and TII guidelines.* • *It is recommended that the "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites" (http://www.fishingireland.net/environment/constructionanddevelopment.htm) be consulted when planning to undertake works on this site. The maintenance of habitat integrity (both in-stream and riparian) is essential in safeguarding the ecological value of this important urban natural resource. The specific details of any works directly affecting watercourses or riparian habitats in the area, must first be submitted to IFI for assessment.*
Pollution with other substances - RPS (2022) Biodiversity EIAR Chapter	• *Tools and equipment are not to be cleaned in County Brook (Fassaroe Stream) or Cookstown River. Water used for cleaning should not be disposed of in the County Brook or any other watercourse.* • *Chemicals/fuels used should be stored in sealed containers in the site lockup prior to use.* • *Chemicals shall be applied in such a way as to avoid any spillage or leakage.* • *Fuelling should take place in designated areas of hardstanding and not be conducted within 50m of the County Brook (Fassaroe Stream) or Cookstown River.* • *Spill kits should be made available close to the river and all staff will be properly trained on correct use.* • *To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas. Oil and fuel storage tanks will be stored in designated areas, and these areas will be bunded to a volume of 110% of the capacity of the largest tank/ container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) will be diverted for collection and safe disposal.* • *Machinery used on site should be regularly inspected to ensure there is no leakage from them and to ensure the machinery will not cause contamination of watercourses. All machinery operating in these locations should be steam-cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs.* • *Raw or uncured waste concrete should be disposed of by removal from the site.* • *Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks should be trapped on-site to allow sediment to settle out and reach neutral pH before clarified water is released to the stream or drain system or allowed to percolate into the ground.* • *Waste oils and hydraulic fluids should be collected in suitable leak-proof containers and transported from the site and off-site areas for disposal or recycling.*

Activity	Mitigation Measures
	• *Where required, fuel should be transported in a mobile, double skinned tank and a spill tray will be used when refueling (if taking place outside a compound area).* • *All areas of land that are to be used for site compounds and storage depots should be fenced off at a minimum distance of 50 metres from the watercourse.*
Environmental Incidents and Accidents - RPS (2022) Biodiversity EIAR Chapter	• *An emergency-operating plan should be established to deal with incidents or accidents during construction that may give rise to pollution within any watercourse. This shall include means of containment in the event of accidental spillage of hydrocarbons or other pollutants (including oil booms, soakage pads, etc.* • *Oil booms and oil soakage pads should be kept on site to deal with any accidental spillage.*
RPS (2022) Screening for Appropriate Assessment and Natura impact Statement	<u>Sediment and Erosion Management Measures</u> • *Top soil stripping in proximity to any watercourses shall be undertaken as much as feasible in dry weather conditions and all stockpiles will be located greater than 100m from the watercourse. Stockpiles within 200m of the watercourses will be covered.* • *Appropriate management of excess material stockpiles to prevent siltation of watercourses.* • *Temporary construction compounds will not be located close to road cuttings, watercourses or Ballyman Glen SAC or where it is likely that groundwater will be encountered.* • *All oils, solvents and paints will be stored within suitably designed bunded areas with a bund volume of 110% of the capacity of the largest tank/container.* • *Refuelling will take place in designated areas of hardstanding. A supply of spill kits and hydrocarbon adsorbent packs will be stored along the construction areas. Personnel will be trained in the use of this equipment. Waste oils and hydraulic fluids will be collected in suitable leak-proof containers and transported from the site and off-site areas for disposal or recycling.* • *Machinery used on site will be regularly inspected to ensure there is no leakage from them and to ensure the machinery will not cause contamination of watercourses.* • *Where required, fuel will be transported in a mobile, double skinned tank and a spill tray will be used when refuelling (if taking place outside a compound area).* • *Concrete, including, but not limited to, waste and wash-down water, will be contained and managed appropriately to prevent pollution of watercourses. Concrete pouring will be prevented during periods of heavy rainfall. Use of quick setting mixes will be used.* • *Protection measures will be put in place by the Cosgrave Property Group to ensure that all hydrocarbons used during the Construction are appropriately handled, stored and disposed of in accordance with recognised standards as detailed by the Environmental Protection Agency and/or Wicklow County Council, e.g., approved waste contractor, off-site treatment/ recycling/disposal, etc.* • *Eroded sediments will be retained on Site with erosion and sediment control structures such as sediment traps, silt fences, sediment control ponds. Cut off ditches to divert surface water run-off from entering excavations will be utilised.* • *Guidelines for minimising impacts on water quality and fisheries in relation to Construction will be implemented including, but not limited to, CIRIA C532 "Control of water pollution from construction sites Guidance for consultants and contractors", Inland Fisheries Ireland guidelines and TII guidelines.* • *All watercourses that occur in areas of land that are to be used for Site compounds and storage depots will be fenced off at a minimum distance of 50 metres from the watercourse. In addition,* • *appropriate measures will be taken to ensure that silt laden or contaminated surface water runoff from such compounds and depots do not discharge directly to watercourses.* • *Run-off velocities and erosive energy will be reduced by increasing the lengths of flow paths for precipitation run-off, through the Construction of interceptor ditches and channels with low gradient, and by lining unavoidably steep interceptors or conveyance ditches with filter fabric, rock or polyethylene lining to prevent channel erosion.* • *The length and steepness of slopes will be minimised where practicable.* • *Riparian vegetation will be left intact where practicable. Protection will be afforded to riparian vegetation by fencing prior to commencement of any Works. Where practicable, the fencing will be set a minimum distance of 5 metres from the bank of the watercourse or at the edge of a woody canopy, whichever is the greatest.*

Activity	Mitigation Measures

- *Runoff and wash down water from exposed aggregate surfaces, cast in place concrete and from concrete trucks will be trapped on site to allow sediment to settle out and reach neutral pH. Cosgrave Property Group will consult and comply with the requirements of the National Parks and Wildlife Service and the Inland Fisheries of Ireland. Waste products and pollutants associated with the works will not be permitted to enter watercourses or groundwater and all precautions necessary will be taken to prevent the spillage of diesel fuel or other solvents.*

Measures for the installation of Surface Water Outfall

- *Rigorous sediment, erosion and pollution control measures have been provided for the proposed works. Good practice measures for the prevention of pollution will be employed at all times during the construction and operational period of the development to prevent run off into the springs and alkaline fen within Ballyman Glen SAC or into County Brook.*
- *As part of the construction of the outfalls within and adjacent to Ballyman Glen SAC, bunding shall be put in place to prevent run off into the springs and alkaline fen within Ballyman Glen SAC or into County Brook.*
- *Valuable habitats adjacent to working areas shall be demarcated to indicate clearly that no access is permitted. Where construction activity takes place in habitats categorised as ecological features (i.e., valuable habitats) it is important that activity is limited to the footprint of the infrastructure and immediate surrounds. Again areas where access is restricted should be demarcated.*
- *Access and egress to the location of the new outfall will be via the area cleared for the surface water pipe.*
- *Mitigation measures to prevent the spread of invasive non-native species.*

Measures for Capping, ESB Works and Localised Slope Stabilisation Works at Northern Boundary

- *Measures to avoid impact on the surrounding environment will include:*
- *Landfill capping to be placed at the base of the new slope construction to the required thickness wherever land fill is present.*
- *Slopes (existing or resulting from excavation) steeper than 1(v):5(h) will be benched prior to receiving fill.*
- *Temporary drainage will be installed to prevent surface water runoff from the adjacent land from flowing onto the slopes and cause instability and/or erosion.*
- *Bunding and silting ponds will be constructed/installed at the toe of the slope to intercept running water with suspended solids and/or concrete spillage (or other chemicals, oil, diesel etc) entering the Glen.*
- *Water will then be flowing to siltation ponds and discharged when clear of suspended solids. Water found contaminated with cement, oil, petrol or other chemical will be pumped for treatment or safe disposal*
- *Minimise run-off velocities and erosive energy by maximising the lengths of flow paths for precipitation runoff, constructing interceptor ditches and channels with low gradients to minimise secondary erosion and transport, and lining unavoidably steep interceptors or conveyance ditches with filter fabric, rock or polyethylene lining to prevent channel erosion.*
- *Sediment basins and traps should be installed before any major site grading takes place. Additional sediment traps and silt fences should be installed as grading takes place to keep sediment contained on site at appropriate locations.*
- *Runoff-control measures should be located in conjunction with sediment traps to divert water from planned undisturbed areas away from the traps and sediment-laden water into the traps.*

Measures for Protection of Petrifying Springs and Alkaline Fen

- *The following measures will be implemented for the storage and use of hydrocarbons on site:*
- *Diesel tanks, used to store fuel for the various items of machinery, will be self-contained and doublewalled.*
- *Refuelling will be carried out from these tanks or from delivery vehicles and will not be left unattended.*
- *Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice - (Enterprise Ireland BPGCS005).*
- *Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of.*
- *Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or recycling.*

Activity	Mitigation Measures
	• *Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction site to deal with any accidental spillage.* Measures to avoid Degradation of Petrifying Springs and Alkaline Fen • *Landscaping design includes planting schemes to close any existing gaps at the boundary of Ballyman Glen SAC to discourage visitors from entering the SAC.* • *Landscaping design will include tree/ shrub planting along the western boundary of the Fassaroe Phase 1 lands to close any gaps in the hedgerow to discourage visitors from entering the SAC at this location.*

7.7. Light Pollution

Obtrusive light from a construction site is a form of pollution. Construction lights can cause glare and light trespass. These are forms of obtrusive light which may cause nuisance to others.

7.7.1. Risk Identification

Contractors shall undertake a qualitative light pollution risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.13.

Table 7.13 – Example of Light Pollution Risk Assessment

	Risk Assessment	Example procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark a site plan with the location of all potential receptors including housing, schools, health-care facilities, roads and key wildlife populations. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for lighting.
02	Identify the construction activities and sources of light pollution that may affect the receptors identified.	These could include depots, storage areas, night working activities etc.
03	Evaluate the risk of the construction activities creating light pollution for the identified receptors.	Assess the likelihood of an activity causing pollution, damage or harm.
04	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods; provide adequate screening, directional light). 3. Protect the receptor (screens). 4. Put emergency procedures in place.

7.7.2. Light Pollution Control Plan

Contractors should develop, implement and maintain a Light Pollution Control Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.14).

Table 7.14 – Light Pollution Mitigation Measures

Activity	Mitigation Measures
General	Maintain levels of lighting acceptable for health and safety and avoid over lighting areas. Dim or switch off lights when task is finished. Minimise the spread/glare of light by assessing/managing direction. Lower the height of lights to minimise glare. Use screens, shields, baffles and louvers to help reduce light spill.

	Use specifically designed lighting equipment to minimise the upward spread of light near to and above the horizontal.

7.8. Archaeology and Cultural Heritage

Heritage is an irreplaceable resource, so it is recognised that cultural resources must be safeguarded for future generations. Construction activities have the potential to impact on archaeology and heritage through the destruction or disturbance of sites or artefacts.

7.8.1. Risk Identification

Contractors shall undertake a qualitative archaeological and heritage risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.15.

Table 7.15 – Example of Archaeology and Cultural Heritage Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all sensitive receptors within or adjacent to the construction site.	Mark a site plan with the location of all potential receptors including villages, forts, palaces, houses, and towers. This will help the planning of the overall layout of the construction site.
02	Identify the construction activities that may affect the receptors identified.	These could include depots, storage areas, excavation, waste storage, haul roads etc.
03	Evaluate the risk of the construction activities damaging the identified receptors.	Assess the likelihood of an activity causing pollution, damage or harm.
04	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods or operations - alternative haul roads). 3. Protect the receptor (screens). 4. Put emergency procedures in place.

7.8.2. Archaeology and Cultural Heritage Management Plan

Contractors should develop, implement and maintain an Archaeology and Heritage Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.16).

Table 7.16 – Example of Archaeology and Cultural Heritage Mitigation Measures

Activity	Mitigation Measures
General	In the event that intact and/or important archaeological or cultural items are identified during construction activities, work must stop and Wicklow County Council and the Department of Arts, Heritage and the Gaeltacht and the National Museum of Ireland should be notified immediately. Work should not recommence until authorised by Wicklow County Council and the Department of Arts, Heritage and the Gaeltacht and the National Museum of Ireland. Records should be maintained of all finds. Where practicable remains should be preserved in situ using appropriate engineering methods: 1. Raising ground levels 2. Using suitable materials and loading 3. Maintenance of Hydrological regimes.
Archaeological Heritage - RPS (2022)	• Prior to the commencement of development, a suitably qualified and licence-eligible archaeologist should be appointed. • •

Activity	Mitigation Measures
Archaeological, Architectural and Cultural Heritage EIAR Chapter	• A temporary safety barrier shall be erected, under supervision of the appointed archaeologist, around Site CH-1 in order to ensure that no accidental damage is caused to the monument during the works associated with the realignment of the adjacent road. • A 10m wide buffer area should be established around the perimeter of the detected outer edge of the monastic enclosure of Site CH-4. This should be marked by means of the erection of a temporary post-and-rope fence. No development works shall be undertaken, or materials, including spoil, stored within this buffer area. In addition, no construction related vehicles should enter the buffer area, • Prior to the commencement of development/site preparation works, the extent of the subject development should be subjected to archaeological investigations. Where considered feasible, an archaeological geophysical survey should be undertaken, followed by a programme of intrusive testing. A report detailing the results of such investigations should be prepared for submission to the Local Authority and National Monuments Service, Department of Housing, Local Government and Heritage. The report should detail any subsurface archaeological remains if such are identified, assess the impact of the development on such remains and propose any further archaeological requirements necessary prior to commencement of construction works (including monitoring, recording and excavation if and as appropriate). No site preparation/construction works should commence until written agreement to any such further archaeological proposals is forthcoming from the Local Authority and/or National monuments Service.
Architectural Heritage RPS (2022) Archaeological, Architectural and Cultural Heritage EIAR Chapter	There are no protected structures, within the meaning of the Planning and Development Act, 2000, or NIAH-listed structures, situated within the boundaries of the proposed development lands. There are three Protected Structures and three NIAH-listed structures located outside the subject proposed boundaries but within the defined study area, Given the locations of these structures and the extents of their attendant grounds (curtilages), it is not considered likely that any direct impacts will occur during the construction phase of the development with respect to these structures of architectural heritage interest. Consequently, no mitigation measures are deemed necessary.

7.9. Traffic Management

Accidents involving construction vehicles and/or mobile equipment have the potential to cause serious injury or death and damage to the environment. Work zones on construction sites are used to move traffic in an approved direction and are typically identified by signs, cones, barrels, and barriers.

7.9.1. Risk identification

Contractors shall undertake a traffic management risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.17.

Table 7.17 – Example of Traffic Management Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of all traffic sensitive areas within or adjacent to the construction site.	Mark a site plan with the location of all potential traffic sensitive areas including villages, forts, palaces, houses, schools, shopping districts, commercial/leisure areas roads and other rights of way. This will help the planning of the overall layout of the construction site and enable the identification of suitable sites for vehicle/pedestrian entrances, storage areas etc.
02	Identify the construction activities which may affect the traffic sensitive areas identified.	These could include depots, storage areas, excavation, waste storage, haul roads etc.
03	Evaluate the risk of the construction activities impacting on traffic sensitive areas.	Assess the likelihood of an activity causing harm or obstruction.

	Risk Assessment	Example Procedure
04	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods or operations - alternative haul roads). 3. Protect the receptor (screens, signs, barriers). 4. Put emergency procedures in place.

7.9.2. Traffic Management Control Plan

Contractors should develop, implement and maintain a Traffic Management Control Plan. The Plan forms an important management tool that acts as the catalyst for reducing the negative transport effects of construction work (e.g. congestion, air pollution and noise) on local communities, residents, businesses and the environment. By promoting efficient working practices, shorter haulage routes and reducing deliveries, the implementation of the Plan not only gives rise to the above benefits, but also helps saves costs.

The Plan should include but not be restricted to the mitigation measures below (Table 7.18):

Table 7.18 –Traffic Management Mitigation Measures

Activity	Mitigation Measures
RPS (2022) Traffic and Transportation EIAR Chapter	*The following mitigation measure shall apply during the construction stage:* *All construction activities will be managed and directed by a Construction Traffic Management Plan (CTMP). The details of the CTMP will be agreed with the roads department of the Local Authority in advance of construction activities commencing on-site. The CTMP will as a minimum detail such as:* • *Location of site and materials compound;* • *Location of areas for construction site offices and staff facilities;* • *Details of site hoarding and security;* • *Construction traffic will be limited to certain routes and times of the day, with the aim of keeping disruption to pedestrians, cyclist, general traffic and public transport to a minimum;* • *During peak network hours (0800 – 0900 and 1700-1800) construction traffic movements will be discouraged;* • *The daily construction programme will be planned to minimise the number of disruptions to the local highway network by staggering HGV movements to avoid site queueing;* • *Measures to prevent spillage of spoil or materials on the public highway including the use of on-site wheel washing facilities and street cleaning measures;* • *Any traffic management plans that may be required for a road closure or pedestrian footpath closure, including appropriate signage advance public notice procedures;* • *Details of appropriate monitoring and mitigation measures to minimise noise, dust and vibration impacts on any identified sensitive receptors;* • *Details of how the contractor will be encouraged to promote sustainable travel to and from the site by its employees.*

7.10. Contaminated Land

The term ‘land contamination’ covers a wide range of situations where land is contaminated in some way by previous use. This is often associated with industrial processes or activities that have now ceased, but where waste products or remaining residues present a hazard to the general environment.

7.10.1. Risk Identification

Contractors shall undertake a contaminated land risk assessment or appraisal prior to the commencement of construction activities. An example risk assessment is shown in Table 7.19.

Table 7.19 – Example of Contaminated Land Risk Assessment

	Risk Assessment	Example Procedure
01	Identify the location of contamination risks by undertaking site visits and desk-based studies of relevant documents - EIA etc.	Mark a site plan with the location of all potential contamination risks including waste deposits, petrol stations, oil stores etc.
02	Identify the construction activities that may create ground contamination.	These could include depots, storage areas, waste storage, etc.
03	Evaluate the risk of the construction activities leading to ground contamination.	Assess the likelihood of an activity causing pollution, damage or harm.
04	Implement mitigation to eliminate or reduce risks.	Use the following hierarchy to manage the risk: 1. Remove the risk (different construction methods/activities). 2. Control the source (modify construction methods or operations) 3. Protect the ground (screens). 4. Put emergency procedures in place.

7.10.2. Contaminated Land Control Plan

Contractors should develop, implement and maintain a Contaminated Land Control Plan. The Plan should include but not be restricted to the mitigation measures below (Table 7.20).

Table 7.20 – Example of Contaminated Land Mitigation Measures

Activity	Mitigation Measures
General	The contractor will manage and control the potential contamination of land from construction activities through the implementation of the CEMP and method statements as appropriate. The contractor will notify Atkins immediately if contaminated land is discovered or suspected. The contractor will work with Atkins to: • Undertake a risk assessment of the potential contamination. • Evaluate options for remediation including: ○ Containment ○ Monitoring ○ Treatment ○ Removal/Disposal The contractor will implement remediation strategy and monitor as appropriate.

7.11. Population and Human Health

The construction phase of the proposed development will result in the creation of a large construction site which will have temporary construction traffic and noise related impacts which have the potential to affect the existing local residential community.

The construction phase of the development will have impacts related to generation of dust and release of odours with potential for impact on human health. The construction works have potential for impact on the health of construction workers. This relates in particular to the remediation works to the historic landfill sites.

Contractors should implement the following mitigation measures (Table 7.21).

Table 7-21 - Example of Human Health Mitigation Measures

Activity	Mitigation Measures
Population – RPS (2022) Population and Human Health EIAR Chapter	*The following general mitigation measures will be implemented during the construction phase of the proposed development at Fassaroe which will minimise potential adverse impacts due to traffic or noise during construction.* • *A construction management plan and associated construction traffic management plan shall be developed, to minimise construction related inconveniences. Both plans will be agreed in advance with the Local Authority.* • *Appropriate temporary signage will be put in place during construction.* • *Provision will be made for reasonable and safe facilities for pedestrians and cyclists during the construction period.* • *Construction materials, where possible, will be sourced locally in order to reduce potential traffic delays and to support the local economy.* • *Normal Health and Safety standards will also be applied during the construction phase to mitigate against any potential adverse impacts on workers at the site or on residents or other road users during the construction period.* *In addition, please refer to mitigation measures relating to air quality and noise control set out above which will minimise adverse impacts for local residents.*
Human Health – RPS (2022) Population and Human Health EIAR Chapter	*To manage risk to construction workers at and in the vicinity of the former landfill sites, all relevant operatives will be suitably training in the HSA Guide to the Safety, Health and Welfare at Work General Application Regulations 2007, Part 8: Explosive Atmospheres at Places of Work.* *Potential for adverse impacts on human health for construction workers were identified to:* • *potential exposure of waste and gas during excavation / remedial works at the historic landfill sites, and* • *potential asbestos exposure with the proposed house demolition on Berryfield Lane* *To mitigate these particular risks the following mitigation will be employed.* ***Site Access*** • *To protect the personnel outside the work area and for proper control of the areas being worked in, it will be necessary to take complete and secure possession of the site. Secure temporary fencing shall be erected around the waste excavation area. An area shall be delineated around the proposed excavation which will be regarded as a safety zone beyond which the contractor's plant shall not be permitted to leave unless it undergoes full decontamination to ensure waste is not exported from site.* • *Measures will be required to ensure that only authorised persons can enter the work area and that they are trained, competent and inducted for the operations being carried out within the site. The contractor must put in place rigorous accident and emergency procedures and ensure that all persons on site are familiar with these.* • *Due to the nature of the material in question, all excavation and movement of waste should be carried out by mechanical means.* *Personal Protective Equipment* • *Strict rules and standards will be enforced regarding PPE around the works area. This will include at a minimum helmet, gloves, tyvek suits, steel toed boots and safety glasses. Appropriate respiratory equipment will be maintained on site and there will be ongoing monitoring for gaseous hazards. The monitoring will be agreed with the contractor, but provision must be made for raising the alarm, emergency procedures and a plan for alerting those outside the work areas.* • *In addition, suitable hygiene and welfare facilities and PPE should be provided in accordance with the requirements of the Safety, Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013 to manage potential risks to construction workers.* *Dust Suppression* • *The excavation of the works must be planned to minimise the risk of any material becoming airborne through the creation of dust. The contractor will have to put measures in place for dust suppression (water bowser) and have regard to weather conditions during the works to avoid run-off or severe dryness which could lead to problems with containment.*

	Gas and Odour Control • *A detailed construction methodology for the excavation works shall be prepared by the contractor and communicated to all site personnel to ensure that no confined spaces or trenches deeper than 1m are created during the excavation of waste. Where confined spaces or trenches greater than 1m are created, gas detection equipment and appropriate breathing apparatus should be used by all personnel in the vicinity of the confined space/trench.* • *The works must be planned to minimise the risk of the release of odours and gases to surrounding areas including the contractor's compound and the wider community. Site operatives in the vicinity of the landfill sites will be instructed to report all unusual, concentrated or significant odours on-site, so that measures may be taken to identify the source of the odour and eliminate it. Gas monitoring techniques will be put in place by the contractor. For nuisance odours, automated odour control systems may need to be put in place, as necessary, to periodically release a fragrance to mask or neutralise unpleasant odour.* • *A wheel-washing facility shall be established for trucks leaving the site to minimise the transport of potentially odorous clay particles onto adjacent roads.* • *A no smoking policy will be strictly enforced onsite.* *Exposed Waste Material* *To mitigate the impacts arising from the exposed waste the following measures will be implemented:* • *The contractor shall excavate the waste in areas as small as possible in order to limit the exposure of the waste. The contractor shall prepare an excavation plan which supports this ethos;* • *Should excessive wind conditions prevail, such that there is a risk of uncontrolled exposure to the waste with the consequences of it becoming windblown then the excavation shall cease until the weather becomes more amenable to the safe excavation of the waste. Any exposed areas of waste shall be covered with compacted clean material at the end of every working day as a minimum, in order to minimise the exposure of the waste to the winds;* • *An area around the proposed excavation will be delineated which will be regarded as a safety zone beyond which the contractor's machinery is not permitted to leave unless it undergoes full decontamination;* • *Only fully sealed containers shall be used for the removal of waste offsite; and* • *Prior to demobilisation, the contractor shall properly decontaminate all equipment and appropriately dispose of the decontamination water, field waste and contaminated personal protective equipment (PPE).* *Asbestos* *During the site investigations to date only 1 of 53 samples of waste tested positive for asbestos. This waste was in Site 1. Nonetheless there remains a risk that asbestos or Asbestos Containing Material (ACM) could be uncovered during the excavation of waste in Site 3B. It is also possible that there could be asbestos within the proposed building for demolition.* *It shall therefore be a requirement that the contractor for the works has in place, prior to the works, an Asbestos Management Plan, prepared in accordance with the following guidance and regulations:* • *AGS 2012, Interim Guidance ' Site Investigation Asbestos Risk Assessment for the Protection of Site Investigation and Geotechnical Laboratory Personnel';* • *CIRIA 2014, C733 A Guide to Understanding and Managing Risks; and* • *Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010.* *It is also required to undertake an asbestos survey of the dwelling proposed for demolition prior to the construction of works. In the event that asbestos is identified this shall be addressed in the Asbestos Management Plan.*
Landfill Remediation Design – RPS (2022) Fassaroe Phase 1 Development Remediation Strategy Report	1. <u>Scope of Landfill Remediation Measures</u> *The proposed landfill capping remedial measures, have been designed to meet the requirements of the Certificates of Authorisation and to accommodate the construction of the Phase 1 Cosgrave Development, specifically to:* • *Minimise infiltration of water and maximise clean run-off from the landfill areas;* • *Promote surface drainage and maximise clean run-off from the landfill areas;* • *Control landfill gas migration; and,* • *Provide a physical separation between waste and human and environmental receptors.*

The proposed landfill capping measures comprise mitigation and management proposals to eliminate any potential adverse impacts of the landfills on the development proposed, and in particular any potential to impact on human health or the uses proposed which include residential and amenity uses. The proposals will effectively close-off any potential pathways from the landfills to the proposed new uses, including amenity uses on top of the landfills and residential uses adjacent to them, all in accordance with best practice.

It should be noted that while the lands on which Sites 2, 3A, 3B and 3C are located are owned by Cosgrave Developments, Wicklow County Council as the CoA holder is responsible for the operation, control and maintenance of the sites and for ensuring the conditions of the Certificates of Authorisation are complied with. Agreement has been obtained from Wicklow County Council to include the capping of the landfills (including Site 1) within the proposed Phase 1 development as it is acknowledged that the remediation of the sites in accordance with the Certificates of Authorisation is intrinsically linked to the future after use of the site post-development.

2. Proposed Site Afteruse

Site 1: Site 1 is to be developed as a parkland amenity area consisting of densely planted trees to the west, with open green areas and pedestrian pathways to the centre and east.

Site 2: Site 2 is to be developed as a parkland amenity area with the following features:

- *Open green areas;*
- *Areas of planted trees;*
- *Pedestrian pathways;*
- *Two surface water attenuation ponds for amenity features and to accommodate storm run-off from the proposed development;*
- *A main access road to be constructed in fill; and,*
- *Stepped outdoor amphitheatre.*

Site 3A: Site 3A does not lie within the proposed footprint of the Phase 1 development this site will receive a landfill capping system and will be restored to its current use as grassland.

Site 3B: The main access road to the east of the proposed development will pass through Site 3B. The road will be constructed in cut (below the existing ground levels). The southern portion of Site 3B will be restored to its current use as grassland.

Site 3C: As Site 3C does not lie within the proposed footprint of the Phase 1 development this site will receive a landfill capping system and be reinstated to its current use as grassland.

3. Proposed Capping System Design – Proposed Capping System Details

The proposed land afteruse in each of the sites to be capped varies both from site to site and within each site. Therefore the material makes up of each area, depending on afteruse, will be different. However, in all landfill areas to be capped the following minimum capping system will be installed (in order of placement):

- *Regulation layer (maximum thickness 300mm);*
- *Gas collection geocomposite (approximately 4-6mm thickness);*
- *1mm thick low permeability geomembrane (LLDPE-linear low density polyethylene) liner having a hydraulic conductivity of less than or equal to 1x10-9m/s;*
- *Surface water drainage geocomposite (approximately 4-6mm thickness);*
- *850mm Subsoil layer; and,*
- *150mm Topsoil layer.*

In areas to receive roads or pavements, the subsoil and topsoil layers will be replaced with suitable engineering materials and will maintain the minimum of 1m cover from the surface water geocomposite to finished road/pavement level. The minimum finished ground level shall be 1m above the capping surface water geocomposite and liner and a maximum of 1.3m above existing ground.

The purpose of the subsoil and topsoil layers in a normal landfill application is to provide a 1m physical barrier to the capping system geocomposite and geomembrane layers. Therefore in areas which are to be raised by >1.3m above existing ground level, additional depths of general fill or subsoil materials will be used to make up the depth required. This will then be overlain by topsoil in landscaped areas to the required depth for planting. Areas to receive roads or pavements will similarly need to maintain the 1m cover from the surface water geocomposite to finished road/pavement level. To represent this, the minimum capping system and the overlying materials proposed for the various proposed post-capping land uses throughout the various sites.

Confirmatory Slit Trenches

To date, the extent of the waste footprint at each of the landfill sites has been determined through a combination of borehole, trial pit and geophysical survey investigations. Prior to installation of the capping systems a series of slit trenches will be excavated along the current interpretation of the waste perimeter to determine the exact location of the perimeter.

Landfill Gas Management Design

At all five Sites, despite their age, waste is currently generating a residual amount of landfill gas and will continue to do so for some years. Landfill gas migrates along the path of least resistance. At present, the gas simply migrates towards the surface of the landfills. In areas where the existing cover material is not well compacted the landfill gas will migrate through the cover material and into the atmosphere. In areas where the existing clay cover material is well compacted the landfill gas will be prevented from venting through the surface and will therefore migrate laterally through the underlying sand and gravel deposits. This lateral migration of landfill gas is evident in a number of boreholes which have been drilled outside of the waste areas. With the installation of a low permeability capping layer the gas will be prevented from venting through the surface of the landfill and will therefore build up in pressure and eventually migrate laterally beneath the edges of the sites, potentially towards residential units. To prevent this occurring a gas management system shall be incorporated into the rehabilitation measures.

Leachate Interception

Each of Sites 1, 2, 3A, 3B and 3C infiltration of rainwater and decomposition of the waste has resulted in leachate plumes beneath the waste bodies. These leachate plumes extend a considerable distance below the waste bodies (approximately 40m below the waste in the case of Site 2) and migrate in the direction of the groundwater flow regime, generally to the north-east. In some areas also, for example Site 1, there is evidence of perched leachate which is as a result of an intermediate stratum of over-compacted waste or cover material preventing or reducing infiltration of liquid beneath it and resulting in a localised head of leachate. Given the nature of the waste and the likely ad-hoc fashion in which it was filled, it is possible that, following removal of vegetation and grading of the waste surface to receive the capping system, seepage from wet/saturated pockets of waste may result in a build-up of leachate against the underside of the capping system geocomposites. This would be more likely to occur on the down-gradient side of the waste bodies. This leachate could then travel between the surface of the waste and the gas drainage geocomposite and make its way to the perimeter of the waste body. However, the nature of such leachate breakouts, if any, would be sporadic, localised and random to a degree. It is also more likely that leachate would seep back down into the waste body again locally without traveling to the edge of the waste.

In order to redirect any localised leachate seepages back into the waste, it is proposed that the gas drainage geocomposite shall be returned into the ground at the edge of the waste body.

This will mean that any minimal amounts of leachate which may have seeped upwards into the geocomposite, will be directed back down into the waste body by the vertical element of the geocomposite. This volume of leachate would be minuscule in comparison to the total volume of leachate currently within and below the waste body.

It is also important to note that leachate generation, and therefore the likelihood of any seepage, will be greatly reduced by the installation of the proposed best practice low permeability capping system, which will minimise infiltration of rainfall.

At Site 3B, in order to accommodate the access road which will be constructed in cut through the site, it is proposed that all of the waste beneath the pavement layers will be excavated down to clean material. As the existing ground is generally flat, there is no risk of stability issues due to a build-up of leachate head. Notwithstanding this, a granular fill blanket will be laid at the base of the road pavement beneath the capping lining materials, this will facilitate the draining away of leachate from the capping materials in the direction of the groundwater gradient (i.e. north-eastwards), which will maintain the current situation.

Surface Water Drainage Design

Once the low permeability geomembrane liner has been installed, infiltration of surface water through the capping system will be minimal. Surface water at finished ground level (e.g. on grassed areas, pathways etc.) will drain overland towards the river, as currently takes place. However some infiltration of surface water will continue to occur through the soils overlying the capping system. This will need to be managed independently in a subsurface drainage system. In order to prevent ponding of this water on the capping materials, a surface water collection geocomposite will be installed above the LLDPE geomembrane. As noted above, the surface water geocomposite will provide sufficient flow capacity above the LLDPE geomembrane to ensure that the water is drained towards the perimeter of the waste body. Here the LLDPE liner and surface water geocomposite will be continued through a subsurface drain.

This will consist of a perforated pipe installed at a depth of 1.2m bgl, within a granular stone-filled trench. This subsurface drain will be laid at grade with the existing site topography for Sites 1 and 2 and will be connected by a series of manholes. This subsurface drain will connect to the main development surface water drainage system, prior to the outfall at the river.

The capping system will provide attenuation for the runoff from the capped sites. The manner by which these areas are attenuated , and its effect on the peak flow and greenfield run-off rate is described below:

- *Based on a permeability of 1 x 10-5 m/s for the backfill and a hydraulic conductivity of 1 x 10-4 m/s for the surface water geocomposite in the capping system (which is 1m minimum below the finished ground surface), the average time of concentration in the sub-surface infiltration drain is approximately 23.5 days.*
- *In a storm event, the precipitation which does not flow as surface run-off will infiltrate through to landfill cover soils, attenuating naturally through the cover soils as it does so, until it hits the geocomposite, where it will be further attenuated at 1x10-4m/s. This attenuation and lengthy time of concentration means that there will not be a peak flow from the subsurface infiltration drain and therefore will be no increase to the greenfield run-off rate.*
- *Even when the ground is already saturated prior to a storm event, the cover soils would not have capacity to hold the water so the majority of the water flows as surface run-off, as would occur naturally in the absence of a capping system.*
- *To summarise, any infiltrating water will be naturally attenuated through the capping cover soils and surface water geocomposite as it makes its way to the perimeter drain. Due to the lengthy time of concentration, there will be no peak flow associated with the sub-surface infiltration drain.*

At Site 3B, as the road is to be constructed and cut through the waste, any surface water infiltrating through to the capping system will be allowed to discharge to the road surface water drain on either side of the carriageway. To the north of the road cut, the waste footprint remaining following construction of the road will be approximately 300m2 of grass surface. Therefore the anticipated infiltration of surface water through to the capping system will be negligible, so no subsurface drainage is proposed on the north of the road.

4. Slope Stabilisation

In order to accommodate both the construction of the landfill capping system and the Phase 1 development, slope stabilisation measures will need to be installed in the four areas where landslips and potentially unstable fill areas have been identified to the north of Site 2. This will need to be undertaken at an early stage in the Phase 1 development and prior to the installation of the capping system or loading/surcharging on the landfill areas.

Section A - Planning Drawing 5186693/HTR/01/DR/0609

The typical cross-section for the slope stabilisation works in Section A is shown on planning drawing 5186693/HTR/01/0609. As part of the stabilisation works in this section all material above the slip surface will be excavated and replaced with acceptable fill material at a gradient of 1(V):3(H). The toe of the new slope will then extend slightly further toward the river than the existing toe. Above the shoulder of the existing top of the slope, the earthworks will be cut in order to provide a shallower gradient of 1(V):4(H). This area can then be considered to be part of the park. Additional fill will be placed on the area above the proposed remediation area if required.

The new fill material will be benched into the existing slope at a gradient of 1(V):5(H) or steeper if required. All newly formed slopes will be backfilled following the excavation of material.

The landfill capping system will be installed above the waste material prior to the placement of new fill material on top of this.

Section B - Planning Drawing 5186693/HTR/01/DR/0609

The typical cross-section for the slope stabilisation works in Section B is shown on planning drawing 5186693/HTR/01/DR/0609.

It has been reported that slope failures have previously occurred at Section B, one while undertaking the geophysical surveys in May 2016 and another following this.

Stabilisation works for Section B will be similar to those proposed for Section A. Slipped material on the lower half of the slope will be excavated and the area regraded and filled with acceptable fill material at a slope of 1(V):3(H). The results of the geophysical survey showed the material underlying the slip surface to consist of natural sand/gravel. However it is possible that some slip material consists of waste. Therefore it may be necessary to treat all material to be removed as waste material.

Due to landtake constraints it will be necessary to construct a reinforced earth slope at a gradient of 1(V):2(H), with an approximate height of 5-6m. Fill will then be placed above this at a gradient of 1(V):3(H) to tie in with the top of the landfill capping to be provided in the park area. All material above the slip surface will be excavated.

The landfill capping system will be provided at the base of the new fill above the waste material for the upper half of the slope and if waste is encountered, on the lower half also.

Section C - Planning Drawing 5186693/HTR/01/DR/0610

The typical cross-section for the slope stabilisation works in Section C is shown on planning drawing 5186693/HTR/01/DR/0610.

There is evidence of a slope failure at Section C. However it was not possible to inspect the slope surface due to the presence of vegetation and therefore the slope profile was estimated. The stabilisation works for Section C will be the same as those described for Section A with a new approximate slope of 1(V):2.5(H). The material to be excavated at the base of the slip surface is thought to consist of natural ground. Should this be confirmed, the landfill capping system will not be required in this area.

Section D - Planning Drawing 5186693/HTR/01/DR/0610

The typical cross-section for the slope stabilisation works in Section D is shown on planning drawing 5186693/HTR/01/DR/0610. There is evidence onsite that slope failures have occurred in this area. The slope in this area is quite steep which is not adequately represented on the LIDAR survey due to the presence of vegetation. The proposed stabilisation works for Section D will consist of regrading works to the area at a slope of 1(V):2(H). The existing slope will be benched prior to the placement of acceptable fill material. It is also proposed to construct a wedge of coarse granular material at the toe of the slope as scour protection for the river and relatively flat ground on the riverbank.

5. Settlement

It is possible, given the history of each of the Sites 1, 2, 3A, 3B and 3C that only low levels of compaction of waste occurred during filling operations. As such, with the installation of a minimum of 1 m of cover soils above the waste and additional fill above this to make up the finished ground level, this loading may result in settlement of the landfill areas. During the detailed design, consideration will therefore be given to measures to minimise the impact of potential settlement, including the inclusion of a geogrid system, at critical locations in the capping system, to reduce differential settlement. In addition, the earthworks programme for the Phase 1 development will be devised to consider provision for the surcharging of Site 1, 2, 3A, 3B and 3C with clean excavated material at an early stage in the development works (once the slope stabilisation works on Site 2 have been completed and prior to installation of the capping system). This will promote settlement so that post-capping settlement of the landfill areas is reduced as much as possible.

6. Excavation and Removal of Waste off-site

Site 1: There is the requirement for modest excavations within the waste body of Site 1. Where possible the material will be utilised on site in an appropriate manner to assist in the reprofiling of the waste body, and excess material will be excavated from this location and removed off-site to a licenced waste facility.

Site 2: There is the requirement for modest excavations within the waste body of Site 2. Where possible the material will be utilised on site in an appropriate manner to assist in the reprofiling of the waste body, and excess material will be excavated from this location and removed off-site to a licenced waste facility.

During the piling process for the road embankment which traverses the southern point of Site 2 (piling options shown on Drawing 5186693/HTR/01/DR/0607-0608), waste will be brought to the surface. This material will be placed beneath the capping system or if necessary will be moved off site to a licenced waste disposal facility.

Site 3B: It is proposed to construct a new access road through Site 3B as shown on Drawing 5186693/HTR/01/DR/0606, drawing CP19001-RPS-00-XX-DR-C-DG0007 S3 P02. In order to accommodate the required levels for the road, the final profile level of Site 3B must be lowered. This will be achieved through the excavation of waste from Site 3B and transportation to a licenced waste disposal facility. As waste below the road would result in long term settlement, measures would be required to mitigate this impact (e.g. rigid platform, piles, ground replacement). As most of the waste will be excavated to reach the required levels, the option of excavating the remaining waste and replacing it with acceptable material to the base of the road construction is considered the most economical and time efficient approach Waste within Site 3B currently extends to 4-4.5m bgl. It is proposed that all waste within the footprint of the road pavement in Site 3B will be excavated down to clean material and removed offsite. Where possible the material will be utilised on site in an appropriate manner to assist in the reprofiling of the waste body, and excess material will be excavated from this location and removed off-site to a licenced waste facility.

Excavation of Waste

The following mitigation and management measures will be required to be implemented during the excavation of waste from landfill Sites 1, 2 and 3B.

Site Access

To protect the personnel outside the work area and for proper control of the areas being worked in, it will be necessary to take complete and secure possession of the site. Secure temporary fencing shall be erected around the waste excavation area. An area shall be delineated around the proposed excavation which will be regarded as a safety zone beyond which the contractor's plant shall not be permitted to leave unless it undergoes full decontamination to ensure waste is not exported from site. Measures will be

required to ensure that only authorised persons can enter the work area and that they are trained, competent and inducted for the operations being carried out within the site. The contractor must put in place rigorous accident and emergency procedures and ensure that all persons on site are familiar with these. Due to the nature of the material in question, all excavation and movement of waste should be carried out by mechanical means.

Personal Protective Equipment

Strict rules and standards will be enforced regarding PPE around the works area. This will include at a minimum; helmets, gloves, tyvek suits, steel toed sole protective boots and safety glasses. Appropriate respiratory equipment will be maintained on site and there will be ongoing monitoring for gaseous hazards. The monitoring will be agreed with the contractor, but provision must be made for raising the alarm, emergency procedures and a plan for alerting those outside the work areas. In addition, suitable hygiene and welfare facilities and PPE should be provided in accordance with the requirements of the Safety, Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010 amendments and the Safety Health and Welfare at Work (Construction) Regulations 2013 to manage potential risks to construction workers.

Dust Suppression

The excavation of the works must be planned to minimise the risk of any material becoming airborne through the creation of dust. The contractor will have to put measures in place for dust suppression (water bowser) and have regard to weather conditions during the works to avoid run-off or severe dryness which could lead to problems with containment.

Gas and Odour Control

The anaerobic decomposition of putrescible waste generates landfill gas which comprises methane and carbon dioxide. Gas monitoring carried out on Site 3B to date has consistently recorded methane concentrations ranging from 25.8% v/v to 70.4% v/v and carbon dioxide ranging from 17.2%v/v to 36.6%v/v. Therefore it is expected that methane and carbon dioxide will be encountered during the Site 3B excavations.

A detailed construction methodology for the excavation works shall be prepared by the contractor and communicated to all site personnel to minimise creating confined spaces or trenches deeper than 1m during the excavation of waste. Where confined spaces or trenches greater than 1m are created, gas detection equipment and appropriate breathing apparatus should be used by all personnel in the vicinity of the confined space/trench.

The works must be planned to minimise the risk of the release of odours and gases to surrounding areas including the contractor's compound and the wider community. Site operatives in the Site 3B area will be instructed to report all unusual, concentrated or significant odours on-site, so that measures may be taken to identify the source of the odour and eliminate it. Gas monitoring techniques will be put in place by the contractor.

For nuisance odours, automated odour control systems may need to be put in place, as necessary, to periodically release a fragrance to mask or neutralise unpleasant odour. A wheel-washing facility shall be established for trucks leaving the site to minimise the transport of potentially odorous clay particles onto adjacent roads.

A no smoking policy will be strictly enforced onsite.

Exposed Waste Material

During the excavation works the waste material will be exposed, increasing the risk for windblown litter.

Waste material and contaminated material may also be exported offsite attached to equipment and machinery.

To mitigate the impacts arising from the exposed waste the following measures will be implemented:

- *The contractor shall excavate the waste in areas as small as possible in order to limit the exposure of the waste. The contractor shall prepare an excavation plan which supports this ethos;*
- *Should excessive wind conditions prevail, such that there is a risk of uncontrolled exposure to the waste with the consequences of it becoming windblown then the excavation shall cease until the weather becomes more amenable to the safe excavation of the waste. Any exposed areas of waste shall be covered with compacted clean material at the end of every working day as a minimum, in order to minimise the exposure of the waste to the winds;*
- *An area around the proposed excavation will be delineated which will be regarded as a safety zone beyond which the contractor's machinery is not permitted to leave unless it undergoes full decontamination;*
- *Only fully sealed containers shall be used for the removal of waste offsite; and,*

- *Prior to demobilisation, the contractor shall properly decontaminate all equipment and appropriately dispose of the decontamination water, field waste and contaminated personal protective equipment (PPE).*

Asbestos

During the site investigations to date only 1 of 53 samples of waste tested positive for asbestos. This waste was in Site 1. Nonetheless there remains a risk that asbestos or Asbestos Containing Material (ACM) could be uncovered during the excavation of waste in Site 3B. It shall therefore be a requirement that the contractor for the works has in place, prior to the works, an Asbestos Management Plan, prepared in accordance with the following guidance and regulations:

- *AGS 2012, Interim Guidance 'Site Investigation Asbestos Risk Assessment for the Protection of Site Investigation and Geotechnical Laboratory Personnel';*
- *CIRIA 2014, C733 A Guide to Understanding and Managing Risks; and,*
- *Safety Health and Welfare at Work (Exposure to Asbestos) Regulations 2006 and 2010.*

7. Capping System Construction Quality Assurance (CQA)

CQA Plan

As part of the design, a CQA Plan will be prepared for the installation of the capping system in accordance with the requirements of the EPA Landfill Manual: Landfill Site Design. The CQA Plan will set down the procedures for sourcing, transporting, placing, testing, repairing and protecting the capping materials prior to, during and after construction. The CQA Plan will set out the roles and responsibilities of the various parties on site and the reporting to be provided by the manufacturer, installer and CQA Monitor. This plan will help to ensure the design of the capping system is not compromised during its construction.

CQA Supervision

Third party supervision of the capping works by a specialist CQA consultant is required by the EPA Landfill Manual: Landfill Site Design and will be provided by a suitably qualified and experienced company. The CQA contractor will be responsible for overseeing the capping works and ensure that the main contractor adheres to the Works Requirements. A CQA validation report will be submitted to the EPA following the construction for the capping system. The CQA validation report will set out all aspects of the construction from supply through to final placement and testing.

A quality control system will be put in place for all documentation relating to the capping works. All documentation will be kept on-site and available for inspection at all times. CQA documentation will include the following:

- *Delivery, handling and storage of materials;*
- *Geomembrane panel layout and programme;*
- *Geocomposite panel layout and programme;*
- *Monitoring programme;*
- *Geomembrane seam testing;*
- *Geocomposite seam testing;*
- *Soil inspection; and,*
- *Laboratory testing results.*

8. Landscaping

As the afteruse of the sites 3B will require the establishment of vegetation, there needs to be a recuperation period during which the soil is allowed to recover from the effects of movement, storage and replacement. Following this period, a landscape plan will be implemented to establish, maintain and monitor vegetation in order to successfully develop the landscaped areas of the site to their intended after-use. This will include cultivating and improving the soil to allow for the establishment of vegetation. Timing of the final landscaping works will be influenced by a number of factors

- *Settlement rates across the site;*
- *Installation of environmental pollution control systems; and,*
- *Seasonal conditions.*

Landfill remediation proposals is discussed in detail in Chapter 2 of this EIA Report, Volume 3 Parts 3 and 4 of the EIAR and the Historic Landfill Remediation Strategy Report and Gas Management Strategy lodged as part of the current application documentation

8. Emergency Response Plan

The contractor shall establish, implement and maintain procedures to identify and manage potential environmental emergency situations and potential accidents. The contractor shall respond to actual emergency situations and prevent and mitigate adverse environmental impacts.

The contractor should periodically test, review and update emergency preparedness and response procedures.

8.1. Key Requirements

During construction accidents, incidents and emergencies that have an environmental impact may occur. In the event of an emergency, the first response is to locate the source of that which is giving rise to the environmental impact where appropriate and stop continuation of the situation, followed by the containment, control and mitigation of the situation.

For the construction site The Emergency Response Procedure will be displayed within the Site Office / compound.

A copy of the Material Safety Data Sheets for all the chemicals used on the project site will also be kept at the site office.

The main objectives of the Emergency Response Plan are to:

- Ensure that all means are available to contain the consequences of an accidental spill, fire or release of oil/fuel;
- Ensure that employees are suitably trained to respond to fire and spill;
- Ensure that proper reporting takes place; and
- Ensure that proper investigation is undertaken.

All contractor personnel and sub-contractors will be instructed and rehearsed, as appropriate, in the requirements of the emergency response procedure. Following control of an incident or emergency, an investigation will be conducted, and corrective actions identified and addressed. The Contractor's Environmental Manager will verify the close out of environmental related actions and notify the Employer and/or the Employer's Representative of any emergency.

8.2. Emergency Incidents

Emergency incidents are those occurring that rise to significant negative environmental effects including but not limited to the following:

- Any malfunction of any mitigation measure and/or environmental protection system;
- Any emission that does not comply with requirements of the contract and relevant licenses/permits;
- Any circumstance with potential environmental pollution; or
- Any emergency that may give rise to environmental effects (e.g. significant spillages or fire outbreak).

8.3. Spill Contingency Plan

The main causes of contamination can occur through:

- Spillage of hazardous material including fuel oils, waste materials or chemicals;
- Spillage of wastewater sewage and other liquid effluents; and
- Spillage of contaminated wash down water with oils, chemicals etc from vehicles, equipment and machinery.

Prior to commencing activities on site, Contractors should develop, implement and maintain a Spill Contingency Management Plan. The Plan should include but not be restricted to the mitigation measures below (Table 8.1).

Table 8.1 –Spill Mitigation Measures

Activity	Mitigation Measures
Mitigation Actions /Emergency Response	Contractors will carry out regular inspections/ audits of hazardous materials usage, handling and storage areas and regular/thorough maintenance of vehicles and hydraulic systems and inspections of sanitary facilities and disposal. All contractors handling hazardous materials will keep appropriate spill cleanup material adjacent to storage and maintenance areas.

Minimise the amount of diesel, oil, paint, thinners and other chemicals stored on site that pose potential spillage environmental hazards and use materials that minimise environmental impact such as lead-free paints, asbestos free materials etc.

Storage areas will be located away from drains/trenches/wastewater collection devices in an impervious bund area (volume of the storage bund >110% of the largest storage tank contained within the bund).

Collection systems will be provided/bunded if necessary under machinery or equipment that may leak hydrocarbons/hazardous substances.

The contractor shall be responsible for training all staff in the procedures for handling spills and shall provide all staff with appropriate personal protective equipment.

The contractor shall provide all staff with appropriate personal protective equipment.

Avoid impacting adjacent sites by ensuring all contractors activities, equipment and waste storage is confined to the allocated site boundary.

In the event of a spill:

- Identify and stop the source of the spill and alert people working in the vicinity;
- Notify the Environmental Manager immediately giving information on the location, type and extent of the spill so that they can take appropriate action;
- If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;
- Contain the spill using spill control materials, track mats or other materials as required. Do not spread or flush away the spill;
- If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses and/or sensitive habitats;
- If possible, clean up as much as possible using the spill control materials;
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with appropriate permits so that further contamination is limited;
- The Environmental Manager shall inspect the site as soon as practicable and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring; and
- The Environmental Manager will notify the appropriate stakeholders such as Wicklow County Council, National Parks and Wildlife Service and/or the EPA.

8.4. Emergency Incident Response Plan

The Plan will contain emergency phone numbers and method of notifying local authorities, statutory authorities and stakeholders. The Plan will include contact numbers for key personnel. The Contractor will ensure that all staff and personnel on site are familiar with the emergency requirements.

In the case of work required in an emergency, or which if not completed would be harmful or unsafe to workers, the public or the local environment, Wicklow County Council will be informed as soon as reasonably practicable of the reasons and likely duration. Examples may include: where the ground needs stabilising if unexpected ground conditions are encountered or equipment failure.

In the event of an emergency incident occurring, the Contractor will be required to investigate and provide a report to include the following, as a minimum:

- A description of the incident, including location, type of incident and the likely receptor;
- Contributory causes;
- Negative effects;
- Measures implemented to mitigate adverse effects; and
- Any recommendations to reduce the risk of similar incidents occurring.

Further, if any sensitive receptor is impacted, the appropriate environmental specialists will be informed and consulted with accordingly.

Any response measures will be incorporated into an updated Emergency Incident Response Plan.

8.5. Emergency Access

The Contractor will be required to maintain emergency access routes throughout construction and identify site access points for the working area.

8.6. Extreme Weather Events

The Contractor will consider the impacts of extreme weather events and related conditions during construction. The detailed CEMP should consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements for staff. As appropriate, method statements should also consider extreme weather events where risks have been identified.

9. References

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APPENDIX 3A

N11 Junction 6 Traffic Management Framework Agreement

N11 Junction 6 Traffic Management Framework Agreement

WICKLOW COUNTY COUNCIL

Technical Note

September 2020

Client:
Wicklow County Council,
County Buildings,
Station Road,
Wicklow,
Co. Wicklow.

DOCUMENT CONTROL SHEET

Client	Wicklow County Council
Project Title	N11 Junction 6 Traffic Management Framework Agreement
Project Phase	
Document Title	Technical Note

Issue	Status	Author(s)	Reviewed By	Approved By	Issue Date
1	Final Draft		DO'B	MF	Sept 2020

1.0 INTRODUCTION

As described in the NTA coordinated Bray and Environs Transport Study, a traffic management framework is to be established between Wicklow County Council and TII. The aim of the Framework is to identify appropriate local and national road mitigation measures which will facilitate traffic monitoring and management of queuing in the vicinity of the Junction 6, N11 Interchange and also facilitate the development of the lands at Fassaroe.

A proposed agenda for the draft traffic management framework was drafted as part of the Bray and Environs Transport Study. This agenda is included in Appendix A and the items identified therein are referenced in the following sections.

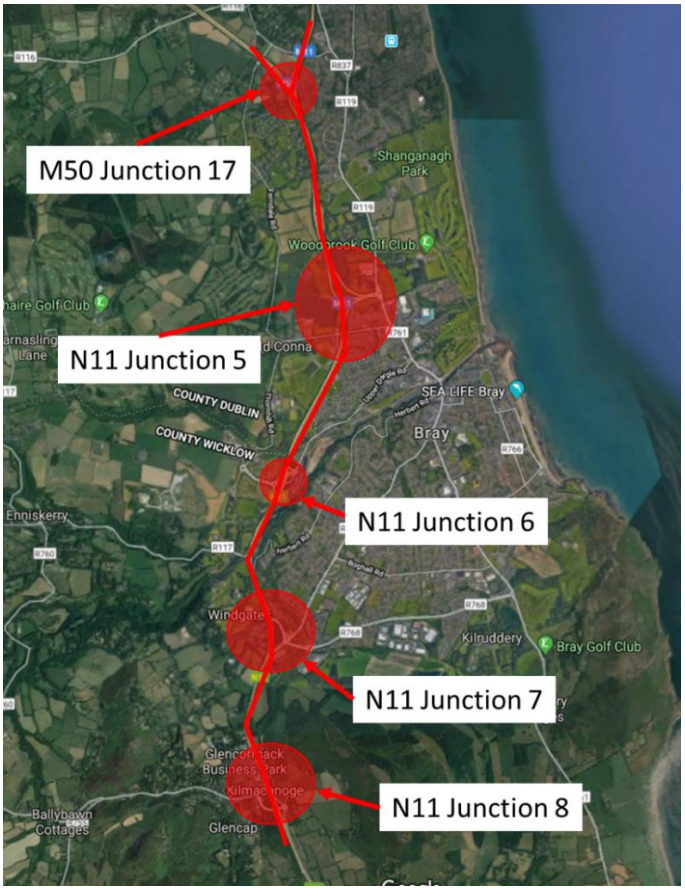
The recommendations set out within this framework include installation of several traffic management measures. The details of these measures will be subject to further detailed design and will be agreed with the relevant stakeholders throughout this design process.

2.0 TRAFFIC MANAGEMENT FRAMEWORK AGREEMENT

2.1 Identification of Appropriate Traffic Modelling to be Undertaken

The type and extent of modelling to be undertaken was identified in a scoping document prepared in May 2019 and agreed by all parties. Microsimulation was agreed as the most appropriate modelling type and the extent of this is as shown in the figure below.

Figure 0-1 - Agreed Microsimulation Model Extent



The completed model includes for all existing geometry within the study extents with volumes and journey times calibrated for both the AM and PM peak periods (3+ hours). Future year scenarios have been modelled to include committed infrastructure upgrades such as the N11 Junction 8 upgrade scheme and committed development throughout the Bray area. The results of this modelling are detailed in the Microsimulation Modelling Results Report (doc ref: 5186693DG0058) and the recommendations set out within are included in and inform the recommendations below.

2.2 Identification of Required Existing Bray North Internal Road Network Modifications

In line with the BETS requirements Wicklow County Council is undertaking infrastructure improvements on Upper Dargle Road, Castle Street (Bray Bridge) and Main Street in Bray that will complement the Bus Connects Core Bus Corridor proposals and significantly improve bus journey times. These improvements will facilitate the efficient operation of bus services between Fassaroe and Bray town centre and DART Station.

Proposals on Upper Dargle Road are being prepared to provide bus priority in the Little Bray area between Junction 6 Fassaroe and the Sunnybank Junction, where it will tie-into existing bus priority infrastructure on Dublin Road and Castle Street. The current priority measures on Dublin Road and Castle Street will be further enhanced by the National Transport Authority as part of the Route 13 Bray Core Bus Corridor project. The Little Bray scheme is programmed for construction completion before the end of 2021, in advance of the first occupations in Fassaroe.

The works that Wicklow County Council are designing, including the Bray Bridge and on Main Street will further extend the Bus Connects proposals south of the river in Bray offering fully enhanced bus priority measures from Fassaroe to Bray Main Street and DART Station. The Bray Bridge scheme consists of footbridges on either side of the existing bridge and the provision of a southbound bus lane on the existing bridge. The design of this scheme is being coordinated with the Council's Main Street Decongestion Scheme. The latter is, inter alia, being designed to improve bus priority on Main Street. The Bray Bridge scheme is programmed for construction completion in September 2021 which is again ahead of the proposed first occupations in Fassaroe.

In addition to these significant bus priority improvement schemes, detailed design is currently ongoing on the Bray DART Station Transport Interchange scheme. This scheme is being implemented to improve bus interchange at the station together with enhanced pedestrian and cyclist access. This scheme is programmed to be completed construction in early 2021.

2.3 Identification of Appropriate Physical Demand Management Measures at N11 Junction 6

2.3.1 CCTV Camera and Traffic Counters

A CCTV camera will be provided at the interchange which will be connected to the Dublin Traffic Management and Incident Centre. The preferred location for this will be agreed prior to installation. Detection loops will be provided on both on-ramps in conjunction with traffic signals as part of the installation and operation of ramp metering. These loops will also be used as traffic counters to monitor traffic movements entering the N11 at Junction 6.

2.3.2 Queue Detection and Traffic Monitoring Units

TMUs will be installed on the N11 mainline on the approach to the junction in both directions. The location of these will be agreed with TII, noting the presence of an existing TMU 500m north of the southbound off-ramp at Junction 6.

The recommended option for traffic management at N11 Junction 6 is to maintain the existing priority operation of the two roundabouts. The results of the modelling for all scenarios including priority operation indicate that there are minimal queues and delays on all arms of the roundabouts at Junction 6 and therefore the installation of queue detection on the N11 off-ramps is not required.

2.3.3 Appropriate Traffic Signals at N11 Junction 6

The results of the modelling for all scenarios ultimately conclude that traffic signals are not recommended at Junction 6. Whilst signals have a small benefit to travel times on the N11, the installation of signals would have a significant negative impact on traffic travelling through the two Junction 6 junctions, including ultimately significant queues and delays on multiple arms with potential to impact on the N11 mainline. These queues and delays would also have a corresponding significant negative impact on the public transport bus routes travelling across the N11 through Junction 6.

In all modelled scenarios, the results indicate that there is more than sufficient capacity at the existing roundabout to cater for predicted traffic volumes with minimal queues and delays. These minimal queues and delays also determine that no further measures are required to prioritise bus movements through the two junctions across the N11. It is therefore recommended to retain the two priority-controlled roundabouts in their current layout.

In order to provide the ability to control traffic accessing the N11 when necessary, ramp metering signals will be introduced on the northbound and southbound on-ramps at Junction 6 with associated traffic detection and control equipment to allow demand management to be employed, if necessary. These measures, in coordination with the CCTV cameras and traffic monitoring and equipment will allow for appropriate control of traffic at N11 Junction 6 when required.

2.4 Assessment of Potential for Additional Storage on Diverge Lanes

In all modelled scenarios with the retention of the current roundabout priority control there is minimal queueing and delays on all arms of the Junction 6 roundabouts, including the N11 diverge lanes. Therefore, no additional storage on these lanes is required.

2.5 Appropriate Safety Standards

No changes to existing road geometry or junction controls are proposed. Ramp metering signals, CCTV cameras and traffic monitoring equipment will be installed. There will, therefore, not be any significant changes to the operation or safety of the junction when compared to the existing scenario. The proposed traffic management measures will be subject to a Road Safety Audit process.

2.6 Compatibility of the Framework with M11 Junction 4 to Junction 14 Improvement Scheme

The scope of the framework and the recommendations herein incorporate the retention of the current roundabout priority operation and the introduction of ramp metering at the two on ramps along with provision of CCTV cameras and traffic monitoring equipment. In this context it can be concluded that these recommendations would not prejudice, and would be compatible and complimentary with, the progression of the M11 N11/M11 Junction 4 to Junction 14 Improvement Scheme. It is recognised that some of these recommendations may be superseded by the N11 upgrade scheme which will incorporate any required appropriate upgrade of this junction in accordance with that project's overall objectives.

2.7 Appropriate Mechanism for Delivery

The delivery mechanisms for infrastructure will be contingent on the ongoing transport improvement proposals at and adjacent to the Fassaroe junction. These include, but are not limited to, the M11/N11 Junction 4 to 14 scheme, M11 Bus priority scheme, pedestrian and cycle bridge over the N11 and links to Bray town centre, Bus priority on the Upper Dargle Road and the development of lands at Fassaroe.

APPENDIX A - AGENDA FOR DRAFT TRAFFIC MANAGEMENT FRAMEWORK AGREEMENT

NTA Bray and Environs Transport Study

Item: Proposed Agenda for Draft Traffic Management Framework Agreement

As described in the NTA coordinated Bray and Environs Transport Study, a traffic management framework is to be established between Wicklow County Council and TII. The aim of the Framework is to identify appropriate local and national road mitigation measures which will facilitate traffic monitoring and management of queuing in the vicinity of the Junction 6, N11 Interchange and also facilitate phase 1 (a) Fassaroe development proposal of 658 houses and associated supporting facilities.

The agenda for the Framework should include for following:

1. The identification of appropriate traffic modelling to be undertaken to establish the capacity of the junction within the existing N11/M11 traffic regime. The scope of the modelling and its nature to be agreed between TII and Wicklow County Council.
2. Subsequent to item no. 1, identification of required existing Bray North internal road network modifications to alleviate/manage/limit traffic congestion on the N11 and associated local road network (bus priority, widening, dedicated left/right turns, signalling etc.),
3. The identification of appropriate physical demand management measures to "limit" the amount of traffic accessing the N11 at agreed peak hours. Infrastructural requirements to be investigated as part of this process include:
    a) CCTV camera at the interchange to be connected to the Dublin Traffic Management and Incident Centre, together with traffic counters to monitor traffic movements exiting and entering M11 at J6.
    b) Queue detection technology, and traffic monitoring units on the mainline N11 in advance of the off ramps.
    c) Appropriate Traffic signals Junction 6 and local road network in the vicinity including Upper Dargle Road, La Vallee and Fassaroe Link Road to be connected to the Dublin Traffic Management and Incident Centre.
4. Assessment of potential for modification to Interchange to give additional storage on diverge lanes.
5. Demonstration that all appropriate safety standards can be addressed.
6. Demonstration that the outcomes of the Framework will need to be compatible and complementary to the progression of the M11 N11/M11 Junction 4 to Junction 14 Improvement Scheme.
7. Appropriate mechanisms for delivery. The cost of the design and implementation of this infrastructure shall not be borne by TII therefore Wicklow County Council will devise the appropriate mechanisms for delivery.

APPENDIX 3B

TII Response to Junction 6 Traffic Management Proposals

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Michael Flynn
Senior Engineer
Wicklow County Council

By email: Michael Flynn <MiFlynn@wicklowcoco.ie>

Dáta|Date
1 October, 2020

Ár dTag|Our Ref.
TII20-110924

Re. N11 Junction 6 Traffic Management Framework Agreement

Dear Mr. Flynn,

I wish to welcome and acknowledge receipt of your email of 9 September, 2020, in relation to the above matter which included the Technical Note dated September, 2020, titled N11 Junction 6 Traffic Management Framework Agreement.

The Technical Note addresses the Draft Traffic Management Framework Agreement Agenda agreed between Wicklow County Council and TII in response to the requirements outlined in Table 3.1 of the NTA Bray and Environs Transport Study, 2019, in order to facilitate the development of 650 residential units and appropriate residential support facilities on the lands at Fassaroe.

TII welcomes the commitments and proposals outlined in the Technical Note and can confirm general agreement to the proposals outlined by Wicklow County Council, subject to the following;

- An appropriate scheme or arrangement is in place to deliver all the proposed measures as TII will not be responsible for the costs of mitigation required to facilitate private development proposals impacting the national road network.
- All proposed measures to be in place prior to the first occupation of any residential unit on the proposed Fassaroe lands.
- In the interests of completeness, queue detectors on the off-ramps shall be installed. In particular, the southbound off ramp (eastern roundabout) is a very compact arrangement and potential queuing all the way through the junction is a possibility which will require monitoring.
- Appropriate Traffic signals at Junction 6 and local road network in the vicinity, are to be connected to the Dublin Traffic Management and Incident Centre/Motorway Traffic Control Centre.
- In accordance with the NTA Bray and Environs Transport Study (April, 2019), the Traffic Management Framework Agreement facilitates the development of 650 residential units and appropriate residential support facilities on the lands at Fassaroe. Further phases of the build out of the lands at Fassaroe are required to be governed by a separate implementation and monitoring plan to be developed by the Council. It is TII's understanding that work on this requirement has not yet commenced.

Subject to your commitment to the above provisions, TII will arrange for formal confirmation of TII's agreement with proposals outlined in the Technical Note to issue to the Council and the NTA.

Yours sincerely,

Tara Spain,
Head of Land Use Planning.

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Bonneagar Iompair Éireann
Ionad Gnó Gheata na Páirce
Sráid Gheata na Páirce
Baile Átha Cliath 8
Éire, D08 DK10

Transport Infrastructure Ireland
Parkgate Business Centre
Parkgate Street
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APPENDIX 3C

NTA Response to Junction 6 Traffic Management Proposals

Údarás
Náisiúnta Iompair
National Transport Authority

Harcourt Lane, Dublin 2

Dún Scéine, Baile Átha Cliath 2

tel: 01 879 8300
fax: 01 879 8333
email: info@nationaltransport.ie
web: www.nationaltransport.ie

Mr Michael Flynn,
Senior Engineer,
Wicklow County Council

9th October 2020

Re. N11 Junction 6 Traffic Management Framework Agreement

Dear Mr Flynn,

The NTA welcomes the receipt of your email of the 9th September and the attached Technical Note related to the Traffic Management Framework Agreement for the development of Fassaroe.

The NTA is of the view that, subject to the agreement of Transport Infrastructure Ireland (TII) and subject to the progress in the delivery of bus priority between Fassaroe and Bray Rail station, the proposals contained within the technical note are sufficient to accommodate a development of approximately c.650 residential units, as per the Bray and Environs Transport Study (BETS). The NTA would like to highlight the additional requirements set out for this first phase of the development of Fassaroe in section 3.2 of the BETS, namely:

a) That the proposed development provides fully for walking and cycling trips to all local services within Fassaroe;
b) That the applicant will provide a bus service to Bray DART station in advance of demand justifying public investment as part of the expansion of the bus network under BusConnects;
c) That the applicant has fully assessed a requirement for a bus service to Bride's Glen or Cherrywood Luas and provides same if demand is deemed sufficient in advance of demand justifying public investment as part of the expansion of the bus network under BusConnects; and
d) That the applicant demonstrates how demand for travel to schools from Fassaroe can be accommodated without undue recourse to the private car.

As required under section 3.3 of the BETS, further phases of the build out of these lands beyond c.650 units are to be governed by a separate implementation and monitoring plan to be developed by Wicklow County Council (WCC) with input from the NTA and TII.

Subject to the above, the NTA will confirm our agreement with the proposals outlined in the Technical Note and issue same to WCC and TII.

Yours sincerely,

Michael MacAree
Head of Strategic Planning

APPENDIX 3D

TII Traffic Management Framework Agreement, 16.04.21

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Michael Flynn
Senior Engineer
Transportation & Roads Infrastructure Department.
Wicklow County Council

By email: Michael Flynn <MiFlynn@wicklowcoco.ie>

Dáta|Date
16 April , 2021

Ár dTag|Our Ref.
TII20-110924, TII21-112999

Re. N11 Junction 6 Traffic Management Framework Agreement

Dear Mr. Flynn,

I wish to welcome and acknowledge receipt of your emails of 8th and 12th April 2021 (see attached) in relation to the above matter and material included in the Technical Note dated September, 2020, entitled N11 Junction 6 Traffic Management Framework Agreement.

The Technical Note addresses the Draft Traffic Management Framework Agreement Agenda agreed between Wicklow County Council and TII in response to the requirements outlined in Table 3.1 of the NTA Bray and Environs Transport Study, 2019, in order to facilitate the development of 650 residential units and appropriate residential support facilities on the lands at Fassaroe. In response to this note, TII requested a number of commitments by letter dated 1st of October 2021 from Wicklow County Council.

For clarity, Wicklow County Councils responses, in above mentioned emails, are denoted in red to TII's letter dated 1st of October 2021 are as follows:

- An appropriate scheme or arrangement is in place to deliver all the proposed measures as TII will not be responsible for the costs of mitigation required to facilitate private development proposals impacting the national road network.
  Wicklow County Council envisage that any grant of planning permission will condition the developer to pay for the cost of the traffic management infrastructure as set out in the framework agreement. Otherwise Wicklow county council will deliver this infrastructure at their own cost.

- All proposed measures to be in place prior to the first occupation of any residential unit on the proposed Fassaroe lands.
  The Bray Transport Study agreed by all parties' sets out the timeframe for delivery of the traffic management measures at junction 6. These traffic management measures are required to be in place prior to the first occupancy of any residential unit at the Fassaroe development. This matter will be dealt with by way of a condition of any grant of planning permission.

- In the interests of completeness, queue detectors on the off-ramps shall be installed. In particular, the southbound off ramp (eastern roundabout) is a very compact arrangement and potential queuing all the way through the junction is a possibility which will require monitoring.

  Wicklow County Council will ensure that queue detectors will be installed on the off ramps and monitored as requested.

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- Appropriate traffic signals at Junction 6 and local road network in the vicinity, are to be connected to the Dublin Traffic Management and Incident Centre/Motorway Traffic Control Centre.
  Wicklow county council will ensure that Traffic signals at Junction 6 and the local road network in the vicinity are connected to the Dublin Traffic Management and Incident Centre/Motorway Traffic Control Centre.

- In accordance with the NTA Bray and Environs Transport Study (April, 2019), the Traffic Management Framework Agreement facilitates the development of 650 residential units and appropriate residential support facilities on the lands at Fassaroe. Further phases of the build out of the lands at Fassaroe are required to be governed by a separate implementation and monitoring plan to be developed by the Council. It is TII's understanding that work on this requirement has not yet commenced.

  Further phases of the build out of the Fassaroe Lands are recommended to be governed by a separate implementation and monitoring plan to be developed by Wicklow County Council with input from the NTA and TII, in accordance with Section 3.3 of the Bray and Environs Transport Study. (Clarified in email dated 12th April 2021)

As a result of these commitments outlined above by Wicklow County Council, TII can now confirm agreement to the proposals outlined by Wicklow County Council for N11 Junction 6 Traffic Management Framework Agreement in order to facilitate the development of 650 residential units and appropriate residential support facilities on the lands at Fassaroe.

TII looks forward to inputting with the NTA into the further phases of the build out of the lands at Fassaroe which are required to be governed by a separate implementation and monitoring plan to be developed by the Council in due course.

Yours sincerely,

Tara Spain,
Head of Land Use Planning.

Spain Tara

From: Michael Flynn <mflynn@wicklowcoco.ie>
Sent: Monday 12 April 2021 13:27
To: Landuse Planning
Cc: Spain Tara; Douglas Winston; Fitzsimons John; Colm Lavery; John Bowes; Deirdre Forde; 'Michael MacAree'; 'David Clements'; Keenan Declan
Subject: RE: Fassaroe Meeting Requirements and Response

Hi Tara

Yes –I can confirm that further phases of the build out of the Fassaroe Lands are recommended to be governed by a separate implementation and monitoring plan to be developed by Wicklow County Council with input from the NTA and TII, in accordance with Section 3.3 of the Bray and Environs Transport Study.

Regards,

Michael

From: Landuse Planning [mailto:LandUsePlanning@tii.ie]
Sent: 12 April 2021 12:48
To: Michael Flynn
Cc: Spain Tara; Douglas Winston; Fitzsimons John; Colm Lavery; John Bowes; Deirdre Forde; 'Michael MacAree'; 'David Clements'; Keenan Declan
Subject: RE: Fassaroe Meeting Requirements and Response

Michael

Thank you for this email.

Before we can sign off , could you please clarify that in accordance with Section 3.3 Further Phases of Fassaroe of the Bray and Environs Transport Study that further phases of the build out of these lands are recommended to be governed by a separate implementation and monitoring plan to be developed by Wicklow County Council with input from the NTA and TII rather than a traffic management and monitoring plan as indicated in the email below.

Both the developer and ABP should be aware of this requirement.

Regards

Tara

Tara Spain
[Head of Land Use Planning
Transport Infrastructure Ireland
Parkgate Business Centre, Parkgate St., D08 DK10, Ireland.
[web: www.tii.ie
[email:LandUsePlanning@tii.ie
[t:+353 1 6463600

www.tii.ie
info@tii.ie
+353 (01) 646 3600

From: Michael Flynn <mflynn@wicklowcoco.ie>
Sent: Thursday 8 April 2021 15:45
To: Landuse Planning <LandUsePlanning@tii.ie>
Cc: Spain Tara <Tara.Spain@tii.ie>; Douglas Winston <Winston.Douglas@tii.ie>; Fitzsimons John <John.Fitzsimons@tii.ie>; Colm Lavery <clavery@wicklowcoco.ie>; John Bowes <JBowes@wicklowcoco.ie>; Deirdre Forde <DMForde@wicklowcoco.ie>; 'Michael MacAree' <michael.macaree@nationaltransport.ie>; 'David Clements' <David.Clements@nationaltransport.ie>
Subject: RE: Fassaroe Meeting Requirements and Response

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Hi Tara

I refer to your correspondence in response to the draft N11 Junction 6 Traffic Management Framework Agreement. We have been liaising with the project team working on the M11/N11 Junction 4 to Junction 14 scheme and you might ensure that all departments in TII are fully briefed on the proposed Framework Agreement.

I would respond to the issues raised in your correspondence as follows;

- An appropriate scheme or arrangement is in place to deliver all the proposed measures as TII will not be responsible for the costs of mitigation required to facilitate private development proposals impacting the national road network.
  Wicklow County Council envisage that any grant of planning permission will condition the developer to pay for the cost of the traffic management infrastructure as set out in the framework agreement. Otherwise Wicklow county council will deliver this infrastructure at their own cost.

- All proposed measures to be in place prior to the first occupation of any residential unit on the proposed Fassaroe lands.
  The Bray Transport Study agreed by all parties sets out the timeframe for delivery of the traffic management measures at junction 6. These traffic management measures are required to be in place prior to the first occupancy of any residential unit at the Fassaroe development. This matter will be dealt with by way of a condition of any grant of planning permission.

- In the interests of completeness, queue detectors on the off-ramps shall be installed. In particular, the southbound off ramp (eastern roundabout) is a very compact arrangement and potential queuing all the way through the junction is a possibility which will require monitoring.
  Wicklow County Council will ensure that queue detectors will be installed on the off ramps and monitored as requested.

- Appropriate Traffic signals at Junction 6 and local road network in the vicinity, are to be connected to the Dublin Traffic Management and Incident Centre/Motorway Traffic Control Centre.
  Wicklow county council will ensure that Traffic signals at Junction 6 and the local road network in the vicinity are connected to the Dublin Traffic Management and Incident Centre/Motorway Traffic Control Centre.

As agreed in the Bray Transport Study, further build out of the Fassaroe site will be governed by a further traffic management and monitoring plan.

My understanding is that the developer is scheduled to meet with ABP for a pre-planning meeting in the coming weeks. I trust it is order to inform ABP that the N11 Junction 6 Traffic Management Framework Agreement in respect of the initial 650 units at Fassaroe is in place subject to formal sign-off by TII.

Regards,

Michael

From: Landuse Planning [mailto:LandUsePlanning@tii.ie]
Sent: 06 October 2020 15:54
To: Michael Flynn
Cc: Spain Tara; McCormack Michael; 'David Clements (David.Clements@nationaltransport.ie)'; Kangley Virginia; Douglas Winston; Keenan Declan
Subject: FW: Fassaroe Meeting Requirements and Response

Hello Michael

I forward TII's feedback on the draft framework agreement.

As indicated Subject to the Council's commitment to the provisions outlined in the letter, TII will arrange for formal confirmation of TII's agreement with proposals outlined in the Technical Note to issue to the Council and the NTA.

Regards
Tara

Tara Spain
[Head of Land Use Planning
Transport Infrastructure Ireland
[web: www.tii.ie
[email:LandUsePlanning@tii.ie

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info@tii.ie
+353 (01) 646 3600

From: Michael Flynn <MiFlynn@wicklowcoco.ie>
Sent: Wednesday 9 September 2020 21:10
To: Landuse Planning <LandUsePlanning@tii.ie>; Michael Flynn <MiFlynn@wicklowcoco.ie>

Cc: 'Michael MacAree' <michael.macaree@nationaltransport.ie>; McCormack Michael <Michael.McCormack@tii.ie>; David Clements <David.Clements@nationaltransport.ie>; Spain Tara <Tara.Spain@tii.ie>; Colm Lavery <clavery@wicklowcoco.ie>; Declan O'Brien <DPOBrien@wicklowcoco.ie>; 'Boyle, Kieran' <Kieran.Boyle@atkinsglobal.com>
Subject: RE: Fassaroe Meeting Requirements and Response

Hi to All

Please find attached draft N11 Junction 6 Traffic Management Framework Agreement.

The draft framework agreement is proposed on the basis of extensive modelling and assessment of options for traffic management at N11 junction 6, and in response to the comments and feedback received in relation to this work.

I would draw you attention to the conclusion that the provision of traffic signals are not recommended at this junction. Notwithstanding the foregoing, traffic signals will be provided on the northbound and southbound on-ramps at Junction 6 with associated traffic detection, control equipment and CCTV to allow demand management to be employed, if necessary.

Can you please let me have your comments on the draft framework agreement.

Regards,

Michael

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APPENDIX 3E

Letter from WCC re. Proposed Action Area Plan

Comhairle Contae Chill Mhantáin
Wicklow County Council

Forbairt Pleanála agus Comhshaol
Planning Development and Environment

Áras An Chontae / County Buildings
Cill Mhantáin / Wicklow
Guthán / Tel: (0404) 20148
Faics / Fax: (0404) 69462
Rphost / Email: plandev@wicklowcoco.ie
Suíomh / Website: www.wicklow.ie

Maria Lombard
RPS Consulting,
Innishmore,
Balllincollig,
Cork P31 KR68

Date : 1st November 2021.

RE : Fassaroe Proposed Action Area Plan

Dear Ms Lombard,

I am writing in reference to the Proposed Action Area Plan submitted on the 28th September 2021 by RPS in respect of AAP1 : Fassaroe. This Action Area is submitted having regard to the zoning objectives, and Action Area criteria set out in the Bray Municipal District Plan 2018. On initial review of the proposed Action Area Plan, it is considered that this Plan would appear, in principle, to accord with the zoning objectives and overarching Action Area criteria identified in the Bray Municipal District Plan 2018. The Planning Authority would intend to issue this Proposed Plan to all stakeholders encompassed by the Action Area boundary, to seek their comment, before final assessment, and potential Approval.

Regards,

Edel Bermingham SEP

Tá an doiciméad seo ar fáil i bhformáidí eile ar iarratas.
This document is available in alternative formats on request.
Ba chóir gach comhfhreagras a sheoladh chuig an Stiúrthóir Seirbhísí, Forbairt Pleanála agus Comhshaol.
All correspondence should be addressed to the Director of Services, Planning Development & Environment.

APPENDIX 4A

List of Community and Education Services in the Vicinity of Application Site

APPENDIX 4A: LIST OF COMMUNITY AND EDUCATION SERVICES IN THE VICINITY OF APPLICATION SITE

Table 1: Public Services and Facilities

Type	Name	Address / Location	Lat	Long
Bank	Bank of Ireland	45 Main St, Bray, Co. Wicklow, A98 V5X6	53.2013341	-6.1106823
Bank	AIB Bank	108 Main St, Bray, Co. Wicklow, A98 KN77	53.2043048	-6.109666
Bank	Ulster Bank	63 Main St, Bray, Co. Wicklow, A98 A0C7	53.201345	-6.1117178
Bank	Permanent TSB	66 Main St, Bray, Co. Wicklow, A98 X8E2	53.2015778	-6.1110322
Bank	Bank of Ireland	Unit 4, Building 5, Cherrywood Business Park, Dublin 18, D18 R270	53.2442954	-6.1397205
Credit Union	Bray Credit Union	Credit Union House, Main Street, Bray, Co. Wicklow	53.2008056	-6.1109339
Credit Union	Core Credit Union Shankill	Main St, Shankill, Dublin, D18 DY84	53.2316216	-6.1244412
Fire	Bray Fire Station	Boghall Rd, Ballymorris, Bray, Co. Wicklow	53.1876502	-6.1228892
Fire	Greystones Fire Station	Victoria Rd, Rathdown Lower, Greystones, Co. Wicklow	53.1499999	-6.0703537
Fire	Dun Laoghaire Fire Station	Kill Ave, Dún Laoghaire, Dublin	53.2816860	-6.1536485
Garda	Enniskerry Garda Station	Enniskerry Lodge, Church Hill, Enniskerry, Co. Wicklow	53.1913864	-6.1693006
Garda	Greystones Garda Station	6 Marine Terrace, Rathdown Lower, Greystones, Co. Wicklow, A63 PP58	53.1479580	-6.0632050
Garda	Bray Garda Station	Convent Ave, Bray, Co. Wicklow, A98 E093	53.1985904	-6.1007626
Garda	Shankill Garda Station	Dorney Ct, Shanganagh, Dublin	53.2335246	-6.1232005
Ambulance	Order of Malta Ambulance Corps	Hawthorn Road, Little Bray, Bray, Co. Wicklow	53.2071845	-6.1183655
Ambulance	National Ambulance Service Loughlinstown	Seaview Gate, Co. Dublin	53.2397627	-6.1280629
Faith	St. Patrick's Church	Enniskerry, Co. Wicklow	53.1894995	-6.1708009
Faith	St. Mary's Parish Church	Kilgarran, Co. Wicklow	53.1939	-6.1752977
Faith	Kilbride Church of Ireland	Springfield, Co. Wicklow	53.1884805	-6.1424645

Type	Name	Address / Location	Lat	Long
Faith	St. Fergal's Parish	Killarney Rd, Ballymorris, Bray, Co. Wicklow	53.189379	-6.127354
Faith	Christ Church	Church Rd, Bray, Co. Wicklow	53.1969719	-6.114743
Faith	Our Lady Queen of Peace	230 Merrion Rd, Dublin, D04 NX33	53.3180577	-6.2096124
Faith	Saint Mochonog's Church	Kilmacanogue Village, Co. Wicklow	53.1685304	-6.1402126
Faith	Bray Methodist Church	Florence Rd, Bray, Co. Wicklow	53.203424	-6.1087424
Faith	St. Andrew's Presbyterian Church	Bray, Co. Wicklow	53.2044729	-6.1090165
Faith	The Holy Redeemer Church	Main St, Bray, Co. Wicklow	53.203555	-6.1121917
Faith	Cornerstone Church at the Well	The Well, Church Terrace, Main St, Ravenswell, Bray, Co. Wicklow, A98 VE43	53.2048587	-6.1121785
Faith	Celula Bray	Flat 4, Prince of Wales Terrace, 5 Quinsborough Rd, Bray, Co. Wicklow, A98 R128	53.204773	-6.1042898
Faith	St. Peter's Church	Chapel Ln, St Peters Rd, Little Bray, Bray, Co. Wicklow	53.2090294	-6.1188262
Faith	Calvary Bible Baptist Church Bray	Due to fire, presently meeting at the Royal Hotel, Main St, Bray, Co. Wicklow	53.201689	-6.112533
Faith	Our Lady Of The Wayside Church	Glenamuck South, Co. Dublin	53.2359007	-6.1969169
Faith	Kilternan Parish Church	Anglican Communion, Enniskerry Rd, Glebe, Kilternan, Co. Dublin	53.2436524	-6.2022847
Faith	St Columbanus	Loughlinstown Dr, Ballybrack, Co. Dublin	53.2475688	-6.1329335
Faith	Rathmichael Parish Church	Ferndale Rd, Shankill, Dublin	53.2343799	-6.1404518
Faith	St Anne's Shankill	Shanganagh Rd, Shankill, Dublin 18	53.2341127	-6.1261091
Faith	St. James Church Crinken	R119, Dublin Rd, Bray, Co. Dublin	53.2195776	-6.1217554
Faith	Christian Assembly Bray	27 Florence Rd, Bray, Co. Wicklow, A98 RD68 Florence Rd, Bray, Co. Wicklow, A98 RD68	53.2035577	-6.1077308
Faith	St Mary and St Demiana Coptic Orthodox Church	4-5 The Pines, Herbert Rd, Killarney, Bray, Co. Wicklow	53.1957415	-6.1266713

Type	Name	Address / Location	Lat	Long
Faith	Villa Pacis Parish Centre	Putland Rd, Newcourt, Bray, Co. Wicklow	53.1929957	-6.1076316
Faith	Holy Redeemer Parochial House	Bray, Co. Wicklow	53.2036368	-6.1144438
Faith	Jehovah Witnesses	64A O'Byrne Rd, Oldcourt, Bray, Co. Wicklow, A98 WC99	53.1913205	-6.1111653
Final Disposition	Springfield Cemetery	Ballymorris, Bray, Co. Wicklow	53.1858855	-6.129969
Final Disposition	Kilmacanoque Cemetery	Kilmacanoge North, Co. Wicklow	53.168425	-6.1367917
Final Disposition	Shanganagh Cemetery	Dublin Rd, Cork Little, Co. Dun Laoghaire-Rathdown	53.221349	-6.1211017
Final Disposition	Bray Cemetery	Little Bray, Bray, Co. Wicklow	53.2090296	-6.1188007
Final Disposition	Glencullen Cemetery	Glencullen, Co. Dublin	53.2232827	-6.2183824
Final Disposition	The Grove Cemetery	Rathdown Lower, Greystones, Co. Wicklow	53.1578694	-6.0840636
Final Disposition	St. Patrick's Chapel and Graveyard	Newtown, Co. Dublin	53.2233881	-6.2166952
Final Disposition	Kilternan Cemetery Park	Ballycorus Road Kilternan Dublin 18, Dublin	53.234542	-6.1728387
Final Disposition	Bishops Lane Cemetery	Kiltiernan, Kilternan, Co. Dublin	53.2350732	-6.2022948
Final Disposition	Redford Cemetery	R761, Redford, Greystones, Co. Wicklow	53.1558127	-6.0914544
Post Office	Little Bray Post Office	Unit 7, Castle St, Little Bray, Bray, Co. Wicklow, A98 W254	53.2061859	-6.1107776
Post Office	Post Office	45 Kilgarron Park, Knocksink, Enniskerry, Co. Wicklow, A98 KP99	53.192671	-6.1831862
Post Office	Ballywaltrim Post Office	Kilbride Lane, Ballywaltrim, Bray, Co. Wicklow	53.1902275	-6.1262641
Post Office	Shankill Post Office	Violet House, Dublin Rd, Shanganagh, Dublin 18	53.2311094	-6.124004

Type	Name	Address / Location	Lat	Long
Post Office	Post Office	35B Vevay Rd, Newcourt, Bray, Co. Wicklow	53.1914574	-6.1051704
Post Office	Foxrock Post Office	1 Brighton Rd, Foxrock, Co. Dublin	53.2665107	-6.1838115
Post Office	Bray LFO / DSU	21 Beechwood Cl, Kilruddery Demesne East, Bray, Co. Wicklow, A98 YW89	53.1868361	-6.1034033
Post Office	Bray Post Office	Quinsborough Rd, Bray, Co. Wicklow	53.2048136	-6.1071895
Recycling Centre	Bray Recycling Centre	21 Beechwood Cl, Kilruddery Demesne East, Bray, Co. Wicklow	53.1870341	-6.1066069
Recycling Centre	Marrakesh Ltd Recycling Centre	Kilmurray, Bray, Co. Wicklow, A98 X3C1	53.15127	-6.132465
Recycling Centre	Shanganagh Recycling Centre	Cork Little, Co. Dublin	53.2223563	-6.117808
Recycling Centre	Bring Centre	Rathsallagh Dr, Shankill, Dublin, D18 E6H7	53.2365787	-6.1200922

Table 2: Schools

School Name	Address / Location	Est. Driving Distance To Site	Level	Enrolment 10/11	Enrolment 15/16	Enrolment 20/21	Lat	Long
St Gerard's	Thornhill Road, Old Conna	850m	Preschool Primary Secondary	N/A N/A 483	N/A N/A 531	20 230 564	53.203927	-6.1356252
Loreto Secondary	Vevay Road, Bray	3.9km	Secondary	842	818	745	53.196832	-6.1069987
St. Cronan's BNS	Vevay Road, Bray	3.6km	Primary	505	517	486	53.1991202	-6.1081632
St. Patrick's Loreto	Vevay Road, Bray	3.3km	Primary	761	799	764	53.1996988	-6.1103325
Presentation College	Headlands, Newcourt, Bray	4.7km	Secondary	612	662	652	53.192315	-6.1031202
Scoil Chualann	Vevay Road, Bray	4.2km	Primary Gaelscoil	252	236	225	53.1934942	-6.1048577
North Wicklow Educate Together	Putland Road, Bray	4.6km	Secondary	Not open until 2018	Not open until 2018	270	53.1924626	-6.1022024
St. Andrews National	Newcourt Road, Bray	4.6km	Primary	210	219	211	53.1893287	-6.1016611
Newcourt Special School	Newcourt Road, Bray	4.7km	Primary & Secondary Special Needs	Not relevant.	Not relevant	Not relevant	53.1893016	-6.1014599
Bray School Project NS	Killarney Road, Bray	3.7km	Primary	237	243	240	53.1882958	-6.126445
St. Fergal's National	Schools Road, Bray	3.7km	Primary	526	456	407	53.1870723	-6.1253339
St. Kilian's Community	Schools Road, Bray	4km	Secondary	493	515	420	53.1852425	-6.1270231

School Name	Address / Location	Est. Driving Distance To Site	Level	Enrolment 10/11	Enrolment 15/16	Enrolment 20/21	Lat	Long
Woodlands Academy	Kilcroney, Bray	6.5km via Kilmacanoge	Secondary	Private international boarding schools for non-English speaking students, so not relevant.	Private international boarding schools for non-English speaking students, so not relevant	Private international boarding schools for non-English speaking students, so not relevant	53.1794449	-6.1412411
Dublin Oak Academy	Kilcroney, Bray	3.9km	Secondary	Private international boarding schools for non-English speaking students, so not relevant	Private international boarding schools for non-English speaking students, so not relevant	Private international boarding schools for non-English speaking students, so not relevant	53.186013	-6.140474
St. Peter's	Hawthorn Road, Bray	3.2km	Primary	82	166	169	53.2068516	-6.1179987
Ravenswell	Dublin Road, Bray	3.1km	Primary	228	266	413	53.2091993	-6.1103065
Colaiste Raithin	Dublin Road, Bray	3.2km	Secondary Gaelscoil	225	268	326	53.21001	-6.1088102
Woodbrook College	Dublin Road, Bray	3.3km	Secondary	337	328	436	53.215438	-6.1220545
St. Mary's & St. Gerard's National	Enniskerry	4.6km	Primary	237	210	194	53.1939528	-6.1756749
Powerscourt National	Cookstown, Enniskerry	5.2km via Ballyman Rd	Primary	60	71	91	53.1883781	-6.1676895
St Patrick's National	Curtlestown Lower, Enniskerry	5km measured from R117 south of Roadstone	Primary	58	71	65	53.1862251	-6.2130597

School Name	Address / Location	Est. Driving Distance To Site	Level	Enrolment 10/11	Enrolment 15/16	Enrolment 20/21	Lat	Long
John Scottus School	Old Conna House, Ferndale Road, Old Conna	2.7km	Primary Secondary	Not open	Not open	33 (primary) 120 (secondary)	53.2180744	-6.1382262
Kilmacanogue National School	Kilmacanogue North	5km	Primary	218	218	259	53.1683944	-6.1410771
Gaelscoil Ui Cheadaigh	Vevay Road, Bray	3.4km	Primary	164	185	231	53.1991194	-6.1097397
Bray institute of Further Education	Novara Avenue, Bray		Adult				53.2007951	-6.1089027
College of Management and IT	Southern Cross Business Park, Ballymorris, Bray		Adult				53.186625	-6.122709

Table 3: Creche / Preschools / Montessoris

Name	Address / Location	Est. Driving Distance To Site	Lat	Long
Zebedee's Montessori Preschool	Glenucan House, Killarney Road, Bray	3.8km	53.198259	-6.1183434
Little Harvard Creche & Montessori	Upper Dargle Road, Bray	1.1km	53.1952426	-6.1332917
Saran Wood Creche	Killarney Road, Bray	3.3km	53.182808	-6.1299807
Deepdales Montessori	Southern Cross, Bray	3.9km	53.1816154	-6.1250042
Clever Bears	Hollybrook Park, Bray	4.7km	53.1831234	-6.1094152
Fun Dayz	Quinsborough Road	3.1km	53.204712	-6.1041242
Coillte Academy	2 Cill Sarain,Herbert Road, Bray	3km	53.1931515	-6.1282601
Mother Goose Montessori	Temple Sports Grounds, Vevay Road, Bray	4.2km	53.1929686	-6.1077731
Naionra Ghleann na Darach	Oak Glen View, Bray	4.9km	53.1843041	-6.1103025
Tus Nua Montessori & Playgroup	St Andrew's Hall, Quinsborogh Road, Bray	2.9km	53.204464	-6.1076042
Westfield Montessori	Sidmonton Road	4km	53.196888	-6.1001524
Crescent Montessori	Ardmore Crescent, Bray	3.9km	53.1984592	-6.1195731
Scallywags Childcare	Bentley Avenue, Bray	5km	53.1876817	-6.1096959
Park Academy Childcare	Southern Cross Road, Bray	3.2km	53.1808273	-6.1273167
Hollyoaks Montessori	Hawthorn Road, Bray	3.2km	53.2071152	-6.1172117
Little Haven	Stonehaven, Parknasilloge, Enniskerry	3.6km when measured from R117 south of Roadstone	53.1968012	-6.1941576
Enniskerry Montessori	Church Road, Enniskerry	4.6km	53.1944245	-6.1760293
Cuala Montessori	Cuala Grove, Bray	4.3km	53.1939476	-6.0989857
Marian Preschool & Family Centre	Green Park Road, Bray	2.1km	53.2052164	-6.1188246
Belmont Montessori	Southern Cross Road, Bray	5km	53.1853616	-6.1112672
Little Bunnies Montessori	Aubrey Court, Bray	3.2km	53.2012857	-6.111938

Name	Address / Location	Est. Driving Distance To Site	Lat	Long
Clever Little Bunnies	Ballywaltrim Community Centre	4.1km	53.1891175	-6.1232509
Clare Elizabeth Creche	8 Sidmonton Road, Bray	3.6km	53.20025	-6.1029572
An Naionra ag Gaelscoil Ui Cheadaigh	Vevay Road, Bray	3.3km	53.1993311	-6.1100049
John Scottus School	Old Conna House, Ferndale Road, Old Conna	2.7km	53.2180744	-6.1382262
Enniskerry Preschool	Old Powerscourt National School, Enniskerry		53.1884327	-6.1679205
Piccolini Play and Learn	Enniskerry Community Hall, Bray Road, Enniskerry		53.1932414	-6.1667728
Discoveries Creche and Montessori	Beech Road, Shankill, Dublin		53.2258171	-6.126624
Cois Cairn Playgroup	Cois Cairn Youth and Community Facility, Cois Cairn, Old Connaught Avenue, Bray		53.2114019	-6.1217383
Ravenswell After School Service	Ravenswell Primary School, Dublin Road, Bray		53.2094729	-6.1113292
Happy Days Playschool	Ravenswell Primary School, Dublin Road, Bray		53.20894	-6.1105943
Little Bray Afterschool Service	Little Bray Community Centre, Old Connaught View, Old Connaught, Bray		53.2058711	-6.1276272
Wee Tots	Bray Adult Education Centre, Putland Road Bray		53.1919975	-6.1032548
Little Oaks Academy	Vevay Road, Bray		53.1910004	-6.1043427
Fairhill Montessori School	74 Fairyhill, Bray		53.1940473	-6.124409
Mini Hands Montessori	Kilmacanogue National School		53.1688854	-6.1394177

Table 4: Medical Care Facilities

Type	Name	Address / Location	Lat	Long
Medical	Boghall Medical	Boghall Shopping Centre, Boghall Road, Ballymorris, Bray	53.1890165	-6.1227623
Medical	Town Hall Clinic	Town Hall Centre, Bray	53.2004154	-6.1134633
Medical	Bray Family Practice	Saint Helen's, Meath Road, Bray	53.1993962	-6.0988657
Medical	Duncairn Medical Centre	9 Duncairn Terrace, Bray	53.205143	-6.1045048
Medical	Carlton Clinic	1-2 Novara Avenue, Bray	53.202425	-6.1098862
Medical	Bray Family Practice	Saint Helen's, Meath Road, Bray	53.199363	-6.1005967
Medical	Bray Womens Health Centre	Bri Chualann Court, Adelaide Road, Bray	53.2045426	-6.1041601
Medical	Lucena Clinic	Sessa House, Vevay Road, Bray	53.1995648	-6.1109742
Medical	Davies Physiotherapy	Bray South Business Park, Killarney Road, Ballymorris, Bray	53.1867204	-6.1281559
Medical	Medical Optics	3 Castle Street, Ravenswell, Bray	53.2061733	-6.1117905
Medical	ATAI Clinic	44 Main Street, Bray	53.2016308	-6.1125529
Medical	Pembroke Eye Clinic	Pembroke Lodge, Church Road, Bray	53.1971884	-6.1137104
Medical	Bray Physiotherapy and Sports Injury Clinic	31 Quinsborough Road, Bray	53.20514	-6.1045597
Medical	NewDerm Clinic	1a Novara Avenue, Bray	53.2024951	-6.1099733
Medical	Dr Fidelma Savage	Donard House, Novara Avenue, Bray	53.2023089	-6.1100114
Medical	Dargle Clinic	11A Eglington Road, Bray	53.2036454	-6.1066851
Medical	Enniskerry Physiotherapy Clinic	Medical Centre, Main Street, Enniskerry	53.1930664	-6.1721745
Medical	The Avoca Clinic	Glencormack Business Park, Kilmacanogue North	53.171935	-6.1412067
Medical	Medicare Health Care Studio and Clinic	Glencormack Business Park, Kilmacanogue	53.171703	-6.1405807
Dental	Woodland Othodontics	2a Woodlands Office Park, Bray	53.1861202	-6.104009
Dental	Vevay Dental Centre	35 Vevay Road, Newcourt, Bray	53.1914995	-6.1053035
Dental	Avondale Dental Clinic	3 Newtown vevay, Vevay Road, Bray	53.1936114	-6.1073903

Type	Name	Address / Location	Lat	Long
Dental	Dental Care Ltd	40 Main Street, Bray	53.2018407	-6.1124244
Dental	Novara Dental Clinic	7 Carlton Villas, Novara Avenue, Bray	53.202344	-6.1078842
Dental	Bray Dental Clinic	1 Florence Road, Bray	53.2033841	-6.1093735
Dental	The Dental Suite	Fitzwilliam Terrace, 5 Strand Road, Bray	53.2039994	-6.1013034
Dental	Frances Brandon – Orthodontist, Invisalign, Braces	Bri Chualann Court, Adelaide Road, Bray	53.2044567	-6.1023151
Dental	Quinsboro Dental Clinic	13 Quinsborough Road, Bray	53.2046103	-6.107366
Dental	Smiles Dental Bray	Suite 1 Town Hall Court, Main Street, Bray, Co. Wicklow	53.2001781	-6.1105438
Dental	The Friendly Dentist	Belton House, 2 Castle Street, Ravenswell, Bray	53.2059826	-6.1107886
Pharmacy	Boghall Pharmacy	Boghall Shopping Centre, Boghall Road, Bray, Ballymorris, Bray	53.1892205	-6.1224131
Pharmacy	Roche's Chemist	34 Vevay Road, Newcourt, Bray	53.19167	-6.104949
Pharmacy	Cunningham's Pharmacy	3 Killarney Park, Bray	53.1959708	-6.1239413
Pharmacy	Downey's Pharmacy	Unit 3, Tesco Shopping Centre, Vevay Road, Bray	53.195917	-6.1106907
Pharmacy	Kennedy's Pharmacy	35 Main Street, Bray	53.2022177	-6.1121299
Pharmacy	Lloyd's Pharmacy	Novara Avenue, Bray	53.2023326	-6.1098727
Pharmacy	Lloyd's Pharmacy	Castle Street Shopping Centre, Bray	53.205769	-6.110707
Pharmacy	Boots	105 Main Street, Bray	53.2040726	-6.1117298
Pharmacy	Hilton's Pharmacy	2 Main Street, Bray	53.2042227	-6.1113047
Pharmacy	Quins Pharmacy	Quinsboro Road, Bray	53.204535	-6.1111567
Pharmacy	McCabes Pharmacy	24 Quinsboro Road, Bray	53.2046685	-6.1100346
Medical	Order of Malta Ambulance Corps	Hawthorn Road, Little Bray, Bray	53.2071845	-6.1183655
Nursing Home	FirstCare Nursing Home	Earlsbrook House, 41 Meath Road, Bray	53.1997119	-6.1010321
Nursing Home	Cairnhill Nursing Home	Herbert Road, Bray	53.1989617	-6.1250109
Nursing Home	Dargle Valley Nursing Home	Cookstown Road, Cookstown, Enniskerry	53.1871367	-6.1600692
Nursing Home	Atlanta House Nursing Home	Sdmonton Road, Bray	53.2009487	-6.104927

Type	Name	Address / Location	Lat	Long
Nursing Home	Shannagh Bay Nursing Home	2-3 Fitzwilliam Terrace, Strand Road, Bray	53.2043299	-6.099165
Nursing Home	Tara Nursing Home	Putland Road, Newcourt, Bray	53.1952738	-6.1017293
Home Care Providers	Home Instead Senior Care	3B Southern Cross Business Park, Bray	53.1862815	-6.1224079
Nursing Home	Roseville Nursing Home	49 Meath Road, Newcourt, Bray	53.198755	-6.09878
Nursing Home	Bray Manor Private Nursing Home	47 Meath Road, Bray	53.1993511	-6.0992158
Nursing Home	Kinvara House Nursing Home	Esplanade Terrace, Strand Road, Bray	53.1998193	-6.0970682
Nursing Home	Kylemore Nursing Home and Day Care Centre	Sidmonton Road, Bray	53.1994722	-6.1014945

APPENDIX 5A

Assessment of Water Quality in the Stream Flowing through Ballyman Glen, Co. Wicklow, Aquens Ltd. 2021

An Assessment of Water Quality in the Stream flowing through Ballyman Glen, Co. Wicklow

compiled by

AQUENS Ltd.

September 2021

INTRODUCTION

Aquens Ltd. was commissioned by RPS Group Ltd. to undertake a biological assessment of water quality along the length of the stream running through Ballyman Glen in Co. Wicklow. This stream runs in a south-easterly direction to join the River Dargle in Bray (Upper Dargle Road). The results will input into an EIS of a mixed housing development in Fassaroe which is in close proximity to mid reaches of the stream. The development site boundary to the north would also be in close proximity to the Ballyman Glen SAC.

MATERIALS AND METHOD

The water quality assessment was undertaken using macroinvertebrate indicators. These are an excellent tool when assessing water quality and they are the most common biological element in bioassessment. They are easy to collect, are widespread and abundant and more importantly they exhibit differential responses to physical and chemical changes in their environment. Some macroinvertebrates are sensitive to pollution while others are tolerant. They are not affected by a temporary amelioration of pollution but provide a realistic record of the prevailing conditions, integrating the biological signal over a period of time.

Macroinvertebrate sampling took place on September 10th, 2021 at five locations on the stream (Table 1). Sites were located with respect to the proposed surface water discharge points (SW2 to SW4). Site 1 was above the proposed development site immediately upstream of SW4. Site 2 was between SW2 and SW3 while Site 3 was in the region of SW2 ensuring that it was above an area of extensive poaching by cattle accessing the river. Sites 4 and 5 were positioned further downstream. Site 4 was upstream of a drain to the river which had a heavy growth of sewage fungus at the time of sampling. The sampling method adopted was that applied by the EPA in the national river monitoring program (McGarrigle *et. al*., 2002). Using an FBA (Freshwater Biological Association) pond net (1mm mesh), a 2-minute, multi-habitat kick-sample was taken at each site. In addition, one minute stone-washing was also undertaken. The samples were preserved in 70% IMS and processed in the laboratory. All the macroinvertebrates were identified to the appropriate taxonomic resolution using Freshwater Biology Association taxonomic keys.

The macroinvertebrate data were used to derive a Q-value using the EPA methodology (McGarrigle *et al*., 2002). This Q-value system is a five point scale (Q1-Q5: with intermediate scores obtainable, e.g. Q3-4) based on the proportions of five groups of macroinvertebrates,

with different pollution tolerances (see Appendix 1). Two other biotic indices (BMWP and ASPT – Appendix 11) were calculated. The BMWP score is based on the presence of pollution-tolerant to pollution-sensitive families. Each family is assigned a score. The BMWP score is the sum of these family scores. Families that are sensitive to pollution are assigned higher scores than pollution-tolerant families. A high overall score indicates that the water quality is good. The ASPT is determined by dividing the BMWP score by the number of scoring taxa yielding a score between 1 and 10, values >6 usually indicate excellent water quality. In addition, taxon richness and abundances, the percentage of Ephemeroptera/Plecoptera/Trichoptera (%EPT) and EPT richness were determined.

A range of physical (average depth and width, mesohabitat and substrate composition) and chemical characteristics (dissolved oxygen, temperature, conductivity and pH) were determined on site.

RESULTS

General site conditions

The stream was generally less than 2.5m wide for most of its length assessed with depths averaging 12 cm (Site 1) to 20 cm (Site 4 and 5) at the time of sampling (Table 1). Run (fast, rippled flow) habitat interspersed with pool predominated at most sites except Site 5 which had mainly relatively fast-flowing glide habitat. The benthic substrates were dominated by gravel and cobbles at all sites. These were heavily embedded at Sites 2 and 3 due to calcium carbonate concretion and were consequently difficult to dislodge during kick sampling. Site 5 was sandy in places, with moderate to heavy fine sediment deposition and a high cover of filamentous algae. There was some small patches (<5% cover) of filamentous algae at Site 3 but no evidence of sediment problems at this or the other sites, apart from the aforementioned cattle access which is bringing bankside soil into the reach c. 10m downstream of Site 3.

The study sites were located in reaches which had circa 40% (Sites 1, 2 and 3) 80% (Site 4) cover of overhanging vegetation (Figures 1 and 2). Site 5 was not shaded as can be seen in Figure 2. The tree cover was predominately willow (*Salix* sp.) and hazel (*Corylus* sp.) with some ash (*Fraxinus* sp.) and sycamore (*Acer pseudoplatanus*) and dense understorey of brambles and some ferns at Site 3. Due to the considerable shading there was little instream vegetation apart from isolated small patches of mosses attached to cobbles and *Helosciadium nodiflorum* (fool's water cress) along the stream margins at Site 1, 4 and 5.

Figure 1: Site 1 (a), Site 2 (b), Site 3 (c), heavy concretion on a riffle above site 2 (d) and poaching due to cattle access (e) below Site 3.

Figure 2: Site 4 (a) showing dense overhanging vegetation, Site 5 (b) and filamentous algae and marginal *Helosciadium* vegetation at Site 5 (c).

Table 1: Site characteristics and locations

Site	X	Y	Mean Width (m)	Mean depth (cm)	Instream Habitats				Benthic Substrates		
					Riffle	Run	Glide	Pool	Cobble	Gravel	Sand/Silt
1	52.204515	-6.164453	1.5	12	10	75	-	15	60	30	10
2	52.203140	-6.148158	2.5	15	10	60	-	30	60	30	10
3	58.203288	-6.148158	2.5	15	20	40	20	20	50	40	10
4	53.199390	-6.137137	1.5	20	10	70	0	20	60	30	10
5	53.200728	-6.129128	2.0	20	-	30	50	20	40	30	30

Onsite reading of pH indicated alkaline waters and high conductivity, typical of the geology, with oxygen saturation values between 94% and 100% (Table 2).

Table 2: Onsite results for pH, conductivity and oxygen

Site	pH	Conductivity	Oxygen	
			mgl^{-1}	% Saturation
1	7.87	587	9.54	94.0
2	8.29	626	9.47	100.6
3	8.25	625	9.28	99.7
4	7.73	747	9.27	97.8
5	7.60	701	9.50	100.3

Macroinvertebrate Communities

A checklist of the taxa and their abundances at each of the study sites is given in Table 3. Contrary to the previous survey in 2015 Site 5 recorded the highest taxon richness (23) followed by Site 4 (21) (Table 4). The lowest taxon richness was at Site 2 and this in part may be attributed to heavy concretion of the substrates and little biofilm due to the calcium carbonate precipitation, also a feature of Site 3. At both sites the leaf litter was also covered in calcium carbonate precipitate.

At all but Site 5 *Gammarus duebeni* was the most abundant taxon. The Simuliidae were more abundant at Site 5. The mayflies (Ephemeroptera) were mainly represented by the relatively tolerant *Baetis rhodani*/*atlanticus* with limited representation of the pollution-sensitive, flat-bodied mayflies. *Rhithrogena semicolorata* was only present at Sites 1 and 4. These were small instars, c. 3mm in length. This species emerges in the summer and following egg hatching can be found in the top substrates of rivers in late September onwards which may account for the small numbers encountered. A single specimen of *Heptagenia sulphurea* was recorded at Site 4 and small numbers of the summer mayfly (*Serratella ignita*) were present at Sites 4 and 5. Stonefly (Plecoptera) were represented by two species which occurred in small numbers at Sites 1 to 4. A high number of *Leuctra* sp. was present in the sample from Site 5. The only caddisfly larva to occur at all sites was *Rhyacophila dorsalis*, the other 7 taxa were variably represented at the five sites. Of note is the 38 specimens of *Sericostoma personatum* at Site 5. It is not uncommon when kicking sampling in rivers to hit a patch with large numbers of this species. Beetle (Coleoptera) larvae were predominately riffle beetles and these were most abundant at Site 4. The Diptera (fly larvae) were represented at all sites by Chironomidae (non-biting midge) and Simuliidae (blackfly) in relatively high numbers at

most sites particularly Site 5. *Dicranota* also occurred at all sites, but the four other dipteran larvae had a more sporadic occurrence. The snails and worms were equally sporadic in their occurrences.

Table 3: Occurrence and abundances of macroinvertebrates recorded in a single 2-minute, multihabitat kick sample from Sites 1-4.

Taxon	Family	Genus/species	1	2	3	4	5
Gastropoda	Hydrobiidae	*Potamopyrgus antipodarum* (Gray)	1	-	1	-	3
	Planornidae	*Ancylus fluviatilis* (Müller)	1	-	-	-	-
Oligochaeta	Lumbridulidae	spp. Indet	2	1	-	1	1
	Lumbricidae	*Eiseniella* sp.	-	1	3	1	-
Nematomorpha	Gordiidae	*Gordius* sp.	1	-	2	-	-
Crustacea	Asellidae	*Asellus aquaticus* (L.)	-	-	-	6	1
	Gammaridae	*Gammarus duebeni* Lilj.	1167	139	125	187	18
Plecoptera	Nemouridae	*Protonemura meyeri* (Pictet)	1	1	-	3	3
	Leuctridae	*Leuctra* sp.	-	1	7	6	69
Ephemeroptera	Baetidae	*Baetis rhodani/atlanticus**	14	5	12	19	46
		Alaintes muticus (L.)	1	-	-	2	1
	Heptagenidae	*Rhithrogena semicolorata* Curtis	2	-	-	2	-
		Heptagenia sulphurea (Müller)	-	-	-	1	-
	Ephemerellidae	*Serratella ignita*	-	-	-	2	3
Coleoptera	Elmidae	*Elmis aenea* (Müller)	-	1	-	1	1
		Limnius volckmari (Panzer)	-	-	1	8	-
	Scirtidae	spp. indet.	-	-	-	-	1
	Dytiscidae	spp. indet.	-	-	-	-	1
Trichoptera	Hydropsychidae	*Hydropsyche* sp.	-	5	-	1	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	1	4	5	6	3
	Polycentropodidae	*Plectrocnemia*	-	-	2	1	-
	Sericostomatidae	*Sericostoma personatum* (Spence)	1	-	-	-	38
	Limnephilidae	*Potamophylax latipennis* (Curtis)	8	3	1	-	-
	Goeridae	*Goera* sp.	-	-	-	3	1
	Glossosomatidae	*Agapetus* sp.	3	-	-	-	-
	Hydroptilidae	*Hydroptila* sp.	-	-		-	1
Hemiptera	Veliidae	spp. indet.	-	-	1	-	1
Diptera	Chironomidae	spp. indet.	36	19	15	14	37
	Simuliidae	spp. indet.	36	10	4	4	140
	Tipulidae	spp. indet.	-	-	1	-	5
	Pedicidae	*Dicranota* sp.	9	2	8	6	2
	Tabanidae	spp. indet.	-	-	-	-	1
	Ceratopogonidae	spp. indet.	-	-	-	-	1
	Dixidae	spp. indet.	-	-	-	1	-

*The taxon *Baetis rhodani* is now considered to include two species *Baetis rhodani* and *Baetis atlanticus* (Feeley & McAdam 2020). These were not separated in this study as both are currently considered to have similar water quality requirements.

Table 4: Metric calculations based on the macroinvertebrate data collected at Sites 1 to 5 .

	Site 1	Site 2	Site 3	Site 4	Site 5
Taxon richness	16	13	15	21	23
Taxon abundance	1284	192	188	275	378
Group A	0.23	0.53	0.00	2.21	0.80
Number of Group A taxa	2	1	0	3	1
Group B	1.01	2.11	4.40	4.04	29.41
Number of Group B taxa	4	2	2	3	5
Group C	98.75	97.37	95.60	91.54	69.52
Group D	0	0	0	2.21	0.27
Group E	0	0	0	0	0
Q-value	Q3-4	Q3-4	Q3	Q4	Q3-4
EPT richness	8	7	6	11	9
%EPT abundance	2.41	9.90	14.36	16.73	43.65
BMWP	65	59	62	92	99
ASPT	5.42	5.36	5.17	6.13	5.82

Water Quality

A range of ecological water quality metrics is presented in Table 4. Sites 1, 3 and 5 were rated Q3-4 based on the dominance of Group C taxa and sparse numbers of Group A (pollution sensitive) indicating moderate pollution. The absence of Group A taxa at Site 3 resulted in a Q3 score. Ecological water quality at Site 5 was better than in the 2015 survey (Q3). Note the representation of Q-value Group B taxa at Site 5 and %EPT abundance are elevated because of the large numbers of one species. Site 4 was rated Q4 due to the presence of three Group A taxa, albeit in low numbers which is probably due to the time of year as all were small nymphs. The EPT richness (11), ASPT score (>6) for this site also indicate good water quality.

Concluding Comments

This stream flows through a well wooded valley with the potential to protect the stream from land-use inputs. The cause of the moderate pollution in this river is not clear. It is likely that inputs from agricultural fields are a contributing factor but there may be others from domestic sources or impacts related to the aforementioned cattle access. Chemical analysis would be required to determine the key stressors and whether there is a link to the nearby old landfill site. Some recovery in quality occurred at Site 4 but deteriorated further downstream at Site 5 where urban, including road, inputs are likely to be contributing factors.

References

Feeley, H.B. and Macadam, C.R. (2020) *Baetis atlanticus* (Soldán and Godunko) (Ephemeroptera: Baetidae): a mayfly new to Ireland. *Irish Naturalists' Journal* **37**, 58–59.

McGarrigle, M. L., Bowman, J. J., Clabby, K. J., Lucey, J., Cunningham, P., MacCárthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan C. and Toner, P. F. (2002) *Water Quality in Ireland* 1998 – 2000. EPA. Appendix I.

APPENDIX I (Tables I-II)

EPA Biotic Index-Q-value System

Table I Macroinvertebrates grouped according to their sensitivity to organic pollution (McGarrigle *et al*., 2002)

Taxa	**Group A** *Sensitive*	**Group B** *Less Sensitive*	**Group C** *Tolerant*	**Group D** *Very Tolerant*	**Group E** *Most Tolerant*
Plecoptera	All except *Leuctra* spp.	*Leuctra* spp.			
Ephemeroptera	Heptageniidae	Baetidae (excl. *Baetis rhodani)*	*Baetis rhodani*		
	Siphlonuriidae	Leptophlebidae	Caenidae		
	Ephemera danica		Ephemerellidae		
Trichoptera		Cased spp.	Uncased spp.		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Apheilecheirus aestilvalis*	All except *A. aestivalis*		
Coleoptera			Coleoptera		
Diptera			Chironomidae (excl. *Chironomus* spp.)		*Chironomus* spp.
			Simuliidae		*Eristalis* spp.
			Tipulidae		
Hydracarina			Hydracarina		
Crustacea			*Gammarus* spp.	*Asellus* spp.	
			Austropotamobius pallipes	*Crangonyx* spp.	
Gastropoda			Gastropoda	*Lymnaea peregra*	
			(excl. *Lymnaea peregra* & *Physa* spp.)	*Physa* spp.	
Lamellibranchiata	*Margaritifera margaritifera*		*Anodonta* spp.	Sphaeriidae	
Hirudinea			*Piscicola* sp.	All except *Piscicola* sp.	
Oligochaeta					Tubificidae
Plathyhelminthes			All		

Table II Biotic Indices (Q-values) and typical associated macroinvertebrate community structure and abundance levels (McGarrigle *et al*., 2002)

Macroinvertebrate Faunal Groups	Q5	**Q4**	**Q3-4**	**Q3**	**Q2**	**Q1**
Group A	At least 3 taxa well represented	At least I taxon in reasonable numbers	At least 1 taxon Few - Common	Absent	Absent	Absent
Group B	Few to Numerous	Few to Numerous	Few/Absent to Numerous	Few/Absent	Absent	Absent
Group C	Few	Common to Numerous *Baetis rhodani* often Abundant Others never Excessive	Common to Excessive (usually Dominant or Excessive)	Dominant to Excessive	Few or Absent	Absent
Group D	Few or Absent	Few or Absent	Few/Absent to Common	Few/Absent to Common	Dominant to Excessive	Few or Absent
Group E	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few / Absent to Common	Dominant

Table III Abundance categories and relationship to percentage frequency of occurrence (McGarrigle *et al*., 2002)

Abundance Category	**Approx. Percentage Frequency**
Absent	no specimens
Present	1 or 2 individuals
Scarce/few	<1% of the total fauna
Small numbers	<5%
Fair Numbers	5-10%
Common	10-20%
Numerous	25 -50%
Dominant	50 -75%
Excessive	>75%

Table IV Interpretation of quality ratings (McGarrigle *et al*., 2002)

Quality ratings	**Pollution status**
Q5, Q4-5 and Q4	Unpolluted
Q3-4,	Slightly polluted
Q3 and Q2-3	Moderately polluted
Q2, Q1-2 and Q1	Serious pollution

APPENDIX II

BMWP (Biological Working Party) Score

BMWP (Biological Monitoring Working Party) Score (after Armitage *et al.,* 1983).

Families	*Score*
Siphlonuridae, Heptageniidae, Ephemerellidae, Leptophlebiidae, Potamanthidae, Ephemeridae, Taeniopterygidae, Leuctridae, Capniidae, Perlididae, Chloroplidae, Aphelocheiridae, Phyrganidae, Molannidae, Beraeidae, Odontoceridae, Leptoceridae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae, Perlodidae	10
Astacidae, Lestidae, Agriidae, Gomphidae, Cordulegarsteridae, Aeshnidae, Cordulliidae, Libellulidae, Psychomyidae, Philopotamidae	8
Caenidae, Nemouridae, Rhyacophilidae, Polycentropodidae, Limnephilidae	7
Neritidae, Viviparidae, Ancylidae, Hydroptilidae, Unionidae, Corophidae, Gammaridae, Platycnemididae, Coenagriidae	6
Mesovelidae, Hydrometridae, Gerridae, Nepidae, Naurcoridae, Notonectidae, Pleidae, Corixidae, Halipildae, Hygrobiidae, Dytiscidae, Gyrinidae, Hydrophilidae Clambeidae, Helodidae, Dryopidae, Elmidae, Chrysomelidae, Curculonidae, Hydropschyidae, Tipulidae, Simuliidae, Planariidae, Dendrocoelidae	5
Baetidae, Sialidae, Piscicolidae	4
Valvatidae, Hydrobiidae, Lymnaeidae, Physidae, Planorbidae, Sphaeridae, Glossophoniidae, Hirudinidae, Eropbellidae, Asellidae	3
Chironomidae	2
Oligochaeta	1

List the families present in the sample, assign the appropriate BMWP score to each family present. Sum these to get the total BMWP score. The average score per taxon (ASPT) value is then computed by dividing the total BMWP score by the number of scoring taxa present in the sample. The resulting BMWP value is between 1 and 10.

APPENDIX 5B

Wetlands Surveys

Survey of Annex I Habitats at Ballyman Glen SAC

Prepared for:

RPS Group

by

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Appendix I: Survey notes and associated map.

1 Introduction and background

Wetland Surveys Ireland Ltd. were commissioned by RPS Group to undertake an ecological survey of qualifying Annex I habitats (alkaline fen and petrifying spring) within part of the Ballyman Glen Special Area of Conservation (SAC), in counties Dublin and Wicklow.

The extent of the study area is shown in Figure 1 below. The aim of the survey was to determine the distribution, extent, and condition of alkaline fen and petrifying spring habitat within the study area.

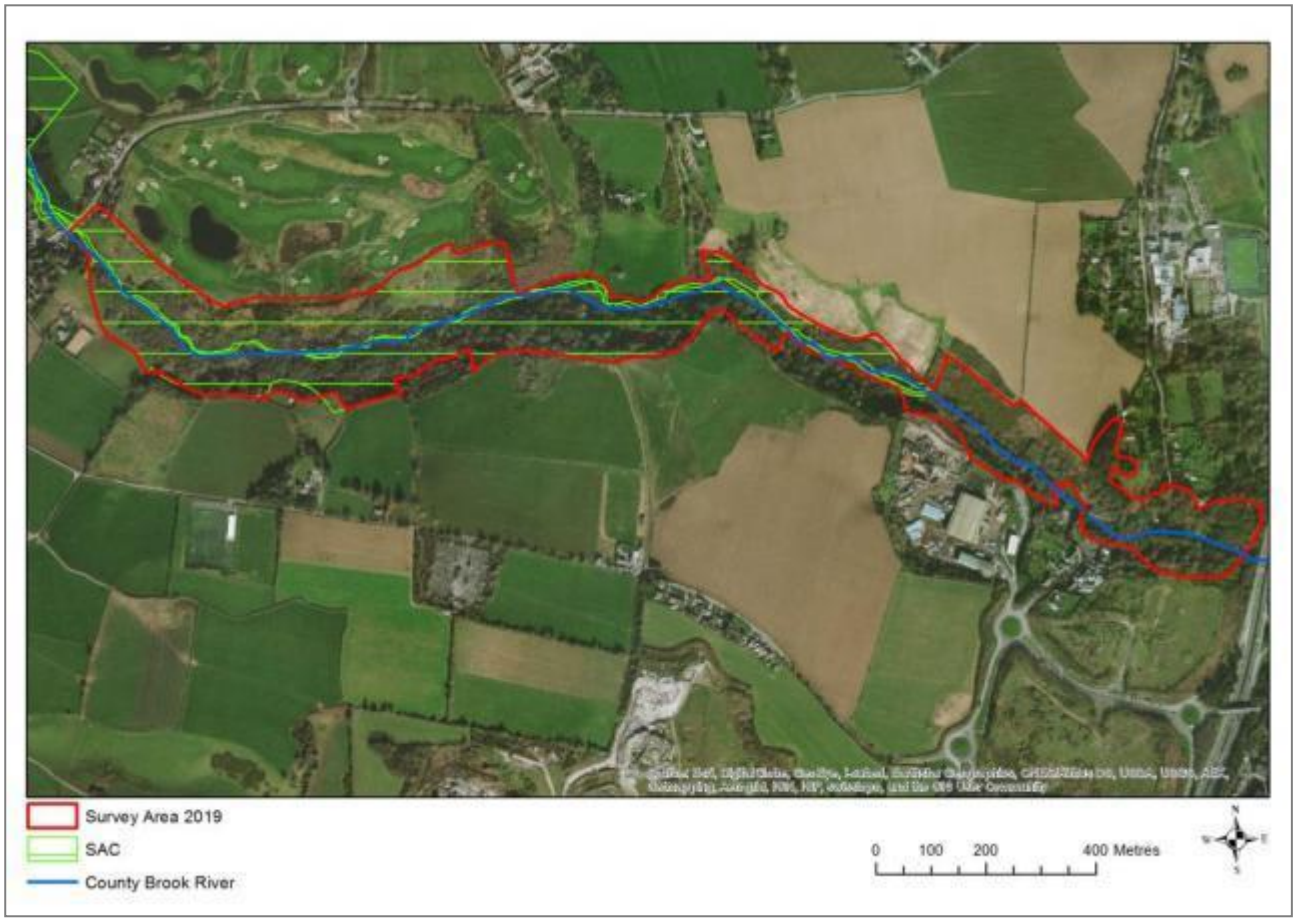

Figure 1: Map showing the extent of Ballyman Glen SAC and the 2019 survey area.

1.1 Study Area

The study area is located within the eastern parts of Ballyman Glen SAC and is approximately 30.3ha in extent (see Figure 1 above). Ballyman Glen SAC (NPWS Site Code: 000713) is located along the county boundary between Dublin and Wicklow, approximately 3 km north of Enniskerry.

The SAC is orientated in an east-west direction with a river, known as the County Brook River, running through the centre of the site. The SAC includes the river and adjacent valley slopes to the north (Dublin) and to the south (Wicklow).

The glen is bounded mostly by steeply sloping pasture with Gorse (*Ulex europaeus*) and areas of hazel wood, wet willow woodland and scrub, with adjacent areas of rough and improved grassland (see Plate 1). The SAC has been selected due to the presence of two Annex I habitats; petrifying springs with tufa formation [7220 – *priority habitat] and alkaline fen [7230].

A small area of alkaline fen occurs in the southern part of the SAC. The fen together with other areas within

the SAC, on both the Wicklow and Dublin side, are associated with petrifying spring/seepage areas that have given rise to deposits of tufa.

The fen is dominated by a field layer of Purple moor-grass (*Molinia caerulea*), with abundant Blunt-flowered Rush (*Juncus subnodulosus*), Black Bog-rush (*Schoenus nigricans*), and long-stalked Yellow-sedge (*Carex lepidocarpa*). Notable species from the fen area include Narrow-leaved Marsh-orchid (*Dactylorhiza traunsteineri*), Marsh Helleborine (*Epipactis palustris*), and Broad-leaved Cottongrass (*Eriophorum latifolium*). [NPWS Site Synopsis].

Gorse (*Ulex europaeus*) and Birch (*Betula pubescens*) are encroaching around the margins of the fen. The site continues to be used for clay pigeon shooting and shattered clay pigeons are scattered throughout.

Wet woodland and scrub occur along the margins of the river on lower slopes for most of the length of the glen. In drier areas hazel (*Corylus avellana*) is dominant, whereas in wetter areas the canopy is dominated by willow (*Salix* spp.), alder (*Alnus glutinosa*), and Ash (*Fraxinus excelsior*). Hawthorn (*Crataegus monogyna*) and Spindle (*Euonymus europaeus*) occur in the shrub layer. Species occurring in the ground layer include Marsh Hawk's-beard (*Crepis paludosa*), Sanicle (*Sanicula europaea*), Herb-Robert (*Geranium robertianum*), Bugle (*Ajuga reptans*), Horsetails (*Equisetum telmateia*), Meadowsweet (*Filipendula ulmaria*) and Remote Sedge (*Carex remota*). In places, petrifying springs and associated seepage areas occur frequently within the woodland areas on either side of the river. Upper slopes of the glen include areas of dry scrub with Gorse (*Ulex europaeus*), dense Bracken (*Pteridium aquilinum*), and more open dry meadows. (NPWS site synopsis; Personal observations).

Plate 1: Overview of Ballyman Glen, view from the western extent of the study area overlooking the glen which is dominated by wooded slopes.

2 Methods

2.1 Desktop review and consultation

A desktop review of existing data sources was undertaken to identify previous data relating to the distribution of Annex I habitats within the study area including a recent survey undertaken but the authors (Crushell and Foss 2017). Sources that were consulted included NPWS designated site data including site specific conservation objectives (SSCOs) (NPWS 2019) and a range of previous ecological reports and publications including; Perrin *et al.* (2008), Lyons and Kelly (2013; 2016), Lyons (2015), and Ball (2001).

2.2 Field survey methods

A walkover of the study area was undertaken during late November 2019. Survey work was undertaken by two experienced wetland ecologists; Dr Patrick Crushell and Mr Brendan Kirwan. During the walkover survey, target notes were recorded on a GPS enabled field computer. These notes recorded features of ecological interest throughout the site.

In instances where Petrifying spring and Alkaline Fen habitat were identified then notes on the key characteristic features were recorded. Springs were characterised according to methods described by Lyons and Kelly (2016) and the tufa formation types recorded (see Table 1).

Habitats present at the site were classified according to Fossitt (2000) and where relevant according to Annex I of the EU Habitats Directive. Guidance in determining whether or not a habitat type may correspond to an EU Annex I type was sought from a variety of sources including European Commission (2013), Lyons *et al.* (2013, 2015, 2016) and Fossitt (2000).

All data was recorded using GIS software (ESRI Collector) running on a GPS enabled field computer.

Table 1: Tufa formation types occurring in Ireland (reproduced from Lyons and Kelly 2016)

Category	Description
Cascade	Developing on steep slopes at varying distances from the water source; characterised by massive, frequently complex build-ups.
Dam	Similar to cascades but forming along streams and rivers and causing the impoundment of water behind a tufa crest.
Stream crust	Sheet-like deposits forming in streams of intermediate to low gradient; these may merge with cascades.
Paludal[1]	Formed in low gradient mires where tufa accumulates around the bases of plants, often surrounded by carbonate muds.
Cemented rudites	Gravels etc. cemented by tufa; often found on coasts where spring water seeps onto shingle banks.
Oncoids / ooids	Unattached, coated grains (<1mm up to 30 cm); the cortex may consist of biotic or abiotic particles, such as stones or plant fragments.

2.3 Habitat mapping

Detailed habitat mapping was prepared using ArcGIS Version 10.6. All data has been projected in Irish Transverse Mercator (ITM) and provided in ESRI shapefile format. Digitising and attribute data recording standards comply with recommended guidelines in Smith *et al.* (2011). Data is mapped as polygon, polyline, or point data as appropriate to the feature being mapped.

All spring locations were mapped using point features, and in some instances where the seepage area extended beyond ca 10 m^2, then it was also mapped as a polygon feature.

Photos were taken at regular intervals during the field survey to assist with subsequent habitat mapping, interpretation and to record features in the wider landscape.

[1] Paludal tufa can be further classified into one of three categories:
Paludal strength 1 = weakly formed, discontinuous, inconspicuous tufa; trace on soil or at base of plants
Paludal strength 2 = intermediate
Paludal strength 3 = strongly formed tufa, often crunchy underfoot, coating the ground with a conspicuous white layer, often with detached chunks of consolidated tufa.

General survey target notes were recorded on a GPS enabled field computers running. These notes referred to such features as; dominant vegetation, habitat types, features of interest, management, hydrology, impacts etc. These survey notes are provided as a point dataset.

2.4 Nomenclature

Plant species nomenclature in this report follows Stace (2010) for vascular plants, Atherton (2010) for mosses and liverworts, and Whelan (2011) for lichens. Some mosses, liverworts, and higher plants not readily identified in the field were collected and keyed out at a later time using appropriate keys.

2.5 Survey Limitations

The surveys were carried out over the winter period (November 2019), a sub-optimal time for the identification of certain plant groups (e.g. grasses, sedges, flowering plants). Such seasonal limitations did not however hinder the identification of habitats or key indicator species such as bryophytes (mosses and liverworts). Some parts of the study area were inaccessible for survey due to dense cover of scrub.

Spatial data was recorded using portable GPS enabled devices. These typically have an accuracy of <5 m, however due to the dense woodland canopy within the study area this level of accuracy may not always have been achieved. The GPS data recorded in the field was reviewed following completion of survey work and any outlier data points identified were adjusted with the aid of survey photography and other mapping resources (e.g. OSI six inch mapping, aerial photography etc).

2.6 Habitat Classification

Habitats were primarily identified using the Fossitt (2000) classification system.

Those areas that, following initial survey, corresponded with the following EU Annex I habitats were targeted for more detailed vegetation survey and assessment as part of the current survey:

- *Petrifying springs with tufa formation (*Cratoneurion*) [7220]
- Alkaline fens [7230]

Correspondence with the EU Annex I Habitat types was mainly informed by the following guidance documents and references:

- Fossitt (2000)
- EU Interpretation manual (2013)
- Lyons and Kelly (2013)
- Perrin *et al.* (2013)
- Corbett (2004)
- NPWS (2019b)
- Lyons and Kelly (2016)
- Lyons (2015)

Brief descriptions of the relevant EU habitats are presented in the following section. These descriptions highlight the key characteristic species and features used in determining correspondence to EU habitats during the current study.

2.6.1 Petrifying Springs with Tufa Formation [7220]

Petrifying Springs with Tufa Formation are defined as springs and seepages where tufa is actively deposited and where characteristic species of bryophytes are dominant or abundant.

'Petrifying springs with tufa formation (*Cratoneurion*) 7220' are a priority habitat in Annex I of the Habitats Directive. They form where lime-rich spring water deposits tufa (calcium carbonate) on the ground surface. Tufa-depositing waters are characterised by having a high pH, high levels of dissolved calcium and bicarbonate ions and by being oligotrophic (low in nitrogen and phosphorus).

Petrifying springs fall into three physiognomic categories:

(i) clearly defined spring heads with consolidated tufa,
(ii) spring heads with associated tufaceous flushes, and
(iii) tufa-forming seepage areas on level ground.

They contain *Cratoneurion* vegetation, typically dominated by bryophytes, and characterised by the presence of *Palustriella commutata* (formerly *Cratoneuron commutatum*) along with *Pellia endiviifolia, Cratoneuron filicinum, Eucladium verticillatum, Bryum pseudotriquetrum, Palustriella falcata* and *Didymodon tophaceus*. Frequently occurring vascular plants are *Festuca rubra, Carex lepidocarpa, C. panicea*, and *Equisetum telmateia*.

Three subtypes of petrifying spring vegetation can be distinguished depending on the setting of the spring: Woodland springs; Coastal springs; and Springs of inland, open habitats. Springs occurring on the Ben Bulben Range constitute a distinct group of high conservation value.

The ecological significance of petrifying springs is seldom confined to a point source; rather, there is often a continuum of intergrading hydrological conditions from the spring head, through a flushed slope and into small streams. Spring heads may be distinct point locations giving rise to small streams immediately below the point of emergence, or water may seep to the surface in a more diffuse pattern over a larger area.

The above description of the habitat is from Lyons and Kelly (2013). A more detailed review of the habitat and associated plant communities is provided in Lyons and Kelly (2013), Lyons (2015), and Lyons and Kelly (2016).

Lyons and Kelly (2016) describe eight distinct plant communities associated with Irish petrifying springs.

Key features used in assessing correspondence with EU Annex I Habitat

- Presence of tufa
- Fed by base rich oligotrophic water
- Generally dominated by bryophytes
- Presence of characteristic species of the *Cratoneurion*
- Wooded or un-wooded
- May occur as discrete spring location with local influence or extend as seepage zones over larger areas

Petrifying spring habitat was recorded frequently throughout the western and northern sections of the study area during the current survey of Ballyman Glen and during survey work in the same area in December 2016, two additional petrifying springs and associated seepage zones were recorded south of the County Brook River during the 2019 survey.

2.6.2 Alkaline fen [7230]

Alkaline fens are typically calcareous basin or flush fen systems with extensive areas of species-rich small sedge communities. These fen systems are often a complex mosaic of habitats, often occurring in association with tall sedge swamp, reedbeds, wet grasslands, springs, and open-water. Alkaline fen is characterised by a broad range of small to medium *Carex* spp., carpets of brown mosses and high species diversity including black bog-rush (*Schoenus nigricans*), blunt-flowered rush (*Juncus subnodulous*), devil's bit scabious (*Succisa pratensis*), hemp agrimony (*Eupatorium cannabinum*) and purple moor-grass (*Molinia caerulea*).

The habitat requires a high water table, a calcareous, low nutrient water supply and minimal water level fluctuation. Low intensity mowing and/or grazing are often important for maintaining species richness. In Ireland, the most extensive areas of alkaline fens are thought to occur in lowland basins underlain by limestone groundwater bodies with a karstic or poorly productive flow regime. Alkaline fens within upland

and lowland flushes, along the fringes of calcareous lakes (e.g. Lough Corrib) and within turloughs, dune slacks and machair are thought to be more limited in local extent but more widespread.

Key features used in assessing correspondence with EU Annex I Habitat

- Presence of a range of small sedge species
- Presence of brown moss layer
- Occurring in natural habitat (e.g. lake edge; flush; infilling hollow, fen areas at the edge of reedswamp)
- Waterlogged peat soils
- Base rich conditions

An area of alkaline fen has previously been reported from the southern part of Ballyman Glen (Curtis 1976, NPWS site synopsis). The fen at this location occurs on moderately sloping lands and is fed by a continuous supply of calcareous groundwater from a series of tufa forming springs emerging on the upper slopes. The fen is dominated by a field layer of Purple moor-grass (*Molinia caerulea*), with abundant Blunt-flowered Rush (*Juncus subnodulosus*), and long-stalked Yellow-sedge (*Carex lepidocarpa*). Notable species from the fen area include Narrow-leaved Marsh-orchid (*Dactylorhiza traunsteineri*), and Broad-leaved Cottongrass (*Eriophorum latifolium*). Moss species occurring in the ground layer include: *Palustriella commutata, Calliergonella cuspidata*, *Ctenidium molluscum*, *and Campylium stellatum*.

This area of fen was confirmed as being present during the current survey, however scrub encroachment is a threat to the habitat.

3 Results

3.1 Site survey history

Much of the glen, both north and south of the river appears largely un-wooded on the historic OSI 6 inch mapping for the area (1837-1842) remaining un-wooded up to the early 20th century with a small localised wooded area occurring within the south-eastern extremity of the study area. These maps also suggest the presence of wet ground and springs within the area.

Brunker (1950) describes Ballyman Glen as follows: "*'One of the most interesting spots in the district is the small strip of alkaline marsh along the County Boundary at the head of Ballyman Glen. Here at the end of May can be seen an abundance of Orchis traunsteinerioides of Pugsley; Epipactis palustris occurs sparingly later in the season, while in a space perhaps fifty yards wide and a quarter of a mile long, no less than twenty sedges can be found with masses of Eriophorum latifolium.*"

Ballyman Glen was identified as an area of scientific interest following a survey of the site during the 1970s (Curtis 1976). This survey describes the open fen area in the southern part of the site, however the area to the north of the river is not described in detail. This area is likely to correspond with the area previously described by Brunker (1950).

A brief report prepared by Ball (2001) that was submitted to the National Parks and Wildlife Service in 2001 summarises the hydrogeology of the area and mentions the presence of tufa springs within the woodland area to the north and south of the river and comments that they are in near natural state with little evidence of trampling by animals. The report includes a review of land fill and sand pit operations in the area of the Ballyman Glen.

A survey of the woodland at Ballyman Glen was undertaken as part of the National Native Woodland Survey (NSNW site code: 0828) (Perrin *et al.* 2008). This survey concentrated on the woodland area to the south of the river. The site report identifies areas of wet pedunculate oak-ash woodland (WN4) and wet willow alder ash woodland (WN6). There is no reference to springs occurring within the woodland areas

surveyed.

Lyons and Kelly (2013) included two springs within Ballyman Glen as part of the conservation assessment for the habitat. One of these springs was associated with the alkaline fen area to the south of the river (while the second spring is located north of the river (within woodland area). The assessment of this second spring was only informed by a brief survey (Lyons and Kelly 2013).

A survey of Ballyman Glen undertaken by Crushell and Foss (2017) in 2016 concentrated on the northern side of County Brook Stream. Tufa springs were reported from both sides of the Glen. Detailed conservations status assessments of these springs were reported.

3.2 Distribution and extent of Annex I habitats

A map showing the distribution of Annex I alkaline fen and petrifying spring habitats recorded within the study area is presented in Figure 2. The springs are indicated as point features, although in places more extensive tufa seepage zones extend from the spring locations and these are indicated by polygon features labelled as Seepage Zone I to Seepage Zone VII.

Survey notes summarising the key features of the study area as recorded during the survey and their relevant locations are presented in Appendix I.

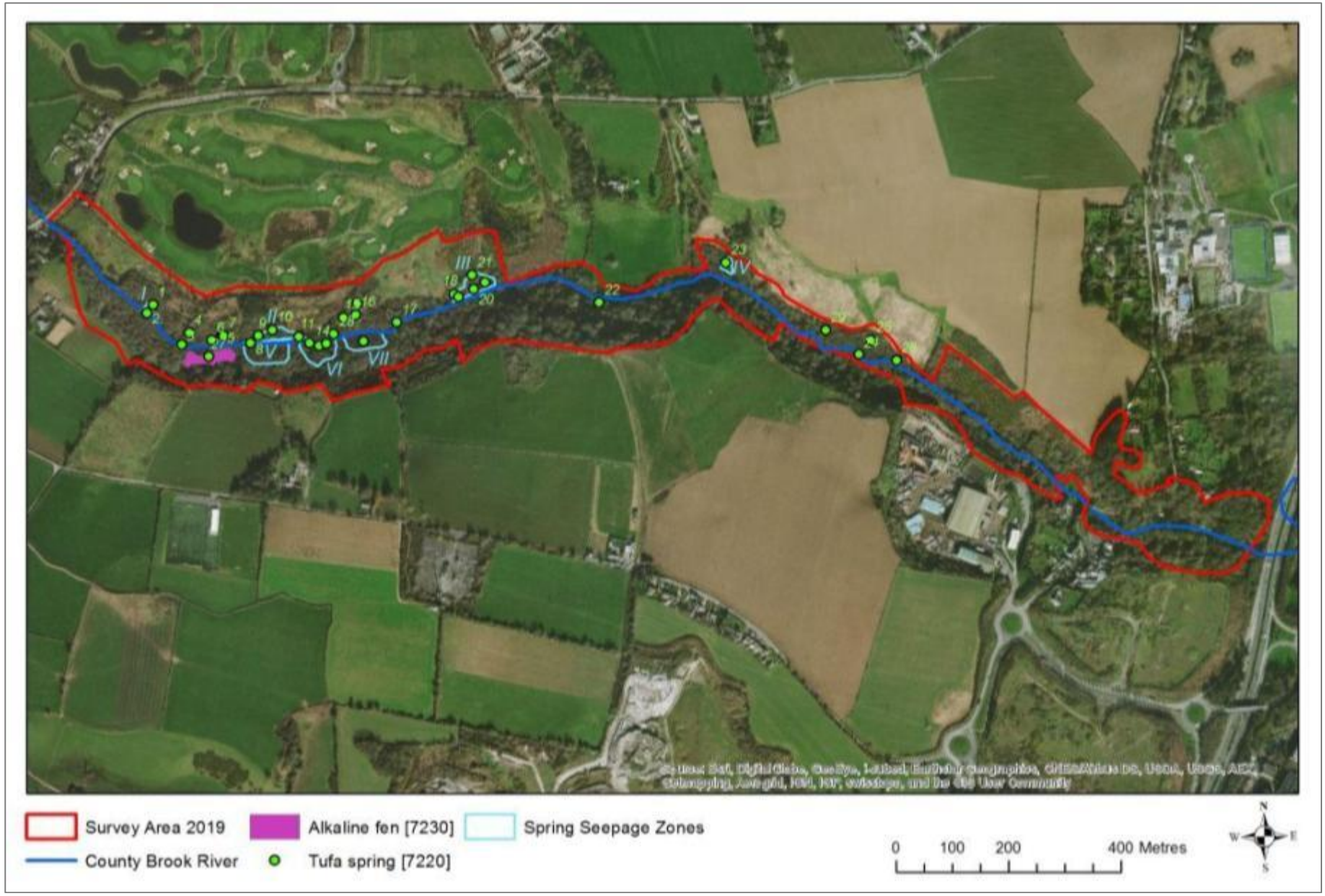

Figure 2: Map showing the distribution and extent of Annex I habitats within the study area.

3.2.1 Alkaline Fen

A single area of Alkaline fen was recorded on a north-facing un-wooded slope to the south of the County Brook River (see Figure 2). The fen habitat is fed by continuous supply of calcareous rich water which has formed extensive tufa substrate. The fen is associated with an extensive seepage area that extends through the woodland to the north to the County Brook River, where strongly consolidated massive tufa formation occurs on the southern river bank.

The fen habitat is surrounded by scrub and woodland (Plate 2) and, based on a review of aerial photography and personal observations, is being encroached by scrub vegetation, predominantly downy birch (Betula pubescens). The extent of open fen is currently estimated to cover 0.18ha compared to ca 0.5ha in the year 2000.

The fen vegetation is dominated by Purple Moor-grass (*Molinia caerulea*) with abundant Great Horsetail (*Equisetum telmateia*), and Black Bog Rush (*Schoenus nigricans*). Locally the ground layer has an almost complete cover of brown mosses with *Calliergonella cuspidata*, *Cratoneuron filicinum*, *Palustriella communata*, and *Ctenidium molluscum* all present.

The timing of the survey did not allow a comprehensive assessment of the fen flora. The vegetation of the area is described in the NPWS Site synopsis for the site as follows:

> *"The vegetation of the main part of the fen is dominated by Greater Tussock-sedge (Carex paniculata), Tall Fescue (Festuca arundinacea), butterworts (Pinguicula vulgaris and P. lusitanica), Black Bog-rush (Schoenus nigricans) and Broad-leaved Cottongrass (Eriophorum latifolium). The site is particularly notable for its orchids, with species including Early Marsh-orchid (Dactylorhiza incarnata), Narrow-leaved Marsh-orchid (D. traunsteineri) and Marsh Helleborine (Epipactis palustris) occurring. In addition, twenty species of sedge have been recorded in the area, including the scarce Long-stalked Yellow-sedge (Carex lepidocarpa)."*

Evaluation: The habitat is of high ecological interest, corresponding with Annex I Alkaline Fen. The fen is known to support two notable higher plant species; *Dactylorhiza traunsteineri and Eriophorum latifolium.* The habitat is somewhat degraded and threatened due to encroachment of scrub and woodland from the edges. However, as the habitat corresponds with an EU Annex I habitat and is a qualifying feature of the SAC, it is deemed to be of international conservation significance.

Plate 2: Alkaline fen with abundant Purple Moor-grass (*Molinia caerulea*), surrounded by encroaching scrub woodland.

3.2.2 Petrifying springs with Tufa formation

Springs and associated seepage zones were recorded throughout the lower slopes of the Glen on both the northern and southern sides of the County Brook River. In all, springs were recorded at 29 locations within the glen (see Figure 2).

The type, distribution, extent and quality of petrifying spring habitat recorded within the survey area are described in the following sections.

In areas where the extent of tufa extended beyond a local area of ca 100 m^2 (10 X 10m), these are mapped as 'seepage zones' in the habitat map (Figure 2). Elsewhere, where the influence of tufa is more localised these are mapped as point locations.

There are seven seepage zones mapped during the current survey, four of which occur to the north of the County Brook River and three of which occur to the south (see Figure 2).

In summary, there were six seepage zones that were mapped as polygons as follows:

- Zone I (ca 303 m^2 in extent) located to north of river in the western end of study area.
- Zone II (ca 1492 m^2 in extent) located north of river, extends in west-east direction parallel to the river.
- Zone III (ca 1882 m^2 in extent) located to north of river in the central part of study area.
- Zone IV (ca 431 m^2 in extent) located to north of river in the eastern part of study area.
- Zone V (ca 2923 m^2 in extent) located to the south of the river in the western part of the study area.
- Zone VI (ca 2017 m^2 in extent) located circa 20m to the east of Zone V on the southern slopes.
- Zone VII (ca 1928 m^2 in extent) located circa 20m to the east of Zone VI on the southern slopes.

The petrifying springs at Ballyman Glen occur on moderate wooded slopes within the glen and also along the banks of the County Brook River. The seepage zones extend up to 40m upslope from the river bank.

They mostly occur as seepage areas with a dominance of paludal tufa although oncoids/ooids (plant fragments coated in tufa deposits) are also occasional. Massive tufa cascades are mostly restricted to river banks, although less dramatic example of this tufa formation also occurs on moderate slopes removed from the river where there is a constant trickle of water. Tufa fused stones and boulders (cemented rudites) were recorded within the riverbed in some areas often in close proximity or just down-steam of tufa cascades on the stream bank, with stream crust tufa (sheet like deposits of tufa) also noted.

The two main types of tufa springs noted during the survey are described in the following paragraph.

Seepage areas vegetation description: The plant communities of the seepage areas mostly correspond with the *Palustriella commutata-Geranium robertianum* springheads as described by Lyons and Kelly (2016). Bryophyte cover is mostly patchy on the sloped paludal tufa sites and is interspersed with a high cover of leaf litter. The dominant species is *Palustriella commutata* at all sites. Other bryophytes that are common in the ground layer include; *Pelia endiviifolia*, *Cratoneuron filicinum, Eucladium verticillatum,* and *Calliergonella cuspidata*. The field layer is mostly sparse with *Equisetum telmateia, Carex remota*, *Chrysosplenium oppositifolium, Adjuga reptans* occurring most frequently with *Eupatorium cannabinum* and occasional ferns. A low cover of *Rubus fruticosus* agg. is usually present.

Canopy cover is moderate to high and consists of a mix of *Salix cinerea*, *Alnus glutinosa*, *Fraxinus excelsior*, *Betula pubescens*, *Corylus avellana*, and associated *Hedera helix*.

Ground surface is typically damp and relatively firm although may be extremely soft and almost quaking in places where the slope is reduced. Where trickling water is present there is often the presence of oncoids / ooids or low firm consolidated tufa ridges.

Plate 3: Seepage zone with paludal tufa occurring beneath the leaf litter.

Massive consolidated tufa vegetation description: Along the river bank massive consolidated tufa often occurs (see spring assessment B3 below). In these examples bryophytes have an almost complete cover with *Palustriella commutata*, *Pellia endiviifolia*, *Aneura pinguis*, and *Conocephalum conicum* most frequent.

A massive consolidated tufa formation along the northern bank of the County Brook River is illustrated in Plate 3-4.

Plate 3-4: Massive consolidated tufa formation along the southern banks of the County Brook River.

Higher plants are sparse and mostly occur around the margins of the solid tufa, and include species such as *Ajuga reptans*, *Chrysosplenium oppositifolium*, *Geranium robertianum*, *Oxalis acetosella, Galium odoratum* and *Ranunculus repens,* and occasional ferns. The canopy is complete and dominated by *Corylus avellana* and *Salix cinerea,* with *Hedera helix* and *Rubus fruticosus* frequently present.

3.2.2.1 Conservation status

An assessment of conservation status of five representative springs at Ballyman Glen using the methodology outlined in Lyons and Kelly (2016) was undertaken as part of a previous study (Crushell and Foss 2017). Each spring was assessed according to; range and area, structures and functions, and future prospects. The overall condition assessment of four springs was considered unfavourable – inadequate while a single spring was deemed to be in favourable conservation status.

The main reason that four of the five springs did not attain favourable conservation status was due to the high levels of deer grazing and associated trampling effects on the surface of springs. Most of the springs within the Glen are likely to conform to this in that as deer grazing is occurring at a similar intensity throughout the wooded slopes of the glen. The exception being those springs which along the river bank where trampling by deer is less evident.

A further assessment of conservation importance was undertaken using a scoring system proposed by Lyons and Kelly (2016). This confirmed that the springs varied from being of moderate to high conservation importance.

<u>*Evaluation:*</u> There are extensive seepage areas on both slopes of Ballyman Glen which are associated with calcareous springs. These springs and seepage areas correspond with the EU Annex I habitat Petrifying springs with tufa formation (Cratoneurion) [7220] and are therefore deemed to be of international conservation significance.

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Appendix II
Survey notes and associated map

Note Number	Category of Note	Note text	Easting (ITM)	Northing (ITM)
N1	General	Location of B2 spring assessment 2016.	722765	718551
N2	General	Bottom of flushed slope with Iris pseudacorus, minor tufa deposits in soil. Palustriella commutata present alongside river indicating seepage from upslope. See photos: SAM2229-2236.	722759	718533
N3	General	Moderate slope with diffuse paludal tufa in substrate. Molinia occurs in upper sections together with calcareous spring indicators (Equisetum telmateia, Palustriella commutata, Calliergonella cuspidata). Poaching by deer. Consolidated tufa occurs at base of Molinia tussocks.	722770	718548
N4	Habitat	River disappears underground for short section (ca 2m) adjacent to small Iris and Phalaris marsh to north of channel	722795	718489
N5	Habitat	Tufa occurring along banks on south side 25m.	722820	718481
N6	General	Minor tufa spring, on moderate slope. Localised influence. Typical calcareous spring species with Equisetum telmateia, Geranium robertianum, Salix cinerea, and Corylus avellana. Mosses include: Palustriella commutata, Cratoneuron filicinum (extent of spring ca 7*10m).	722834	718498
N7	General	Tufa spring occurring along southern bank of stream, consolidated tufa cascade with abundant liverworts (Pellia endiviifolia, Conocephalum conicum, Aneura pinguis) with abundant Palustriella commutata. Occurs along approx. 25m length of river bank on south side.	722821	718477
N11	General	Dense scrub (inaccessible), on dry moderate slope with bracken, gorse, and bramble.	722860	718540
N12	General	Location of B3 spring assessment 2016.	722872	718486
N13	General	Tufa spring along 10m of river bank on southern side, extends from alkaline fen area further upslope to south. Such springs are frequent along southern bank downstream for 50m.	722874	718485
N14	General	Open area of alkaline fen, abundant Molinia, tufa occurs throughout ground layer together with brown mosses. Evidence of clay pigeon throughout.	722869	718456
N15	General	Springs at this location on northern and southern bank.	722892	718494
N16	General	More tufa springs along southern bank.	722895	718493
N17	General	Southern side, small stream entering watercourse, with tufa deposit, through flushed slope further up valley side. Robust tufa 'cascade' formation and typical spring assemblage of mosses and liverworts. Tufa deposits along southern side are frequent, almost continuous.	722943	718480
N18	Habitat	Tufa formation on the southern river bank. Seepage from slop to south.	722956	718471

Note Number	Category of Note	Note text	Easting (ITM)	Northing (ITM)
N19	General	Tufa spring and seepage zone with tufa amongst soil and Palustriella commutata occurring frequently. Equisetum telmateia, Carex remota, Brachythecium rivulare. Alder and Hazel dominate tree layer. Extends down to river. Continuous with other seepage areas to the east.	722957	718493
N22	General	Tufa spring head, willow canopy, good tufa formation. Spring and flush area down-slope extends down to river. Mix of consolidated and unconsolidated tufa in ground layer with trickling water. Location of B4 spring assessment 2016.	722982	718504
N23	General	Good tufa formation with rich moss cover.	722994	718487
N24	General	Low lying swampy area with paludal tufa, appears to be impounded by ridge to east and south (between low-lying area and river). Willow and Alder with individual Sycamore. Some Spindle present.	723029	718492
N25	General	Tufa springs on northern and southern bank dominated by Conocephalum conicum, with Pellia endiviifolia and Aneura pinguis. Tufa cementing stones together in river.	723065	718476
N26	Habitat	Tufa seepage zone on southern side of the river ca 30m upslope. Zone is ca 50m wide with sparse tufa. Extensive leaf litter. Scattered Carex sp. and equisetum. Poor moss cover.	723063	718439
N27	General	Tufa spring arising in Willow woodland to north of river.	723079	718479
N28	Habitat	Large, 1m high Palustriella commutata mound from here tufa seepage down to river bank (ca 3m to south) (spring influence extent is ca 2*5m).	723092	718496
N29	Habitat	Wide seepage zone down to the river. Paludal tufa very evident. Plentiful moss and Carex sp. with lots of leaf litter. Carex dominant, frequent Equisetum telmateia. Tufa in frequent, may be hidden by leaf litter. Area slopes to the north towards the river.	723111	718484
N30	Habitat	Seepage zone from here to the east, Equisetum sp., Carex sp., sparse tufa, very soft underfoot	723113	718478
N31	General	Diffuse seepage zones along this ridge, tufa patchy distribution and with frequent signs in subsoil. Moss cover is frequent, Willow dominates canopy with occasional Ash and Holly.	723130	718530
N32	Habitat	Seepage zone, poor moss cover, decent tufa. Equisetum, Carex sp.	723144	718483
N33	Habitat	Drier, no tufa springs in this area, Birch occurs with Bramble in understory.	723164	718518
N34	Habitat	Seepage zone, poor moss cover, extensive tufa substrate. Equisetum sp., Carex sp.	723185	718482
N35	General	Minor spring zone, with unconsolidated tufa. Seepage down to river bank 5m to south (total spring extent ca 6*2m). Pellia endiviifolia with low moss cover.	723203	718517
N36	General	Area of unmanaged grassland with extensive scrub encroachment (dense bramble and gorse).	723221	718606

Note Number	Category of Note	Note text	Easting (ITM)	Northing (ITM)
N38	General	Minor spring, no water at surface, tufa evident in soil. Equisetum telmateia and Pellia endiviifolia, poor moss cover. To east of this location tufa spring zone to north of river, extends > 20m to north. Patchy moss, tufa amongst bare soil, and Equisetum telmateia.	723305	718567
N39	Habitat	Dry, dense scrub woodland, inaccessible from here to the east on the southern side of the stream.	723327	718546
N40	General	Location of B5 spring assessment 2016.	723343	718588
N41	Habitat	Extensive tufa on terraces along a channel. Low to moderate moss cover, extends south to river.	723360	718588
N42	General	Area of unmanaged grassland with extensive scrub encroachment (dense bramble and gorse).	723353	718650
N43	General	Tufa cascade on steep escarpment to south of river. Palustriella commutata and Pellia endiviifolia at spring head, from base of cliff a small seepage channel continues north-westwards to river.	723563	718552
N44	General	Dry escarpment to south, improved pastures with cattle access to river.	723630	718551
N45	General	Location of B1 assessment 2016.	723791	718627
N46	Habitat	Small wet areas with Iris pseudacorus locally abundant. No tufa.	723844	718568
N48	General	Small tufa spring area in wet wooded hollow. Very local in extent, Eupatorium cannabinum.	723966	718503
N49	General	Small tufa spring on northern bank, ca 1m height. Constant trickle, tufa only appears at stream edge. Seepage channel extends 30m to north where water rises in swampy area, few indicator species, Iris pseudacorus present. Alder dominates canopy. Low moss cover. Tufa restricted to 1 sq m at river bank.	724024	718460
N50	General	Tufa spring at this location on moderate slope and seepage extends to south-east towards river. Species poor, with willow and occasional Alder in canopy (6m high). Diffuse tufa deposition on bare soil, moderate moss cover, with Eupatorium cannabinum, while Equisetum telmateia absent, Mentha aquatica frequent.	724046	718486
N51	General	Tufa spring, with continuous consolidated tufa from river edge extending 4m to north (total spring extent ca 2*4m).	724092	718449
N52	Management	Improved pasture	724130	718431
N53	Management	End of survey. No indication of wetland downstream of here. Gorse on slopes.	724145	718404
N54	Habitat	Mown lawn part of private residence with wood bridge over river	724414	718212
N55	Habitat	No tufa in this section, dry woodland.	723262	718539

APPENDIX 5C

NBDC Species Records

NBDC Records of Protected and Invasive Species from within a 2km Radius of the Application Site

Species name	Date of last record	Designation
Common Frog (*Rana temporaria*)	15/05/2020	Annex V; Wildlife Acts
Arctic Tern (*Sterna paradisaea*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Barn Owl (*Tyto alba*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Barn Swallow (*Hirundo rustica*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Bar-tailed Godwit (*Limosa lapponica*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Black Guillemot (*Cepphus grylle*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Black-headed Gull (*Larus ridibundus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Black-legged Kittiwake (*Rissa tridactyla*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Black-tailed Godwit (*Limosa limosa*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Black-throated Diver (*Gavia arctica*)	29/02/1984	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Brent Goose (*Branta bernicla*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Coot (*Fulica atra*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Goldeneye (*Bucephala clangula*)	29/02/1984	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Grasshopper Warbler (*Locustella naevia*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Greenshank (*Tringa nebularia*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List

Common Guillemot (*Uria aalge*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Kestrel (*Falco tinnunculus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Kingfisher (*Alcedo atthis*)	15/11/2017	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Common Linnet (*Carduelis cannabina*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Pheasant (*Phasianus colchicus*)	31/12/2011	Wildlife Acts
Common Pochard (*Aythya ferina*)	29/02/1984	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Quail (*Coturnix coturnix*)	31/07/1991	Wildlife Acts; Birds of Conservation Concern - Red List
Common Redshank (*Tringa totanus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Common Redstart (*Phoenicurus phoenicurus*)	31/07/1972	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Sandpiper (*Actitis hypoleucos*)	31/07/1991	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Scoter (*Melanitta nigra*)	29/02/1984	Wildlife Acts; Birds of Conservation Concern - Red List
Common Shelduck (*Tadorna tadorna*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Snipe (*Gallinago gallinago*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Starling (*Sturnus vulgaris*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Swift (*Apus apus*)	04/08/2017	Wildlife Acts; Birds of Conservation Concern - Amber List
Common Tern (*Sterna hirundo*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Common Wood Pigeon (*Columba palumbus*)	31/12/2011	Wildlife Acts
Corn Crake (*Crex crex*)	31/07/1972	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Red List

Dunlin (*Calidris alpina*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Eurasian Curlew (*Numenius arquata*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Eurasian Oystercatcher (*Haematopus ostralegus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Eurasian Teal (*Anas crecca*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Eurasian Tree Sparrow (*Passer montanus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Eurasian Wigeon (*Anas penelope*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Eurasian Woodcock (*Scolopax rusticola*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
European Golden Plover (*Pluvialis apricaria*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Red List
European Nightjar (*Caprimulgus europaeus*)	31/07/1972	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Red List
European Shag (*Phalacrocorax aristotelis*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
European Turtle Dove (*Streptopelia turtur*)	31/07/1972	Wildlife Acts; Birds of Conservation Concern - Amber List
Great Black-backed Gull (*Larus marinus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Great Cormorant (*Phalacrocorax carbo*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Great Crested Grebe (Podiceps *cristatus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Great Northern Diver (*Gavia immer*)	31/12/2011	Wildlife Acts; Annex I Bird Species
Greater Scaup (*Aythya marila*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Grey Partridge (*Perdix perdix*)	31/07/1972	Wildlife Acts; Birds of Conservation Concern - Red List
Grey Plover (*Pluvialis squatarola*)	29/02/1984	Wildlife Acts; Birds of Conservation Concern - Amber List

Greylag Goose (*Anser anser*)	31/12/2011	Invasive Species Regulation S.I. 477 (Ireland); Wildlife Acts; Birds of Conservation Concern - Amber List
Hen Harrier (*Circus cyaneus*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Herring Gull (*Larus argentatus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
House Martin (*Delichon urbicum*)	10/05/2016	Wildlife Acts; Birds of Conservation Concern - Amber List
House Sparrow (*Passer domesticus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Jack Snipe (*Lymnocryptes minimus*)	31/12/2011	Wildlife Acts
Lesser Black-backed Gull (*Larus fuscus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Little Egret (*Egretta garzetta*)	15/11/2017	Wildlife Acts; Annex I Bird Species
Little Grebe (*Tachybaptus ruficollis*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Little Gull (*Larus minutus*)	31/12/2011	Wildlife Acts; Annex I Bird Species
Little Tern (*Sternula albifrons*)	31/07/1972	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Long-tailed Duck (*Clangula hyemalis)*	29/02/1984	Wildlife Acts
Mallard (*Anas platyrhynchos*)	31/12/2011	Wildlife Acts
Manx Shearwater (*Puffinus puffinus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Mediterranean Gull (*Larus melanocephalus*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Merlin (*Falco columbarius*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Mew Gull (*Larus canus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Mute Swan (*Cygnus olor*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List

Northern Gannet (*Morus bassanus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Northern Goshawk (*Accipiter gentilis*)	31/12/1844	Wildlife Acts; Birds of Conservation Concern - Amber List
Northern Lapwing (*Vanellus vanellus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Northern Shoveler (*Anas clypeata*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Northern Wheatear (*Oenanthe oenanthe*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Peregrine Falcon (*Falco peregrinus*)	31/12/2011	Wildlife Acts; Annex I Bird Species
Razorbill (*Alca torda*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Red Grouse (*Lagopus lagopus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Red Knot (*Calidris canutus*)	29/02/1984	Wildlife Acts; Birds of Conservation Concern - Red List
Red-breasted Merganser (*Mergus serrator*)	31/12/2011	Wildlife Acts
Red-throated Diver (*Gavia stellata*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Ringed Plover (*Charadrius hiaticula*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Rock Pigeon (*Columba livia*)	31/12/2011	Wildlife Acts
Roseate Tern (*Sterna dougallii*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Sand Martin (*Riparia riparia*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Short-eared Owl (*Asio flammeus*)	29/02/1984	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Sky Lark (*Alauda arvensis*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Spotted Flycatcher (*Muscicapa striata*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List

Stock Pigeon (*Columba oenas*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Tufted Duck (*Aythya fuligula*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Twite (*Carduelis flavirostris*)	31/07/1991	Wildlife Acts; Birds of Conservation Concern - Red List
Water Rail (*Rallus aquaticus*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Amber List
Whinchat (*Saxicola rubetra*)	31/07/1972	Wildlife Acts; Birds of Conservation Concern - Amber List
Whooper Swan (*Cygnus cygnus*)	31/12/2011	Wildlife Acts; Annex I Bird Species; Birds of Conservation Concern - Amber List
Wood Warbler (*Phylloscopus sibilatrix*)	31/07/1991	Wildlife Acts; Birds of Conservation Concern - Amber List
Yellowhammer (*Emberiza citrinella*)	31/12/2011	Wildlife Acts; Birds of Conservation Concern - Red List
Arthurdendyus triangulatus	01/03/2020	High Impact Invasive Species
Butterfly-bush (*Buddleja davidii*)	28/03/2014	Medium Impact Invasive Species
Cherry Laurel (*Prunus laurocerasus*)	30/05/2007	High Impact Invasive Species
Giant Hogweed (*Heracleum mantegazzianum*)	19/07/2019	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland)
Japanese Knotweed (*Fallopia japonica*)	17/05/2020	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland)
Sycamore (*Acer pseudoplatanus*)	29/09/2019	Medium Impact Invasive Species
Three-cornered Garlic (*Allium triquetrum*)	19/02/2021	Medium Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland)
Traveller's-joy (*Clematis vitalba*)	13/06/2005	Medium Impact Invasive Species
Turkey Oak (*Quercus cerris*)	27/08/2006	Medium Impact Invasive Species
Harlequin Ladybird (*Harmonia axyridis*)	01/11/2019	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland)
Marsh Fritillary (*Euphydryas aurinia*)	31/12/1990	Annex II

Grey Seal (*Halichoerus grypus*)	31/12/1968	Annex II; Annex V; Wildlife Acts
Beck Pocket-moss (*Fissidens rufulus*)	31/12/1975	Flora Protection Order 2015 Schedule B (Mosses)
Glass-wort Feather-moss (*Scleropodium tourettii*)	31/12/1879	Flora Protection Order 2015 Schedule B (Mosses)
Large White-moss (*Leucobryum glaucum*)	31/12/1991	Annex IV
Common Lizard (*Zootoca vivipara*)	07/09/1972	Wildlife Acts
Brown Long-eared Bat (*Plecotus auritus*)	18/05/2009	Annex IV; Wildlife Acts
Brown Rat (*Rattus norvegicus*)	30/04/2015	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland)
Daubenton's Bat (*Myotis daubentonii*)	26/08/2014	Annex IV; Wildlife Acts
Eastern Grey Squirrel (*Sciurus carolinensis*)	28/07/2017	High Impact Invasive Species; Invasive Species EU Regulation No. 1143/2014; Invasive Species Regulation S.I. 477 (Ireland)
Eurasian Badger (*Meles meles*)	03/02/2017	Wildlife Acts
Eurasian Pygmy Shrew (*Sorex minutus*)	21/12/1968	Wildlife Acts
Eurasian Red Squirrel (*Sciurus vulgaris*)	08/10/2016	Wildlife Acts
European Otter (*Lutra lutra*)	15/05/2012	Annex II; Annex IV; Wildlife Acts
European Rabbit (*Oryctolagus cuniculus*)	16/09/2018	Medium Impact Invasive Species
Fallow Deer (*Dama dama*)	30/05/2018	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland); Wildlife Acts
Feral Goat (*Capra hircus*)	21/12/1968	Medium Impact Invasive Species
House Mouse (*Mus musculus*)	31/12/1969	High Impact Invasive Species
Lesser Noctule (*Nyctalus leisleri*)	27/08/2009	Annex IV; Wildlife Acts
Natterer's Bat (*Myotis nattereri*)	18/05/2009	Annex IV; Wildlife Acts

Pine Marten (*Martes martes*)	23/07/2015	Annex V; Wildlife Acts
Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	18/05/2009	Annex IV; Wildlife Acts
Red Deer (*Cervus elaphus*)	31/12/2008	Wildlife Acts
Sika Deer (*Cervus nippon*)	06/04/2011	High Impact Invasive Species; Invasive Species Regulation S.I. 477 (Ireland); Wildlife Acts
Soprano Pipistrelle (*Pipistrellus pygmaeus*)	16/07/2010	Annex IV; Wildlife Acts
West European Hedgehog (*Erinaceus europaeus*)	17/11/2020	Wildlife Acts
Whiskered Bat (*Myotis mystacinus*)	18/05/2009	Annex IV; Wildlife Acts

APPENDIX 6A

Criteria For Rating The Magnitude And Significance Of Impacts At EIA Stage National Roads Authority (NRA, TII, 2009)

Table 1 Criteria for Rating Site Attributes – Estimation of Importance of Soil and Geology Attributes (NRA)

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

Table 2 Criteria for Rating Site Attributes – Estimation of Importance of Hydrogeological Attributes (NRA)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Inner source protection area for regionally important water source.
High	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.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Table 3 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Soil/ Geology Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of entirety of geological heritage feature. Requirement to excavate/remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature. Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate/remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate/remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeological Attribute (NRA)

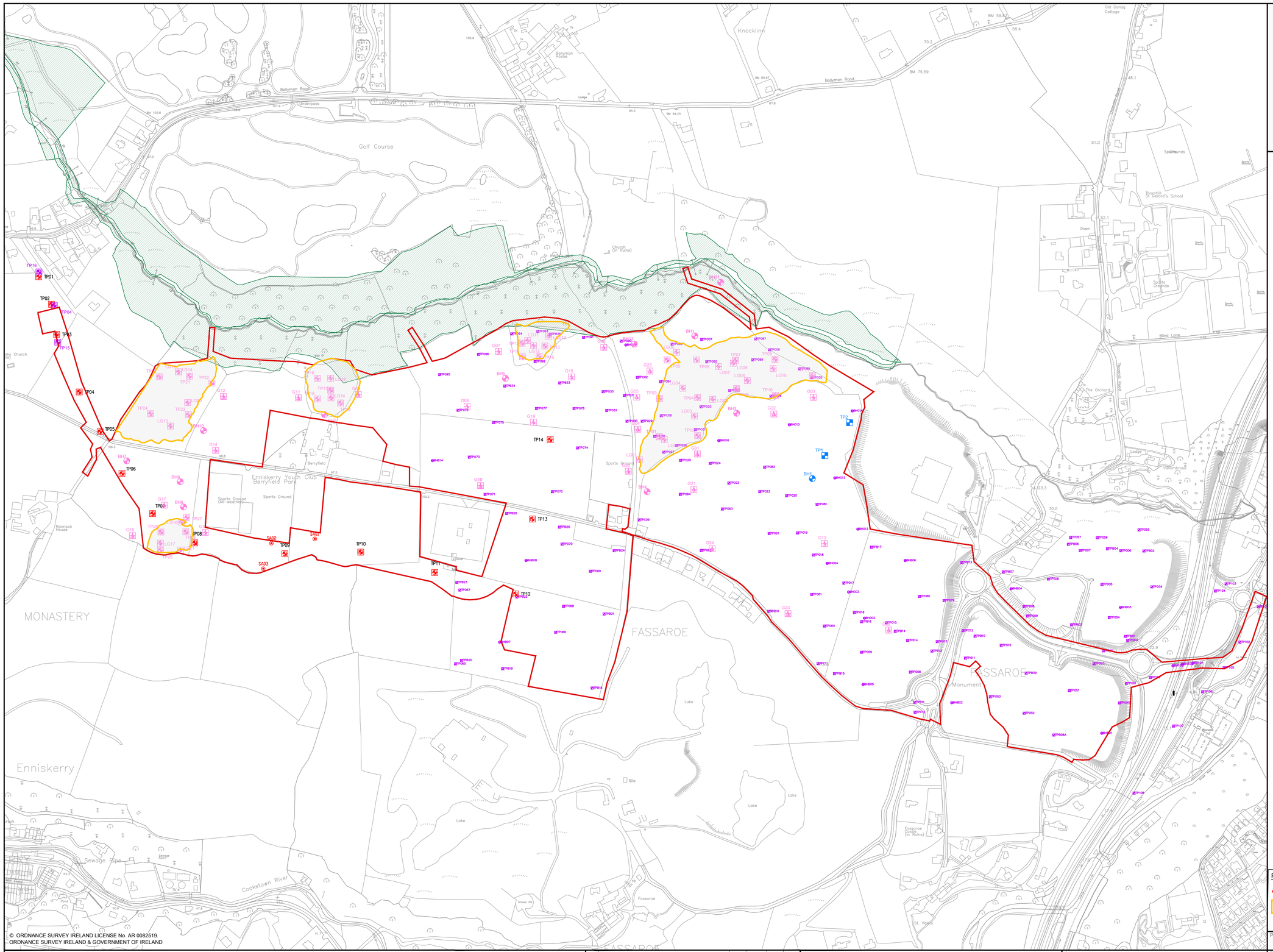
Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 5 Rating of Significant Environmental Impacts at EIS Stage (NRA)

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

APPENDIX 6B

Consolidated GI Locations


Golf Course
Ballyman Road
Knocklinn
Ballyman House
Old Conag Cottage
Thomas St Gerard's School
Sports Grounds
Blind Lane
Church (in Ruins)
Enniskerry Youth Club
Berryfield Park
Sports Ground
Sports Ground (All-weather)
Berryfield
Ronnock House
MONASTERY
FASSAROE
Fassaroe Castle (in Ruins)
Monument
Enniskerry
Sewage Pipe
Cookstown River
Lake
Silo
Gravel Pit
Fassaroe
St. Valery
The Orchard
Lodge
Valombrosa
Chapel
TP01
TP02
TP03
TP04
TP05
TP06
TP07
TP08
TP09
TP10
TP11
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TP16
SA01
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BH38
BH39
BH40

APPENDIX 6C

Bray Western Environs 5138958 TP Logs 2015

	Trial hole 03	Bray Western Environs
Date:		**Location:**
24/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.45	Topsoil	
0.40-1.10	Soft to firm brown slightly gravelly CLAY. Gravel is fine to medium, subrounded.	
1.10-2.00	Soft gravelly CLAY. Gravel is Gravel is fine to medium, subrounded.	Side wall collapse below 1.30m
2.00-2.60	Slightly clayey, sandy GRAVEL. Gravel is fine to medium, some coarse, subangular - subrounded. Occasional cobbles.	
Notes: No water		**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.		**Log By:** CR

	Trial hole 04	Bray Western Environs
Date:		**Location:**
24/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.40-1.20	Soft sandy CLAY.	Side wall collapse below 0.80m
1.20-2.90	Slightly clayey, sandy GRAVEL. Gravel is fine to medium, some coarse, subangular - subrounded. Occasional cobbles.	
Notes: No water		**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.		**Log By:** CR

	Trial hole 05	Bray Western Environs
Date:		**Location:**
24/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.40	Topsoil	
0.40-1.10	Soft to firm brown slightly gravelly CLAY. Gravel is fine to medium, subrounded.	Side wall collapse below 0.40m
1.10-2.60	Slightly clayey, sandy GRAVEL. Gravel is fine to medium, some coarse, subangular - subrounded. Occasional cobbles.	
Notes: No water		**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.		**Log By:** CR

	Trial hole 06	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.30-3.40	Clayey, sandy GRAVEL, gravel fine to coarse, subrounded with occasional subangular. Gravelly clay layers at depth (3.00 – 3.40m)	
Notes: No water		**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.		**Log By:** CR

	Trial hole 07	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.30-2.00	Soft brown slightly gravelly CLAY. Gravel is fine to medium, subrounded.	
2.00-3.10	Un-compact coarse SILT, becoming compact with depth (below 2.80m).	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 08	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.60	Topsoil	
0.60-3.00	Slightly clayey, sandy GRAVEL, gravel is fine to medium, subrounded to rounded with occasional cobbles.	
3.00-3.30	Slightly gravelly SAND. Sand is fine to medium. Gravel is fine to medium.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 09	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.4	Topsoil	
0.4-0.8	Soft brown slightly gravelly clay. Gravel is fine to medium.	
0.8-2.70	Firm to stiff brown gravelly CLAY. Gravel is medium to coarse, subrounded to rounded with occasional cobbles.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 10	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.30-1.30	Soft to firm slightly gravelly CLAY. Gravel is fine to medium, subrounded. Rare cobble.	
1.30-3.00	Slightly clayey, sandy GRAVEL. Gravel is fine to coarse, subrounded.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 11	Bray Western Environs
Date:		**Location:**
23/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.30-1.20	Soft to firm slightly gravelly CLAY. Gravel is fine to medium, subrounded. Rare cobble.	
1.20-2.30	Slightly clayey, sandy GRAVEL. Gravel is fine to coarse, subrounded.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 12	Bray Western Environs
Date:		**Location:**
24/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.40	Topsoil	
0.40-1.20	Soft brown slightly gravelly CLAY. Gravel is fine to medium, subrounded.	Side wall collapse below 0.50m
1.20-1.50	Firm to stiff gravelly CLAY. Gravel is fine to medium, subrounded.	
1.50-2.80	Slightly clayey, sandy GRAVEL. Gravel is fine to medium, some coarse, subrounded. Occasional cobbles.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

	Trial hole 13	Bray Western Environs
Date:		**Location:**
24/03/2015		As shown on Drawing 5138958/SK/001

Depth (m)	Description	Comments
0-0.30	Topsoil	
0.30-1.50	Soft brown slightly gravelly CLAY. Gravel is fine to medium, subrounded.	
1.50-2.10	Firm to stiff slightly gravelly CLAY. Gravel is fine to medium, subrounded.	
2.10-2.50	Slightly sandy, clayey GRAVEL. Gravel is fine to medium, some coarse, subrounded.	

Notes: No water	**Excavator:** JCB3CX
Weather: Sunny with some cloud. Cool breeze.	**Log By:** CR

APPENDIX 6D

Geotechnical Interpretative Report-Warehouse and Ancillary Offices SI 2001

Fassaroe Business Park

Warehouses & Ancillary Offices

Geotechnical Interpretative Report

October 2002

Atkins
Balgriffin House
Balgriffin
Dublin 17

Fassaroe Business Park

Warehouses & Ancillary Offices

Geotechnical Interpretative Report

JOB NUMBER: 1739			DOCUMENT REF: 1739DG037			
1	DRAFT	JM/ND	ND/JB	JB	EG	Oct 2002
		Originated	Checked	Reviewed	Authorised	Date
Revision	Purpose Description					

Atkins
Balgriffin House
Balgriffin
Dublin 17

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Appendix B – Structure Foundation Summary (Preliminary) Sheets (Blocks 1 to 5)

EXECUTIVE SUMMARY

Cosgrave Property Group proposes to create a business park on a site at Fassaroe and has commissioned WS Atkins to undertake a detailed assessment of the ground conditions and the preparation a Geotechnical Interpretative Report.

Prior to this investigation, a total of three ground investigations had already been carried out on this land as well as an additional one at the location of the motorway junction. It is now proposed, as the first stage, to concentrate the development activities to the western part of the site, close to the M11. This will entail the construction of warehouses with offices and associated infrastructure directly linked to the motorway junction. A supplementary ground investigation, specifically targeted to the need of this new project was organised to complement the information available from the previous investigations.

In light of the findings of this investigation together with the relevant data available from the previous investigations, the initial development proposals were modified during the planning application submission process to achieve a balance of excavated and fill material and to enhance ancillary works details. As a result, the final proposed ground levels were adopted.

The present geotechnical interpretative report gives an assessment of the ground and groundwater conditions that will be encountered on site during construction. All the geotechnical information available for the warehouses and ancillary offices development site has been compiled and reviewed. This report therefore updates and supersedes the Sections of the previous reports relevant to this part of the Fassaroe site.

The ground conditions are highly variable throughout the proposed warehouses development site, comprising interbedded layers of clays, silts, sands and gravels. They consist of sequences of normally consolidated deposits, principally loose to medium dense granular material grading from silt to gravel, to heavily overconsolidated Lodgement till (Boulder Clay) which is weathered toward the surface and fresh at depths. The bedrock underlies the superficial deposits at 20m to 40m below ground level.

This report gives an assessment of the bearing capacity at each of the proposed structures locations together with estimation of the settlement and differential settlement beneath the foundations. Generally pad foundations will be adequate for the proposed structures, namely the columns and back walls of the warehouses and the crib wall along the southern boundary.

The required free and fixed lengths of ground anchors are given for hypothetical axial loads and using the proprietary system of a specialist contractor. Length adjustments by the specialist contractor will

be required once the geometry of the installation has been finalised to ensure a safe and cost effective design.

This report reiterates the interpretation of the available data already given for the planning application submission with regards to the acceptability of excavated material and the earthwork balance. It also gives additional recommendations to optimise the efficiency of the earthworks operations with respect to the reuse of the site won materials as engineering or as landscape fill to only leave marginal quantities of soil to be taken off site.

A CBR assessment has been undertaken for the various strata that will form subgrade of the road in cuttings. This report presents pavement thickness requirements using a sub-base over capping and/or without capping design, chainage by chainage along the main and internal access roads in cuts. The pavement design for the road and car parks on embankment will depend on the fill material that will be placed at formation level. The CBR value of each material that will be excavated is given for when it is reused as a subgrade.

The stability of the proposed earthworks have also been analysed. The factor of safety against short term and long term failure were found to be adequate subject to usual good practice measures such as drainage, benching into existing slopes, choice of material and compaction. The stability of the temporary excavation slopes has also been analysed to allow the batter to be formed at a gradient as steep as possible.

Generally, the ground conditions are suitable for the proposed development subject to good working practice and thorough site inspection and supervision during construction. The report highlights where inspections and routine in-situ testing will be required to confirm the adequacy of the design.

Further analyses will be required for the detailed design and this reports highlights areas where particular attention will be required and/or where a scope for cost saving exists.

1. INTRODUCTION

1.1 It is proposed to develop an area of land on the hillside bordering the southern end of the M11 at Fassaroe, Co. Wicklow to create a business park. The site under investigation in this report is the western part of the Fassaroe site where it is proposed to construct warehouses and ancillary offices (See Figure 2.1).

1.2 WS Atkins (WSA) were commissioned by the Cosgrave Property Group (CPG) in October 2001 to procure and supervise a supplementary ground investigation for this site, specifically targeted to the area where the construction of warehouses and ancillary offices is proposed. In addition to the field and laboratory work, an interpretation of the findings was required together with geotechnical design for the proposed development.

1.3 The supplementary ground investigation was undertaken in November and December 2001 by Irish Geotechnical Services Limited (IGSL). It comprised the sinking of boreholes and the excavation of trial pits together with in situ and laboratory testing.

1.4 This report presents an interpretation of the geotechnical data available for this part of the site including the most recent ground investigation. It also updates the interpretations and recommendations made in WSA's Geotechnical Interpretative Report, July 2001 (Ref. 1739DG023) with regards to the development of this area.

1.5 Three ground investigations have been carried out within the Fassaroe site prior to this supplementary site investigation. These investigations have covered the whole of the Fassaroe site including the site currently under study as well as lands located to the west. The findings of these investigations have also been considered in this report.

1.6 The ground profile over the site consists of a sequence of both normally consolidated and overconsolidated glacial outwash deposits comprising clays, silts, sands and gravels, overlying heavily consolidated cohesive glacial till (boulder clay). The Glacial Till lies directly on bedrock of Cambrian/Ordovician slates, phylites and schists. The thickness of the glacial outwash deposits varies greatly over the site, as does their composition.

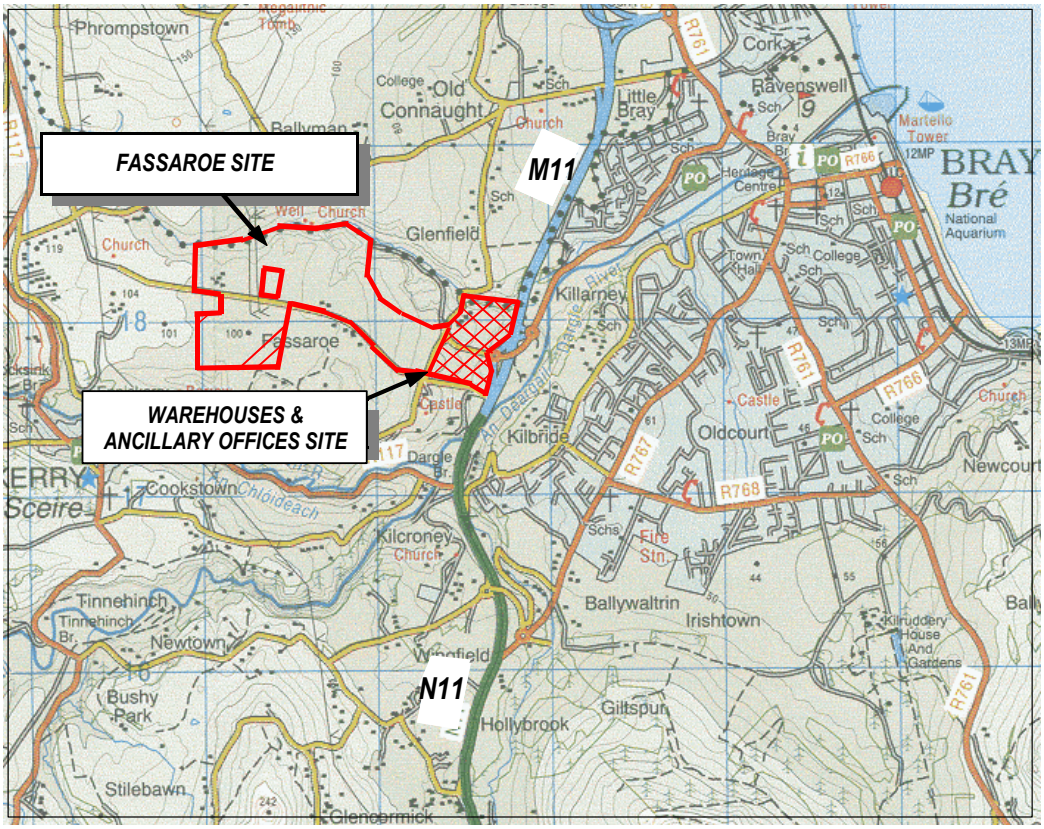
2. SITE DESCRIPTION

Location

2.1 The proposed warehouses and ancillary offices development is located at Fassaroe, west of the town of Bray in County Wicklow. It consists of the eastern part of Fassaroe site which borders the M11. Berryfield Lane follows the southern boundary with Fassaroe Lane running from a junction with the M11 through the middle of the proposed development, and then swinging south along the western boundary.

2.2 The site is situated at National Grid Reference O217 324 (Ordnance Survey of Ireland, Sheets 3-16 and 7-4, 1:10,560 Wicklow). The location of the proposed development along with that of Fassaroe site is shown on Figure 2.1.

Figure 2.1 – Site Location Plan



Topography

2.3 The topography of the site consists of a hillside descending in an easterly direction towards the southern end of the M11, which follows the River Dargle Valley. To the north, the site descends steeply to the Glenmunder River Valley, a tributary of the River Dargle. It lies approximately between 17m and 57m AOD.

Proposed Development

2.4 The proposed development will consist of a business park on the eastern facing hillside bordering the M11. This development will entail the construction of five warehouses/business units on building platforms benched into the existing hill slope together with associated access roads and car parks.

2.5 Three platforms will be constructed to the south of Fassaroe Lane for Blocks 1, 2 and 3 with design floor levels at approximately 34mAOD, 39mAOD and 45mAOD respectively. Blocks 4 and 5 will be built on the north side of this lane and will have floor levels of 33mAOD and 38mAOD approximately.

2.6 Fassaroe Lane and the access road to the Celtic Waste recycling facility will also be realigned and upgraded as part of the scheme. The area of the development is approximately 19 Ha.

3. EXISTING INFORMATION

3.1 Prior to this supplementary investigation, three ground investigations were carried out between 1997 and 2001 within the Fassaroe site and a further investigation at the M11 Junction in 2000. Previous investigations to date at Fassaroe site have consisted of two preliminary ground investigations in 1997 and 1998 (prior to WSA's involvement) and a main ground investigation in 2001.

3.2 The first preliminary ground investigation was carried out in November 1997 as a joint effort by Muir Associates Ltd (MAL) and Irish Geotechnical Services Ltd (IGSL). The second investigation was undertaken by IGSL on behalf of MAL in November 1998.

3.3 The first investigation consisted of the excavation of 12 Trial Pits while the second investigation incorporated 12 Cable Percussive Boreholes and 32 Trial Pits. A total of 4 boreholes and 10 trial pits were located within the current area of investigation. The approximate locations of these exploratory holes are shown on drawing number 1739GE001 issued with WSA's Geotechnical Interpretative Report, Fassaroe Business Park, 2001.

3.4 As part of the MAL investigation, methane gas monitoring in trial pits and contamination testing (ICRCL suites of contaminants) of soil samples from trial pits was undertaken, as well as geotechnical testing. This testing was only carried out on soil samples from within an area of capped landfill located to the northwest of the warehouses development site. Samples taken during IGSL site investigation were tested for geotechnical parameters only.

3.5 The third ground investigation was undertaken by Glover Site Investigations Limited on behalf of Atkins McCarthy and was completed in January 2001. It comprised 25 cable percussive boreholes and 80 trial pits as well as an extensive laboratory testing programme to ascertain the geotechnical characteristics of soils encountered over Fassaroe site. These exploratory hole locations are also shown on drawing number 1739GE001.

3.6 The ground investigation for the M11 interchange comprised 3 boreholes and 11 trial pits. Only one trial pit was located within the proposed development.

3.7 All the ground investigations have been followed by factual and interpretative reports. These reports have been reviewed and, where relevant, their findings and recommendations have been incorporated into this report.

4. GEOLOGY AND HYDROGEOLOGY

Geology

4.1 The geology of the area surrounding the site comprises variable thicknesses of alluvium overlying fluvio-glacial and glacial deposits which in turn overlie the bedrock. The bedrock geology consists of a series of Cambrian/Ordovian low-grade metamorphic and sedimentary formations.

4.2 The superficial geology of this area is dominated by overconsolidated Quaternary glacial and fluvio-glacial sediments overlain by more localised, normally consolidated alluvial deposits associated with the rivers traversing the area. During the Quaternary Period the Wicklow Mountains formed a regional ice centre, giving rise to large thickness of glacial deposits in this area. These deposits consist of very stiff boulder clays, which are generally overlain by the glacial outwash deposits, (fluvio-glacial deposits) comprising interbedded sands, gravels, silts and clays. Both glacial and fluvio-glacial deposits are laterally and vertically variable over the area. The distribution of individual lithologies is also extremely variable, especially within the fluvio-glacial and alluvial deposits.

4.3 The bedrock geology consists dark blue-grey slate, phylites and schist of the Maulin Formation to the north with greywackes and quartzites of the Bray Head Formation occurring to the south. These units are predominantly striking NE-SW with minor deviations in strike due to several folding episodes.

4.4 The predominant structures in the region are primarily northeast-southwest trending normal faults with minor thrust faults and associated folding. These structures influence the overall hydrology and topography of the region area with river valleys following these structural features.

Hydrogeology

4.5 The groundwater regime over the area is dominated by the River Dargle that flows east of the proposed development and its tributary, the County Brook which runs north of the site.

4.6 The local hydrogeology is also likely to have been affected by the formation of a cutting for the construction of the M11 and its associated drainage.

4.7 Within this area, the glacial sand and gravel is recorded as a locally important aquifer. It is likely, but not confirmed, that the sand and gravel aquifer discharges directly into the County

Brook. It is expected that the water table within the granular deposits will descend into the river valleys.

4.8 The proximity of the aquifer to ground level suggests that it is at high risk of contamination.

4.9 The bedrock in the area is not recorded as an aquifer and is thought to be largely impermeable, although a certain amount of fracture permeability may be expected due to the proximity of fault zones.

4.10 In addition to the main perched water table, small isolated perched tables are likely to be encountered in granular horizons contained within cohesive soils or at the top of boulder clay layers.

5. GROUND INVESTIGATION

5.1 The most recent ground investigation was carried out in November and December 2001 by Irish Geotechnical Services Limited (IGSL) and was supervised by WSA. It comprised 15 boreholes and 41 trial pits.

5.2 Light cable percussive techniques were used to advance the boreholes to depths ranging from 4.1m (BH403) to 19.4m (BH415) below ground level (bgl). At two locations, the boreholes were re-drilled using rotary open hole techniques through the superficial deposits followed by rotary coring to maximum depths of 17.0m and 30.1m bgl respectively.

5.3 The trial pits were mechanically excavated with a 20 tonne tracked excavator to depths ranging from 0.35m bgl in TP422 to 5.6m bgl and TP423 and 427. The purpose of these pits was to examine the macro-fabric and local variations of the near surface materials as well as to obtain large bulk samples for earthworks acceptability testing.

5.4 In situ testing consisted of Standard Penetration Tests within the boreholes.

5.5 On completion, a total of 5 groundwater monitoring standpipes were installed in boreholes BH402, 408, 410, 414 and 415. The remaining boreholes were backfilled with arisings or grout while the trial pits were backfilled with compacted arisings.

5.6 Routine classification tests together with consolidation and strength tests were undertaken on selected samples recovered from exploratory holes. In areas of proposed cut, tests to assess the acceptability of excavated material for re-use as fill and its workability were also undertaken. Chemical testing was carried out on soil and groundwater samples to assess the aggressiveness of the ground toward buried concrete. The testing programme consisted of the following:

- Moisture Content
- Moisture Condition Value (MCV) at field Moisture Content
- MCV/Moisture Content relationship (MCV Calibration)
- Atterberg Limits
- Particle Size Distribution
- Total Sulphate Content of Soil
- pH Value of soil

- Organic Matter Content
- Dry Density/Moisture Content Relationship
- California Bearing Ratio
- Unconsolidated Undrained Triaxial Compression Test without Measurement of Pore Water Pressure

5.7 The findings of previous ground investigations and associated laboratory testing results were also taken into account in this report.

6. GROUND AND GROUNDWATER CONDITIONS

6.1 This ground investigation generally confirmed the expected ground and groundwater conditions based on the available information.

Ground Conditions

6.2 A layer of topsoil, typically 0.3m thick, covers the whole site with the exception of existing roads locations.

6.3 Made Ground was encountered in four exploratory holes during this investigation. It varies from granular to cohesive material and is generally associated with previous construction work and the existing roads.

6.4 The natural ground conditions within the development area comprises a complex sequence of normally consolidated fluvial and estuarine soils overlying heavily overconsolidated glacial soils which are in turn underlain by the bedrock at depth.

6.5 The normally consolidated soils are largely associated with the River Dargle and consist of loose to medium dense sands, silts and gravels. These soils tend to be concentrated at the lower levels of the site.

6.6 Varying thicknesses of heavily overconsolidated glacial lodgement till (grey boulder clay) underlies the entire site. This stratum has been eroded to varying degrees by post-glacial rivers, which have deposited associated outwash sediments (gravels, silts sands and clays). Laminated clays are also found on the site which are associated with glacial lake deposition. The majority of these soils have been overconsolidated to varying degrees by various glacial events during the Quaternary. The soil profile is therefore a highly complex and variable, both laterally and vertically, sequence of clays, silts sands and gravels.

6.7 The lodgement till is encountered at ground level generally in the area of the proposed roundabout with a 2m deep weathering profile. The elevation of this stratum then decreases rapidly towards the River Dargle. The lodgement till is also recorded near ground level at lower levels in the eastern area of the site.

6.8 The glacial outwash deposits have been eroded by the River Dargle with the maximum thickness being encountered in the middle of the site.

6.9 Rockhead occurs at depths varying between 20m and 40m below ground level. Shale bedrock was only tentatively proven in one borehole on the site.

Groundwater Conditions

6.10 Groundwater encountered on the site mainly consists of perched water on the lodgement till with the elevation of the water table decreasing towards the River Dargle to the west, and the County Brook to the north.

6.11 The groundwater is generally unconfined although in certain areas it is confined by overlying cohesive strata.

6.12 The permeability of the granular soils is extremely variable. These soils however tend to be well graded with a relatively high proportion of fines that reduces the permeability of this material when compared to uniform gravels.

6.13 Generally, the groundwater levels are below the proposed assumed foundation levels. However, in the southern part of the proposed development, the groundwater level is only 0.5m below the proposed floor level of Block 2 (middle platform) and is therefore expected to be above the level of any shallow foundations for this building.

6.14 A seepage line is evident at the bottom of the southern site where the groundwater table intersects ground level within the cutting slope of the M11.

7. EARTHWORKS DESIGN CRITERIA

SLOPE STABILITY

7.1 Slope stability analyses were carried out using Geosolve's 'Slope', version 9R, based on Bishop's Simplified Method.

7.2 At this stage, a conservative approach has been adopted for the slope stability analysis. Initially, hypothetical cases of worse geometry combined with pessimistic ground and groundwater conditions were analysed. If the analysis revealed an adequate factor of safety against failure for such conditions, the other slopes were deemed stable.

7.3 The choice of factor of safety depends on the level of information on the ground and groundwater conditions, the type of material encountered, the choice of geotechnical parameters, the purpose of the construction, the risk associated with a failure, etc. It is recommended in the BS6031: 1981, Code of Practice for Earthworks that slopes are designed for a factor of safety of 1.3 to 1.4.

7.4 An overall minimum factor of safety between 1.3 and 1.4 is normally required for road earthworks and 1.3 is commonly adopted. Due to the conservative approach adopted throughout the analysis to select and model the cross-sections, it was judged that a factor of safety of 1.3 would be adequate.

Fill

7.5 For the slopes constructed with new fill (building platform embankments), the cross-sections to be analysed were selected based on the principles previously mentioned and on the following criteria:

- Height of proposed slope
- Height of platform above existing ground level
- Gradient of existing slope
- Location of the proposed earthworks in relation to the existing slope
- Nature and strength of the underlying strata
- Depth of groundwater tables

7.6 It has been assumed that site won material would be used to construct the proposed platforms. At this stage of the design, the following parameters were assigned to this material for the analysis:

- c'=0kPa
- φ'=30^{o}

7.7 The above values are considered lower bound values as better quality material will be available on site and should be placed within the structural embankments.

Cutting

7.8 A similar approach has been undertaken for the analysis of the cut slopes. In cutting, the long term stability is usually found to be more critical than the short term and has therefore been analysed by effective stress methods. Piezometric pressures have been modelled based on observed ground water levels and expected long-term water levels within the slopes.

7.9 The slopes of the temporary excavations for the construction of the warehouses have only been analysed for the short term stability. The purpose of this exercise was to assess the stability of the steepest possible gradient that could be achieved in order to minimise the amount of excavation required for the construction.

7.10 In both cases the highest slope combined with the worse case ground and groundwater conditions encountered within the area of the platform or road as appropriate were analysed.

ACCEPTABILITY

7.11 The National Road Authority's Specification for Highway Works, March 1998, has been adopted to classify the excavated material. Volume 1 of this Specification gives the criteria of material classification as acceptable or unacceptable for use as fill material. The majority of materials to be excavated from the platforms or roads cuttings will be acceptable for re-use.

7.12 The criteria which excavated material must comply with in order to be re-used as embankment fill are:

- The ability to be excavated, transported, placed and compacted with normal plant operation;
- The ability to form embankments with stable side slopes;
- Consolidation characteristics, such that internal self settlement will not adversely affect the finished platform profile.

7.13 As detailed in earlier sections of this report the nature of the superficial deposits (including both Made Ground and the Glacial deposits), is extremely variable. This has made the determination of acceptability criteria particularly difficult and consequently a very wide range

of tests have been considered. The tests results that have been used to assess the material acceptability are as follows:

- MCV at field moisture content and calibration
- Compaction
- Undrained shear strength
- Atterberg limits
- Particle size analyses

SUBGRADE

7.14 Within cuttings required to form the Main Access Roads A and B and the Internal Access Roads A, B and C, the subgrade will vary across the site and will comprise Glacial / Fluvio-Glacial Deposits, Glacial Clays, Weathered Lodgement Till and Fresh Lodgement Till. For the design of pavements, laboratory CBR and combined compaction/CBR tests have been carried out. For pavement design on fill (internal access roads and car parks on each building platform) tests were carried out on re-compacted samples taken from proposed areas of excavation. The results of these tests were supplemented with Plasticity Index data to enable a more accurate equilibrium subgrade CBR to be established for each type of material. HD25/94 in Volume 7 of the Design Manual for Roads and Bridges gives details of this relationship.

7.15 Based on the above, the CBR values of the different type of material have been assessed. Typical lower bound CBR values of the soil types expected to be encountered are tabulated below:

Table 7.1 - CBR Values

Soil Type	CBR in cut	CBR on fill
Granular Deposits	5%	>5%
Glacial Clay	4%	3%
Weathered Lodgement Till (silt/silty clay)	3%	2%
Fresh Lodgement Till	>15%	>15%

7.16 Normally, the material underlying the designed final road surface to a depth of 350mm should not be frost susceptible, whether it is pavement, sub-base, capping, fill material in embankments or in situ materials in cuttings. In areas where the Mean Annual Frost Index (MAFI) exceeds 50, the required thickness of non-frost susceptible material is greater. The site is located in coastal area and is eastern facing. The MAFI is therefore not expected to exceed 50 and accordingly, non frost susceptible material is only required within 350mm of the finished road level.

8. EARTHWORKS - ENGINEERING DISCUSSION AND RECOMMENDATIONS

SLOPE STABILITY (FILL)

Choice Of Cross-Section:

8.1 The worse combinations of slope geometry and ground conditions were found to occur along the eastern boundary of the site. Accordingly, cross-sections for analysis were chosen across the eastern slopes adjacent to the boundary (above the M11/N11). The worse case cross-sections occur at chainage CH 340m of Internal Access Road A (north of the Main Access Road Section A) and CH 100m of Internal Access Road B (south of the Main Access Road Section A).

Geotechnical Parameters:

8.2 The geotechnical parameters for the fill and founding materials have been selected in accordance with Section 7 of this report and are detailed below.

Fill Material:

$c'=0kPa$

$\varphi'=30^o$

Founding Stratum:

8.3 The records of exploratory holes located in the vicinity of these proposed slopes were reviewed and the ground conditions were seen to typically consist of Topsoil overlying Glacial Deposits. These deposits are highly variable in nature, grading from clay to gravel with variable amount of secondary constituents, and strength.

8.4 For the purpose of analysis the worse ground conditions encountered in each area, typically firm clay, were modelled into the relevant sections. For simplicity and to maintain a conservative approach, the strata of stiffer cohesive material and/or granular layers were not taken into account.

8.5 The following conservative parameters were initially adopted to start the analyses and were modified as the understanding of the failure mechanism progressed.

$\gamma_B=20kN/m^3$

C_u=60kPa

c'=0kPa

φ'=28º

Groundwater:

8.6 During the ground investigations, groundwater was encountered within the Glacial Deposits in the form of strikes and seepages with variable inflow intensity. The subsequent groundwater levels recorded in the exploratory holes were also variable. These are believed to generally represent perched water tables.

8.7 The groundwater was however modelled as the main water table at shallow depth to represent the highest seepages observed in the exploratory holes or during walkover surveys.

Slope Stability Analyses:

8.8 Several analyses were performed for each cross-section to assess the stability of the slopes under drained and undrained conditions and for different modes of failure.

8.9 The results of each analysis were reviewed and, if the slip circles were judged unrealistic (i.e. too deep or too shallow) the analysis input was modified and/or a sensitivity analysis was carried out on the geotechnical parameters to obtain a factor of safety for a probable failure. Similarly the groundwater level was lowered to be more representative of the actual post construction conditions as drainage will be installed.

8.10 These analyses have revealed factors of safety against short-term or long-term failure of not less than 1.3. This is however subject to the following recommendations:

- Careful selection of the site won material at the time of excavation will enable use of the fill material with better properties into the slopes and 'structural' part of the embankment thus increasing the stability of the earthworks.
- Benching of the new fill into the existing slope and excavation.
- Thorough inspection of the ground/benches at founding level prior to placement of the new fill to identify any soft spots for removal and replacement. Particular attention should also be given to any observed seepages to confirm the adequacy of the proposed drainage or to make further drainage/excavation recommendations.
- Installation of adequate drainage, such as:
  - Counterfort drains into the existing slope and sub-horizontal filter drains on at the rear of the benches. It is anticipated that 2m deep counterfort drains at 15 to 20m spacing should be adequate but the depth and spacing would be subject to modification during site inspections.
  - The provision of a drainage blanket as a possible alternative or in addition to the above measures (also subject to site inspection).
  - Installation of slope and toe drainage, such as herringbone and filter drains.

- Vegetation growing on the slope would enhance the stability further due to the action of the roots and would also limit the action of erosion.
- Excavation of all soft spots and replacement with acceptable material

8.11 The above points should be taken into account and/or specified at the time of the detailed design.

8.12 It is proposed to construct water retention ponds on both lower (eastern) platforms. The ponds will be located adjacent to landscape mounds that will be constructed immediately above the slopes. It is imperative that water never be allowed to percolate through the fill material, as it would otherwise jeopardise the stability of the slopes. Accordingly, these ponds should be lined with an HDPE geo-membrane to a minimum level of 300mm above the expected maximum water level. The membrane should be placed on suitable material and overflow outfalls leading to the drainage system should be provided.

SLOPE STABILITY (CUTTINGS)

8.13 As part of this development, permanent cuttings will be excavated for the realignment of Main Access Roads A and B and for the construction of the new roundabout to the west of the site. The maximum depth of the cuttings is up to approximately 10m.

8.14 An hypothetical 10m slope at a proposed gradient of 1(V):2(H) has therefore been analysed with the worse ground conditions encountered in the area. The following parameters have been attributed to the various strata expected to be exposed in the slope:

Table 8.1 – Geotechnical Parameters for Slope Stability in Cuttings

Strata Description	Depth (m bgl)	Thickness (m)	c' (kPa)	φ' (degrees)
Firm Clay	0.0 - 2.0	2.0	1	28
Stiff Clay	2.0 - 7.5	5.5	2	30
Very stiff Clay	7.5 - >10.0	>2.5	2	32

8.15 The slope stability analyses have shown adequate factors of safety against failure provided that adequate drainage is installed and that vegetation is planted on the slopes following construction.

8.16 The observation and assessment of cutting slopes at the nearby Celtic Waste site have indicated that 1(V):1.5(H) slopes are only marginally unstable because of the lack of drainage and vegetation. This assessment therefore confirms the numerical analyses and slopes constructed at a 1(V):2(H) gradient with adequate drainage and erosion control measures will be stable. Details of the observation and assessment of the above slope together with remedial measure recommendations are given in Atkins report No 1739DG036 entitled Celtic Waste – Slope inspection at Fassaroe.

8.17 Drainage measures should consist of counterfort and/or herringbones drains on the slope as well as french drains at the toe of the slope. Drainage should also be provided at the top of any cutting to prevent surface run off water from the land above discharging onto the slopes and to avoid any ponding water percolating through the slope material.

8.18 During and at completion of the excavation, the slopes should be inspected by a geotechnical engineer to identify local zones of potential instability. Particular attention should be given to any observed seepages to confirm the adequacy of the proposed drainage or to make further recommendations that may appear necessary (e.g. capture and diversion of seepages, depth and/or spacing of drainage, etc).

8.19 Local zones of potential instability may be identified or shallow instability problems may occur during or on completion of the excavation. These should be addressed as the construction proceeds by excavating and replacing pockets of soft or loose material or by installing drainage measures.

8.20 Excavations are required at the rear of each building platform and the stability of these slopes has been analysed. The slopes will eventually be supported by the back wall of the proposed warehouses. The short term stability of a temporary slope has been analysed using the same geotechnical parameters as those used in the analyses of fill slopes. It has been assessed that slopes at 1(V):1(H) would be stable with a factor of safety in excess of 1.3 against failure in undrained conditions (i.e. short-term conditions).

8.21 As discussed previously the temporary slopes should be inspected by a geotechnical engineer to confirm their stability.

8.22 All the above work will be taken into account and/or specified during the detailed design.

ACCEPTABILITY

8.23 Extensive earthworks are required for site levelling and road construction. The cut and fill volumes have been assessed as explained in Section 7 of this Report for each platform and road segment and are outlined in Table 8.3.

8.24 Soil types and associated earthworks parameters are extremely varied over the site and can generally be divided into three separate categories as follows:

- Fluvio-glacial granular soils
- Glacial lodgement till (clayey slightly gravely silt and/or sand to very stiff to hard gravelly sandy clay)
- Glacial cohesive soils

Fluvio-Glacial Granular Soils

8.25 Fluvial and Fluvio-glacial granular deposits are widely spread throughout the site. These soils consist of gravels, sands and silts and the assessment of their acceptability as engineering fill has been based on their particle size distribution and moisture content in relation to their compaction characteristics.

8.26 The vast majority of the granular deposits will be acceptable for reuse as engineering fill. Marginal quantities will arise from areas where the granular soils are clayey and/or silty as well as wet; such material will not be readily acceptable.

Glacial Lodgement Till

8.27 Lodgement till is only likely to be encountered in cut areas near the roundabout and upper Fassaroe Lane.

8.28 The unweathered till consists of very stiff to hard brown sandy gravelly clay. A weathering profile of approximately 2m depth is common over the outcrop area with residual silt and sand being encountered. These soils are however likely to be classed as cohesive soils due to their high fines contents (>15%) in their in-situ condition. Lodgement Till soils are generally likely to be acceptable or marginally acceptable (see paragraph 8.34) for reuse as engineering fill in their in-situ condition.

Glacial Cohesive Soils

8.29 Glacial clays are expected to be encountered throughout the site in variable proportions.

8.30 The Glacial clays typically consist of silty sandy clay grading to silt in places. This material also contains variable amount of gravel and bands or lenses of sand. The main criteria of acceptability of the glacial clays is very much dependent on its moisture content that affect its moisture condition value as described in the following paragraphs.

ACCEPTABILITY OF COHESIVE SOILS

8.31 The earthworks parameters as established by laboratory testing are summarised in Table 8.2 below:

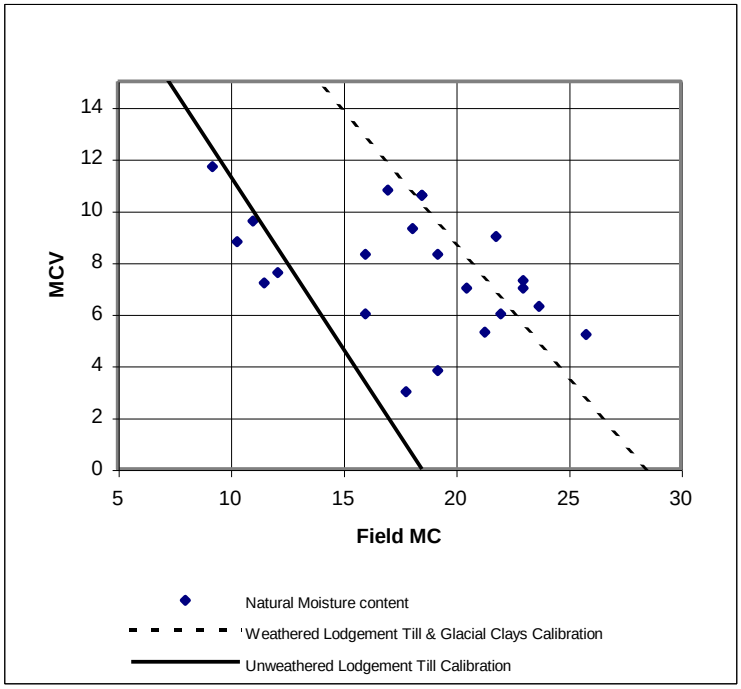
Table 8.2 - Earthworks Parameters – Cohesive Soils

	Very stiff to hard sandy gravelly Clay	Slightly gravelly Silt and/or clayey Sand
Natural Moisture Content (MC)	<13	20
MCV at Natural MC	>7	<8
Plasticity Index	15	-
Liquid Limit	31	-

Note: 1. Parameters obtained from limited laboratory testing.

8.32 Soils with an MCV value of greater than 7.5 are generally considered acceptable as engineering fill whereas soils with MCV values lower than 7.5 generally require processing in order to reduce their moisture content and thus become acceptable. The relationship between MCV and natural moisture content is generally linear for individual soil types as illustrated in Figure 8.1.

Figure 8.1 - Natural Moisture Content vs Moisture Condition Value Relationship



Notes 1: Unweathered LodgementTtill calibration line from two 5 point MCV tests
2: Weathered Lodgement Till & Glacial Clays calibration line from three 5 point MCV tests

8.33 The calibration lines were obtained by testing representative samples at varying moisture contents. This correlation indicates that all unweathered lodgement till will be acceptable for re-use as engineering fill, whereas the weathered till and the Glacial Clays are likely to be unacceptable for reuse in its in-situ condition due to high moisture content and corresponding low MCV. The conditions for reusing excavated materials are discussed in the following paragraphs.

CLASSIFICATION AND RE-USE OF EXCAVATED MATERIAL

8.34 A review of the laboratory testing data has revealed that all the materials that will be encountered within the excavations can be divided into three main categories as listed below:

- Acceptable: Material that will be acceptable for re-use as fill without any treatment. It will comprise fluvio-glacial granular soils and unweathered glacial lodgement till.

- Marginally acceptable: Material that requires minor treatment (drying) prior to becoming acceptable (generally stoney cohesive). This material should be spread in thin layers and allowed to dry naturally but should this be unfeasible, due to time, space or weather constraints, it should be classified as unacceptable
- Unacceptable: Material that would not be acceptable as engineering fill without processing. Generally, this material could however be re-classified as acceptable for reuse as landscape fill.

8.35 The approximate quantities of each category of material likely to be encountered in each cutting area have been tabulated below (based on drawing No. 1739GE021):

Table 8.3 - Anticipated Quantities of cut and fill materials

Area	Cut (m3)	Fill (m3)	Acceptable (m3)	Marginally Acceptable (m3)	Unacceptable (m3)
Northern Platforms (Blocks 4 &5)	64347	70150	51478	6435	6435
Southern Platforms (Blocks 1, 2 & 3)	88616	153216	44308	17723	26585
Main Access Road Section A	42605	25	21303	4261	17042
Nobel Waste Access Road	3305	256	1653	0	1653
Thornhill Road Realignment	3865	0	1933	0	1933
Thornhill Residential Access	280	2	140	0	140
Roundabout	49345	0	29607	4935	14804
Main Access Road section B	22170	30	11085	4434	6651
TOTAL	**274533**	**210750**	**161505**	**37787**	**75241**

8.36 The above anticipated breakdown of earthworks quantities indicates that, in order to minimise the import of engineering fill and disposal of unacceptable material, minor processing of the excavated material will be required.

8.37 The marginally acceptable material could be reused subject to natural drying as described above. The anticipated total amount of fill available for engineering purposes would thus be 199,292m^3.

8.38 A minor quantity of unacceptable material could be lime stabilised prior to being incorporated into the engineering works to compensate the 11,458m3 shortage of acceptable material. The remaining volume of unacceptable material, 63,783m^3, should be reused as landscape fill as much as possible to reduce the volume of material requiring disposal off site (and associated landfill levy charges) as well as reducing the construction traffic in and out of the site.

8.39 At the time of construction, it is recommended that the excavated material is tested to confirm its acceptability. Trial excavations and testing in advance of the earthworks would also allow further optimisation of the volume of acceptable material by careful excavation and use of the 'best quality' material within the more critical parts of the works such as the embankment slopes and the eastern building platforms above the M11.

SUBGRADE

8.40 The subgrade throughout the cutting areas will consist of glacial, fluvio-glacial and lodgement till strata. Accordingly, it will comprise both cohesive and granular materials. The required thicknesses of capping and/or sub-base have been tabulated below for the various sections of road assuming a flexible or flexible composite pavement in accordance with the National Roads Authority's Design Manual for Road and Bridges (Volume 7, UK DMRB Standard HD25/94).

Table 8.4 - Pavement Design

Access Road	Chainage (m)	CBR (%)	Pavement Design	
			Sub base (mm)	Capping (mm)
Main Access Road Section A 3	Ch 000m - 190m	3	150	350
			300	0
	Ch 190m - 260m	4	150	300
			260	0
	Ch 260m - 310m	>15	150	0
Main Access Road Section B	Ch 000m - 150m	>15	150	0
	Ch 150m - 200m	3	150	350
			300	0
	Ch 200m - 260m	5	150	250
			220	0
Internal Access Road Section A	Ch 000m - 060m	5	150	250
			220	0
	Ch 060m - 080m	3	150	350
			300	0
	Ch 080m - 100m	5	150	250
			220	0
	Ch 100m - 120m	4	150	300
			260	0
	Ch 120m - 145m	3	150	350
			300	0
Internal Access Road Section B	Ch 000m - 090m	3	150	350
			300	0

Internal Access Road Section C	Ch 355m - 410m	4	150	300
			260	0

8.41 It is recommended that the base of the formation/subgrade is inspected by a geotechnical engineer prior to the construction of the pavement to confirm the adequacy of the design. Particular attention should be given to any observed seepages and soft spots that should be excavated and replaced. In-situ testing may be required to confirm the design.

8.42 During construction, the formation level should be kept free of water and protected at all time during periods of wet weather.

9. STRUCTURES DESIGN CRITERIA

DESCRIPTION

Warehouses

9.1 The proposed warehouses are typically 44m wide and range in length from 130m (Block 5) to 210m (Block 3). The roof will be approximately 8m above the floor level. It will be grassed and suspended from masts utilising a cantilever design to support the majority of its loading. The vertical loads will be transferred by steel columns to spread foundations. An 'L' shaped reinforced concrete retaining wall will form the back (western) wall of the warehouses

9.2 Two cables will run from the top of each mast (main column) to the end of each 10.8m bay of the retaining wall. The cables will be tensioned in order to counterbalance the forces that will be transmitted by four further cables supporting the roof on the other side of the masts. Ground anchors will be installed to resist the uplift forces due to the two cables.

9.3 The proposed warehouses are to be built on platforms cut into the existing hill side soil slopes and, in the case of the lowermost platforms, they will be partly constructed on engineered fill embankments. The soil slopes above each platform are to be retained by the reinforced concrete retaining wall that will form the back walls of the warehouses.

Retention Measures

9.4 In addition to the back walls located to the rear of the warehouses, further retention measures will be required along the southern boundary of the site where fill, up to approximately 8m high, will be placed to construct the platforms for Block 1 and 2 and Internal Access Road C. An existing lane, namely Existing Local Access Road, also runs along (outside) this boundary the site and is to be maintained.

9.5 Due to land take restrictions, an unsupported slope is not feasible and a retaining wall is to be constructed to avoid the encroachment of this lane by the proposed development. For aesthetic reasons, the construction of a traditional reinforced concrete retaining wall is not possible and accordingly, alternative solutions have therefore been reviewed.

FOUNDATIONS

Loadings

9.6 The pressures at the base of each retention measures (both the warehouses back walls and along the southern boundary) will be minimal, only consisting of self weight and weight of the retained soil with minor surcharge loads due to traffic loads from the internal access roads.

9.7 Based on the information submitted by the Project's Structural Engineers (O'Connor Sutton Cronin and Associates Limited), the structural loadings transmitted to the ground are as tabulated below:

Table 9.1 - Structural Loads

	Service Loads
Main Columns	3100kN
Secondary Columns	140kN
Cables (uplift)	1380kN

9.8 The greatest vertical loads will be at the base of the main columns and will be transferred to the ground using spread foundations. The loads due to the secondary columns and at the base of the wall are comparatively minimal. It has therefore been assumed that if the allowable bearing pressure was adequate for the main columns, then it would also be adequate for the other foundations.

Bearing Capacity

9.9 Soils at foundation level vary significantly throughout the site and within each of the individual structures. The foundation level for the main columns is generally in cut of variable depths depending on each structure. Soils at these depths are generally dense to very dense silty sands and gravels and stiff to very stiff sandy gravelly clays.

9.10 Bearing capacity analyses have been carried out for pad and for strip foundations. This included the determination of the allowable bearing capacity for each different type of strata that will be encountered at founding level within each platform.

9.11 The calculations were carried out using Terzaghi's Bearing Capacity Theory adapted to foundations on non-cohesive and cohesive deposits as required.

Settlement

9.12 Settlement analyses were also undertaken for both foundation types and included immediate or elastic settlement in cohesive and granular materials as well as long term consolidation settlement in the cohesive strata.

9.13 For the settlement in cohesive strata, consolidation and stiffness parameters were derived from oedometer test results and from correlation with other laboratory testing data and standard penetration test (SPT) results.

9.14 Settlement predictions for the non-cohesive deposits have been calculated using SPT results and are based on the empirical relationship given by Burland and Burbridge.

9.15 The preliminary dimensions for each spread foundation type are tabulated below together with the subsequent bearing pressures.

Table 9.2 - Preliminary foundation dimensions and bearing pressures

Foundation Type	Width (m)	Length (m)	Bearing Pressure (Gross)
Pad	4.0	4.0	200kPa
	4.0	3.0	260kPA
	3.0	3.0	350kPA
Strip	2.0		150kPa/m run
	1.0		290kPa/m run

9.16 The pressure at the base of the retaining walls located at the back of the warehouses will only consist of the weight of the fill material and the gross bearing pressure is not expected to exceed 150kPa.

10. STRUCTURES - ENGINEERING DISCUSSION AND RECOMMENDATIONS

SPREAD FOUNDATIONS

10.1 The foundations for main columns were analysed with respect to their bearing pressure and subsequent settlement as detailed in Section 9 of this report. Calculations have been undertaken for each type of spread foundation (pad or strip footing) on each type of material that would be encountered at founding level within each of the building platforms.

Bearing Capacity

10.2 The analyses have shown that allowable bearing capacities are in excess of the bearing pressures at the base of the pad or strip foundations of the main columns (although this depends on the foundation dimensions and the location of each of the warehouses). The individual Structure Foundation Summary sheets for each building platform (appended to this report) should be referred to for details of the assumed foundation dimensions and allowable bearing capacities.

10.3 The bearing pressures at the base of the secondary columns have therefore been deemed allowable.

Settlement

10.4 The settlement analyses carried out for both strip and pad foundations have shown that the settlement below the foundations of the main columns is not anticipated to exceed 25mm. The settlement beneath the secondary columns founded on pad foundations or strip footing will therefore be less than 25mm.

10.5 Differential settlements within the strip footings or between two adjacent main column pad foundations are expected to be less than 15mm. However, differential settlements between adjacent main and secondary column foundations could, in the worse case scenario (i.e. maximum settlement beneath the main column and minimum settlement beneath the secondary column), be up to 25mm.

10.6 Anticipated total and differential settlements for each building platform are summarised on the appended Structure Foundation Summary sheets.

10.7 It is anticipated that the maximum load will only be applied to the main columns once the roof is placed/constructed and the anchors tensioned. It would therefore be prudent to review the assumptions made in this report in light of the final design and the proposed construction stages. Should there be significant discrepancies between the assumptions and the final detailed proposals, further settlement calculations and checks may be required. Such analysis, if required, should take into account the exact dimensions, depths and loadings of the foundation at the each stage of the construction as well as the layering of the ground and the interaction between adjacent foundations.

Construction Issues

10.8 Groundwater ingress is expected within the cutting area of the platforms due to the close proximity of main and/or perched water tables and will therefore be present within some of the excavations for the foundations. These excavations should be kept dry at all times during the construction with provision made for groundwater control and discharge into existing drainage and/or watercourses.

10.9 To minimise the total volume of excavation required for the construction of the foundations, particularly those for the back wall of the proposed warehouses, the batter should be formed as steep as possible. It has been calculated that a slope at 1(V):1(H) would be stable in the short term. Minor instability problems may occur in isolated areas due to weaker bands or saturated lenses, and should be identified and repaired on site.

10.10 The exact nature and quantity of the material that will be excavated for the construction of the foundations will depend on the final design. Section 8 of this report should be referred to for the criteria of acceptability for reuse of this material as fill.

10.11 All the excavations should be inspected by a geotechnical engineer prior to the construction of the foundations to confirm the stability of the slopes and to identify soft spots and seepages. Any soft spots should be excavated and replaced by granular material or lean mix concrete and any seepage or local instability problem should be addressed as appropriate.

GROUND ANCHORS

10.12 The arrangements to attach the cables to the anchors have not yet been finalised but a specialist contractor has been contacted. It has been estimated that, using their proprietary 'Single Bore Multiple Anchor' system, a total fixed anchor length in the fresh lodgement till of the order of 25m would be required for an axial load of 2000kN.

10.13 It has been assumed that a free length in the order of 10m would be required to ensure that the total fixed length is anchored into the fresh lodgement till. The free length will vary at each location depending on the ground conditions at each location and the proposed finished ground level.

10.14 On either side of the warehouses, only one cable will need to be anchored. It is expected that the length of the anchor could be reduced here because the axial load will be approximately 1400kN.

10.15 Depending on the final design, the intermediate ground anchors may have to resist the force transmitted by two cables (one from two adjacent masts) or one anchor would have to be installed for each individual cable. The total load resulting from two adjacent cables would be in the order of 2500kN to 2600kN depending on the geometry of the installation. The total length of the intermediate anchors will have to be adjusted depending on the exact uplift forces to be resisted.

10.16 Once the final layout and exact forces in the cables have been confirmed further detailed analysis should be undertaken by a specialist contractor to confirm the above lengths and to ensure a cost effective design with their in house system.

Construction Issues

10.17 The anchors should be installed after completion of the construction and backfilling of the retaining wall.

10.18 The installation of the anchors should be carefully monitored to ensure that the fixed length is founded in competent strata.

10.19 Trial anchors should be constructed and tested at each structure location prior to the installation of working anchors to confirm the adequacy of the design in relation to the actual ground conditions.

Retention Measures

10.20 The retaining walls at the back of the warehouses have been designed by O'Connor Sutton Cronin and Associates Limited and their foundations have been discussed in the previous paragraphs.

10.21 Aesthetically pleasing retention measure options have been reviewed for the southern boundary of the proposed development. Several systems exist on the market and it has been found that a timber crib wall would be the most appropriate solution. It would allow construction at a sufficiently steep gradient to maintain the required clearance along the Existing Local Access Road at the bottom and along the Internal Access Road C at the top.

10.22 The timber crib wall will be constructed on a reinforced concrete base with a key to prevent from sliding if required. The final design of the crib wall will be undertaken by the manufacturer.

Construction issues

10.23 As discussed previously in the spread foundations section, the formation level of the retention measures will have to be inspected by a geotechnical engineer prior to their construction to confirm the stability of the slopes (back walls) and to identify soft spots and seepages.

10.24 Any soft spot should be excavated and replaced by granular material or lean mix concrete and any seepage or local instability problem should be addressed.

10.25 Groundwater ingress in the excavations is expected and adequate drainage and/or pumping measures should be installed to ensure that they remain dry during construction.

GROUND AND GROUNDWATER CHEMISTRY

10.26 The laboratory test results indicate that soil total sulphate contents (as SO_3) are less than 0.2% and pH values are greater than 7. Although no results were available for the groundwater it is anticipated that Class 1 site conditions would generally apply to any buried concrete in accordance with BRE Digest 363.

11. CONCLUSIONS

11.1 The findings of this investigation indicate that this site is generally suitable for the proposed development comprising the construction of warehouses with mezzanine offices together with the associated infrastructure.

11.2 In terms of earthworks, it has been demonstrated that a cut and fill balance of material can generally be achieved, with minimal quantities of excavated material requiring natural drying or lime stabilisation prior to being incorporated into the engineering works. The remaining unacceptable material could be either disposed off or, to mitigate the construction traffic and landfill levy charges, could be used as landscape fill.

11.3 The slope stability of the proposed cuttings and embankment platforms has generally been found to be satisfactory. These are however subject to adequate construction methods and provision of drainage as highlighted in the relevant sections of this report.

11.4 The foundations dimensions have been given as a general guidance for an estimation of allowable bearing pressures, settlement and differential settlement. At the time of the final design, additional foundation analyses, including bearing capacity and settlement, should be carried out to further optimise the design and enable cost savings.

11.5 Similarly, once the final anchor arrangement is known, the free and fixed lengths of the anchors should be revised to take into account the actual ground conditions at each individual location and the exact loadings.

11.6 It must be noted that throughout the site, groundwater will be one of the main construction constraints for both structures and earthworks. Adequate temporary and permanent drainage measures will be required due to the close proximity of the perched and main groundwater tables as well as the expected rainfall. Recommendations have been made in the report to deal with groundwater during the construction period as well as on a permanent basis. Additional measures such as sediment ponds will have to be taken to discharge of pumped or drained water into watercourses or into the existing drainage network.

11.7 The above recommendations as well as those given in each relevant section of the report should be taken into account at the time of the final design.

APPENDIX A

DRAWING No. 1739GE021 – Exploratory hole Locations

APPENDIX B

STRUCTURE FOUNDATION SUMMARY (PRELIMINARY) SHEETS

Block 1 to 5

12. FASSAROE DEVELOPMENT – BOREHOLE SUMMARY

13.

14. BH403 53.8M AOD SITE 1 - TOP

GL-0.4m	Topsoil
0.4-2.8m	Firm becoming stiff to very stiff very silty very sandy slightly gravelly CLAY
2.8-6.0m	Dense brown slightly clayey very silty fine SAND with a bed of Very Stiff brown grey very sandy very gravelly CLAY with occasional cobbles at 6.0m
10.9-15.0m	Very Stiff brown clayey slightly sandy SILT
15.0-16.3m	Dense brown slightly clayey very silty fine SAND
16.3-19.6m	Dense silty sandy GRAVEL with occasional cobbles

Groundwater	11.2m slow inflow 16m fast inflow rose to 13.4m

15. BH405 42.6M AOD SITE 1 - MIDDLE

GL–0.4m	Topsoil
0.4-9.2m	Medium dense, becoming dense by 5m, grey brown (fmc) SAND with a little gravel above 2.5m
9.2-9.5m	Soft to Firm dark grey very silty CLAY with occasional thin sand laminae (50-60kPa)
9.5-10.9m	Dense brown very silty very clayey (fmc) SAND
10.9-11.6m	Very Stiff brown very sandy gravelly CLAY with occasional cobbles. (300kPa)
11.6-12.5m	Dense brown grey gravelly SAND
12.5-14.0m	Very stiff brown very sandy gravelly CLAY with occasional cobbles
Groundwater	From 4.2m saturated sands – no inflows
	Strike 11.6m Rose to 6.8m Fast inflow

Rotary core to 30m – boulder clay throughout. Possible weathered rock in last meter.

15.1 BH404 50.3m AOD Site 1 – Top

GL-0.3	Topsoil
0.3-2.7	Soft brown slightly silty very sand CLAY
	By 2.7m slightly sandy with occasional gravel and cobbles
3.3-7.2m	Medium dense to dense brown silty clayey fine SAND with laminae / interbeds of Firm SILT
7.2-10.2m	Firm to stiff brown slightly sandy clayey SILT with laminae / beds of brown fine SAND
10.2-13.7m	Very stiff brown interbedded slightly sandy clayey SILT and brown fissured CLAY
13.7-15.7m	Very dense sandy gravel (fmc) (round to sub angular) with occasional cobbles
Groundwater -	Strike 10.5m Rose to 9.8m Fast
	Strike 13.7m Rose to 10m Fast

14-20m	ROTARY OPEN HOLE – Gravel to final depth – possibly clay in last meter? No rock.

15.2 BH406 Site 1 - Bottom

GL-0.2m	Topsoil
0.2-1.9m	Firm, brown, very silty very sandy CLAY (very silty, very clayey SAND???). Slightly moist, friable
1.9-3.8m	Dense to very dense clayey silty fmc SAND with some (fmc sub round to sub angular) Gravel
3.9-10.6m	Very Stiff brown sandy gravelly CLAY with occasional cobbles and sandy pockets. Fissured. (>300kPa)

Groundwater: Strike 3.3m Rose to 3.0m Slow

APPENDIX 6E

GL04184 (GI la vallee sept 2001)

PROPOSED DEVELOPMENT AT

LA VALLEE, FASSAROE

GEOTECHNICAL INVESTIGATION

REPORT 4184

SEPTEMBER 2001

Client: Cosgrave Property Group.

Engineer: Atkins McCarthy

Glover Site Investigations Ltd.,
8 Drumahiskey Road,
Balnamore,
Ballymoney,
Co. Antrim BT53 7QL.

PROPOSED DEVELOPMENT AT

LA VALLEE, FASSAROE

GEOTECHNICAL INVESTIGATION

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APPENDIX 4 INSITU TEST RESULTS

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PROPOSED DEVELOPMENT AT
LA VALLEE, FASSAROE

GEOTECHNICAL INVESTIGATION

1.0 AUTHORITY

On the instructions of Atkins McCarthy, Consulting Engineers, Glover Site Investigations Ltd, were appointed to undertake a preliminary geotechnical investigation on a site aligned along the western bank of the Dargle River near the M11 Fassaroe Interchange, near Bray, Co. Wicklow (Appendix 1).

2.0 SCOPE OF WORKS

The main purpose of the ground investigation was to determine the nature of the sub-surface strata in relation to foundation design for a residential development.

A factual report only was specified.

The ground investigation included the following components;

i) Excavation of 14 No. machine excavated trial pits

ii) Excavation of 3 No. rotary odex boreholes

iii) Sampling and testing of soils obtained as part of the investigation

iv) 7 No. plate load tests.

The investigation was undertaken in accordance with guidance presented in the British Standard Codes of Practice BS 5930 (1999) and BS 1377 (1990).

3.0 FIELDWORK

The fieldwork for the investigation was undertaken initially on the 26th July 2001 under the supervision of an engineer from Glover Site Investigations Ltd, with additional works between 16th August 2001 to 23rd August 2001.

3.1 Trial Pits

A total of 14 No. trial pits were excavated to a maximum depth of 3.2m by means of mechanical excavator. Soil samples obtained took the form of disturbed small jar and large bulk bag samples.

An exploratory hole location plan is presented in Appendix 1 and exploratory hole logs for each trial pit in Appendix 2.

3.2 Rotary Odex Boreholes

A total of 2 No. rotary odex boreholes were drilled using a lorry mounted strata drill with HQ (wireline) core barrel and water flush, to a maximum depth of 8.1m.

3.3 Insitu Testing

Insitu testing in exploratory holes took the form of;

- Standard Penetration Testing using either a split barrel sampler (SPT) or solid 60 cone (CPT) to enable measurement of penetration resistance (N) to be determined under dynamic loading. Results are recorded on individual borehole logs in Appendix 2.

- At locations as advised by the Engineer 7 No. near surface plate loading tests were undertaken utilizing a 600mm diameter plate bearing on the cohesionless soils present below the topsoil layer.

3.4 Standpipe Installations

Groundwater monitoring standpipe of nominal 50mm internal diameter were installed in the rotary odex boreholes. Installation details for each standpipe are presented on instrumentation sheets accompanying the relevant exploratory hole log (Appendix 2).

3.5 Photographs

Photographic plates of the trial pits excavated are presented in Appendix 3.

4.0 LABORATORY WORK

All samples obtained during the ground investigation were transported to the soils laboratory of Glover Site Investigations Ltd in Ballymoney, Co. Antrim.

Laboratory testing scheduled by the Engineer comprised of;

Wet and dry sieve analyses

pH and SO_4 analyses.

All laboratory test results are presented in Appendix 3.

REFERENCES

1. British Standards Code of Practice for Site Investigations BS 5930 : 1981.

2. British Standards Method of Test for Soils for Civil Engineering Purposes, BS 1377 1990.

APPENDIX 1

SITE AND EXPLORATORY HOLE LOCATION PLANS

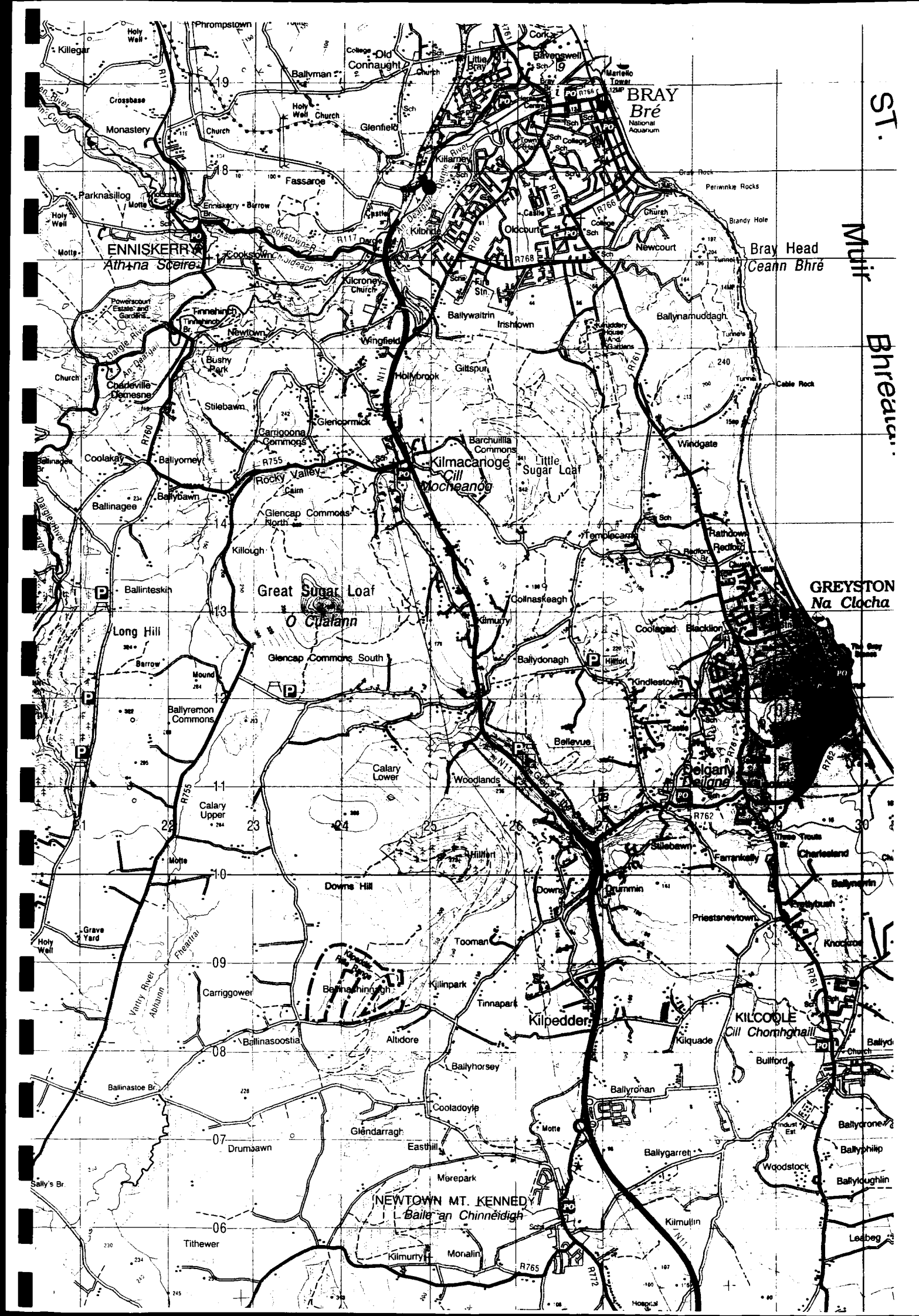
ST. Muir Bhreac
BRAY
Bré
National Aquarium
Bray Head
Ceann Bhré
ENNISKERRY
Áth na Sceire
Kilmacanoge
Cill Mocheanóg
Great Sugar Loaf
An Cruachán
Little Sugar Loaf
GREYSTON
Na Clocha
KILCOOLE
Cill Chomhghaill
NEWTOWN MT. KENNEDY
Baile an Chinnéidigh
Kilpedder
Delgany
Deilgne
Old Connaught
Fassaroe
Glenfield
Killarney
Oldcourt
Newcourt
Windgate
Ballywaltrin
Irishtown
Ballynamuddagh
Wingfield
Bushy Park
Hollybrook
Gittspur
Stilebawn
Glencormick
Carrigoona Commons
Barnhuilla Commons
Rocky Valley
Glencap Commons North
Glencap Commons South
Killough
Ballinteskin
Long Hill
Ballyremon Commons
Calary Lower
Calary Upper
Woodlands
Bellevue
Hillton
Downs
Downs Hill
Drummin
Priestsnewtown
Tooman
Kilinpark
Tinnapart
Altidore
Ballinasoostia
Carriggower
Ballyhorsey
Cooladoyle
Glendarragh
Drumbawn
Easthill
Morepark
Tithewer
Kilmurry
Morialin
Kilmullin
Ballygarret
Ballyronan
Kilquade
Bullford
Woodstock
Ballyphilip
Ballyroan
Ballyknockan
Ballyboughlin
Leabeg
Ballyorney
Coolakay
Ballinagee
Ballybawn
Temolecarne
Rathdown
Redford
Coolagad
Blacklion
Kindlestown
Farrankelly
Charlesland
Ballydonagh
Collnaskeagh
Kilmurry
Ballinastoe Br.
Sally's Br.
Ballinaclash Br.
Enniskerry Br.
Tinnehinch Br.
Redford Br.
Three Trouts Br.
Cookstown R.
Dargle River
Vartry River
Abhainn Fheartlai
Old Connaught
Ballyman
Crossbase
Monastery
Parknasillog
Holy Well
Church
Motte
Grave Yard
Powerscourt Estate and Gardens
Cheadeville Demesne
Milltown
Cable Rock
Periwinkle Rocks
Brandy Hole
Martello Tower
Bavenswell
Little Bray
Cork
Phrompstown
Killegar
Tunnel
Castle
Sch
Coll
Camp
Stn
Hospital
Industrial Est
R117
R760
R755
R761
R762
R766
R767
R768
R765
R772
N11
P
PO
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PLATE BEARING TEST

BOREHOLE

TRIAL PIT

TP54
TP53
TP52
TP51
TP50
TP49
TP48
TP47
TP46
TP45
TP44
TP42
TP41
TP40

PB1A/PB1B
PB2
PB3
PB4
PB5
PB6

BH43
BH41

BLOCK B
BLOCK C

OFFICE BLOCK

STONE WALL
EXISTING STONE WALL
CONC. COVER
BRICK WALL
For roadworks details & spec. Refer to Engr.

DARGLE RIVER

APPENDIX 2

EXPLORATORY HOLE LOGS

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP40
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10							
Medium dense reddish brown very silty slightly gravelly fine to medium SAND with occasional rootlets (FLUVIO-GLACIAL)	(1.00)			0.50	J1			
				1.00	B1			
Medium dense reddish brown silty fine to coarse SAND and GRAVEL with many cobbles and boulders (FLUVIO-GLACIAL)	1.10 (1.00)			1.50	J2			
				2.00	B2			
Medium dense reddish brown very silty slightly gravelly fine to coarse SAND (FLUVIO-GLACIAL)	2.10 (1.10)			2.50	B3			
				3.00	J3			
BASE OF TRIAL PIT 3.20m	3.20						dry:26/07/01	

Plan

Remarks

Slightly unstable between 1.10m - 2.10m.
Concrete pipe 1.10m deep approximately 10" diameter.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP40	TP40

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: **TP41**
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	0.05							
Medium dense dark brown silty fine to medium SAND containing occasional rootlets (FLUVIO-GLACIAL)	(0.95)			0.50	J1			
	1.00			1.00	B1			
Medium dense reddish brown very sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)								
Boulders up to 0.9m in diameter	(1.60)			1.50	J2			
				2.00	B2			
	2.60			2.60	J3		dry:26/07/01	
BASE OF TRIAL PIT 2.60m								

Plan

Remarks

Slightly unstable below 1.00m.
Continually collapsing below 2.50m.
Difficult to excavate due to cobbles and boulders.
Refusal on boulders 2.60m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP41	**TP41**

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP42
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.15) 0.15							
Medium dense brownish grey silty sandy fine to medium GRAVEL containing occasional cobbles (FLUVIO-GLACIAL)	(2.25)			0.50	B1			
				1.00	J1			
				1.50	B2			
				2.00	J2			
END OF BOREHOLE 2.40m	2.40						dry:26/07/01	

Plan

Remarks

Pit unstable below 0.15m.
Continually collapsing below 2.00m deep.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP42	TP42

Glover Site Investigations Ltd

Site	Trialpit Number
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE	TP44

Boring Method	Dates	Client	Sheet
JCB-3CX RUBBER TYRED DIGGER	26/07/01 - 26/07/01	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	AS PLAN	ATKINS McCARTHY	

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL with occasional roots	(0.35)							
	0.35							
Medium dense greyish brown silty fine to medium SAND and GRAVEL containing frequent cobbles and boulders (FLUVIO-GLACIAL)				0.50	B1			
				1.00	J1			
	(2.35)			1.50	B2			
				2.00	J2			
				2.50	B3			
BASE OF TRIAL PIT 2.70m	2.70						dry:26/07/01	

Plan

Remarks

Unstable below 0.35m.
Continually collapsing when 2.50m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP44	TP44

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP45
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL containing occasional rootlets	(0.50) 0.50			0.50	J1			
Medium dense greyish brown very silty slightly gravelly fine to medium SAND containing occasional roots (FLUVIO-GLACIAL)	(1.00) 1.50			1.00	B1			
Medium dense greyish brown silty fine to medium SAND containing many cobbles and boulders (FLUVIO-GLACIAL)	(0.50) 2.00			1.50	J2			
Medium dense greyish brown silty fine to coarse SAND and GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL) Boulders up to 0.6m diameter	(0.60) 2.60			2.00 2.50	B2 J3		dry:26/07/01	
BASE OF TRIAL PIT 2.60m								

Plan

Remarks

Unstable below 2.00m.
Virtual refusal on cobbles and boulders at 2.60m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP45	TP45

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP46
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	0.05							
Medium dense greyish brown silty sandy fine to coarse GRAVEL containing occasional cobbles and boulders (FLUVIO-GLACIAL)	(2.55)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 2.60m	2.60						dry:26/07/01	

Plan

Remarks

Unstable below 0.10m.
Continually collapsing when 2.40m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP46	TP46

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP47
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL containing occasional rootlets	(0.30) 0.30							
Medium dense greyish brown silty sandy fine to coarse GRAVEL containing occasional cobbles and boulders (FLUVIO-GLACIAL)	(2.70)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 3.00m	3.00			3.00	B3		dry:26/07/01	

Plan

Remarks

Unstable below 0.50m.
Continually collapsing below 2.00m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP47	TP47

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: **TP48**
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.40) 0.40							
Medium dense greyish brown silty sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	(2.50)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 2.90m	2.90			2.90	B3		dry:26/07/01	

Plan

Remarks

Slightly unstable below 0.40m.
Continually collapsing below 2.50m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP48	**TP48**

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: **TP49**
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.20) 0.20							
Medium dense greyish brown very sandy fine to coarse GRAVEL containing occasional cobbles and boulders (FLUVIO-GLACIAL)	(2.80)			0.50 1.00 1.50 2.00 2.50	J1 B1 J2 B2 J3			
Medium dense greyish brown silty fine to coarse SAND (FLUVIO-GLACIAL)	3.00 (0.20)			3.00	B3			
BASE OF TRIAL PIT 3.20m	3.20			3.20	J4		dry:26/07/01	

Plan

Remarks

Pit unstable below 0.40m.
Continually collapsing below 2.70m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP49	**TP49**

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: **TP50**
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10							
Medium dense greyish brown very sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	(2.70)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 2.80m	2.80						dry:26/07/01	

Plan

Remarks

Unstable below 0.20m.
Continually collapsing below 2.00m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP50	**TP50**

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP51
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10							
Medium dense brown silty fine to medium sand containing occasional rootlets (FLUVIO-GLACIAL)	(0.30) 0.40							
Medium dense greyish brown silty sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	(2.40)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
				2.80	B3			
Soft yellowish brown slightly gravelly sandy SILT containing some cobbles (FLUVIO-GLACIAL)	2.80 (0.20) 3.00							
BASE OF TRIAL PIT 3.0m							dry:26/07/01	

Plan

Remarks

Unstable below 0.40m.
Continually collapsing when 2.60m deep.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP51	TP51

Glover Site Investigations Ltd

Site	Trialpit Number
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE	TP52

Boring Method	Dates	Client	Sheet
JCB-3CX RUBBER TYRED DIGGER	26/07/01 - 26/07/01	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	AS PLAN	ATKINS McCARTHY	

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL containing frequent roots and rootlets	(0.25) 0.25							
Medium dense greyish brown silty sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	(2.45)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 2.70m	2.70						dry:26/07/01	

Plan

Remarks

Pit unstable below 0.25m.
Continually collapsing below 2.20m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP52	TP52

Glover Site Investigations Ltd

Site	Trialpit Number
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE	TP53

Boring Method	Dates	Client	Sheet
JCB-3CX RUBBER TYRED DIGGER	26/07/01 - 26/07/01	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	AS PLAN	ATKINS McCARTHY	

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL containing occasional rootlets	(0.30) 0.30							
Medium dense brown silty sandy fine to coarse GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	(2.80)			0.50	J1			
				1.00	B1			
				1.50	J2			
				2.00	B2			
				2.50	J3			
				3.00	B3			
BASE OF TRIAL PIT 3.10m	3.10						dry:26/07/01	

Plan

Remarks

Unstable below 0.30m.
Continually collapsing below 2.80m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.53	TP53

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Trialpit Number: TP54
Boring Method: JCB-3CX RUBBER TYRED DIGGER	Dates: 26/07/01 - 26/07/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10							
Medium dense reddish brown very silty fine to medium SAND (FLUVIO-GLACIAL)	(1.50)			0.50	J1			
				1.00	B1			
				1.50	J2			
Medium dense reddish brown silty fine to coarse SAND and GRAVEL containing many cobbles and boulders (FLUVIO-GLACIAL)	1.60 (1.20)			2.00	B2			
				2.50	J3			
BASE OF TRIAL PIT 2.80m	2.80						dry:28/07/01	

Plan

Remarks

Pit unstable below 1.60m.
Continually collapsing below 2.00m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	TR	4184.TP54	TP54

Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Borehole Number: **BH41**
Boring Method: Shell & Auger	Dates: 22/08/01 - 23/08/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Hole Diameters: 200mm Cased to 8.10m	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.30) 0.30							
Medium dense to dense greyish brown silty sandy fine to coarse GRAVEL containing occasional cobbles and boulders	(4.80)			1.00-1.45		CPT N=26		
				2.00-2.45		CPT N=35		
				3.00-3.30		CPT (50)		
				4.00-4.45		CPT N=49		
	5.10			5.00-5.45		CPT N=36		
Stiff brown sandy gravelly CLAY containing some cobbles and boulders	(3.00)							
	8.10							23/08/01
END OF BOREHOLE 8.1m								

Remarks

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale	Logged By
1:50	RB

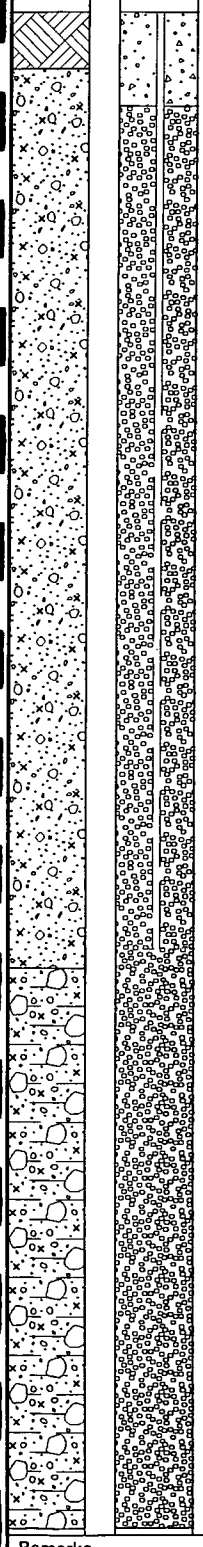
Figure No. 4184.BH41

Borehole Number **BH41**

Glover Site Investigations Ltd

Site	Borehole Number
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE	BH41

Installation Type	Dimensions	Client	Job Number
STANDPIPE	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 99 mm	COSGRAVE PROPERTY GROUP	4184
	Location / **Ground Level (mOD)**	**Engineer**	**Sheet**
	AS PLAN	ATKINS McCARTHY	1/1



Inst. [A]	Level (mOD)	Depth (m)	Description
	-0.50	0.50	Concrete
			Gravel Filter
	-2.00	2.00	
			Slotted Standpipe
	-5.00	5.00	
			Gravel Filter
	-8.10	8.10	

Groundwater Strikes during Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
23/08/01							8.10			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

Upright lockable cover installed.

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Glover Site Investigations Ltd

Site: PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE			Borehole Number: **BH43**
Boring Method: Shell & Auger	Dates: 23/08/01 - 23/08/01	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Hole Diameters: 200mm Cased to 5.45m	Location: AS PLAN	Engineer: ATKINS McCARTHY	Ground Level (mOD):

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.30) 0.30							
Medium dense to dense greyish brown silty sandy fine to coarse GRAVEL containing occasional cobbles and boulders	(3.30)			1.00-1.45		CPT N=49		
				2.00-2.45		CPT N=42		
				3.00-3.45		CPT (50)		
Stiff brown sandy gravelly CLAY containing some cobbles and boulders	3.60 (1.85)			4.00-4.45		CPT (50)		
				5.00-5.45		CPT N=22		
END OF BOREHOLE 5.45m	5.45							23/08/01

Remarks

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale	Logged By
1:50	RB

Figure No. 4184.BH43

Borehole Number **BH43**

Glover Site Investigations Ltd

Site	Borehole Number
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE	BH43

Installation Type	Dimensions	Client	Job Number
STANDPIPE	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 99 mm	COSGRAVE PROPERTY GROUP	4184

Location	Ground Level (mOD)	Engineer	Sheet
AS PLAN		ATKINS McCARTHY	1/1

Legend	Inst. [A]	Level (mOD)	Depth (m)	Description
		-0.50	0.50	Concrete
		-2.00	2.00	Gravel Filter
		-5.00	5.00	Slotted Standpipe
		-5.45	5.45	Gravel Filter

Groundwater Strikes during Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
23/08/01							5.45			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks

Upright lockable cover installed.

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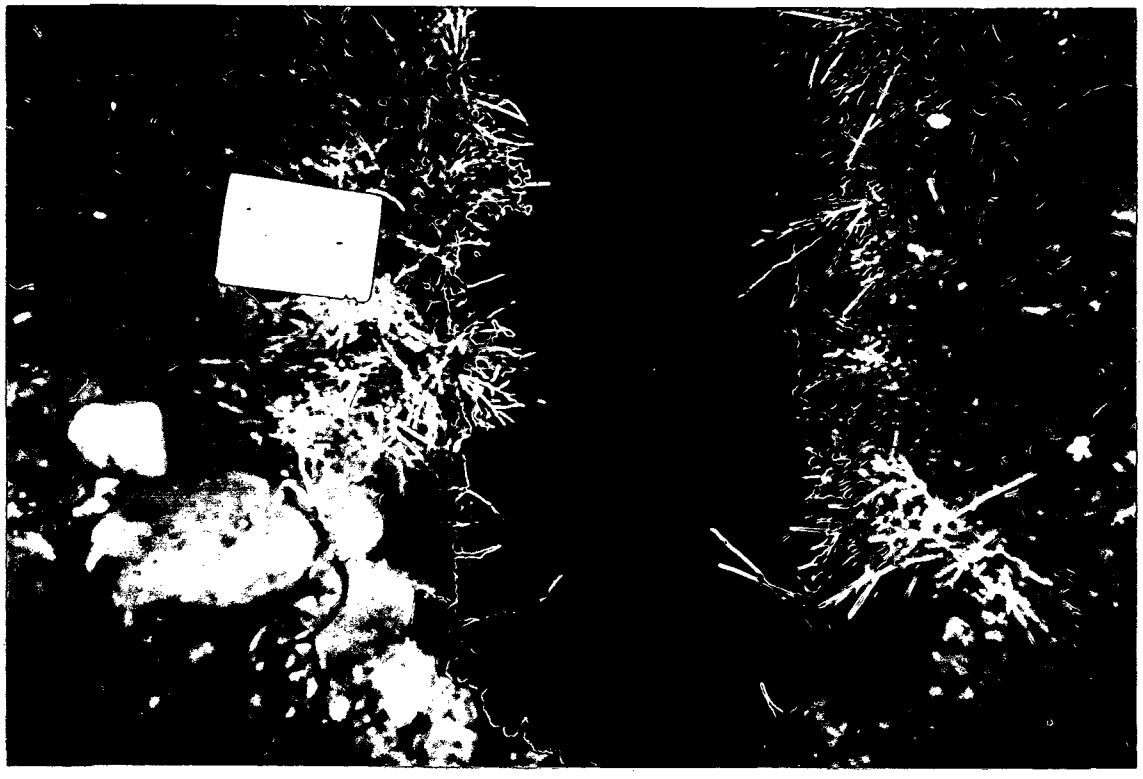
APPENDIX 3

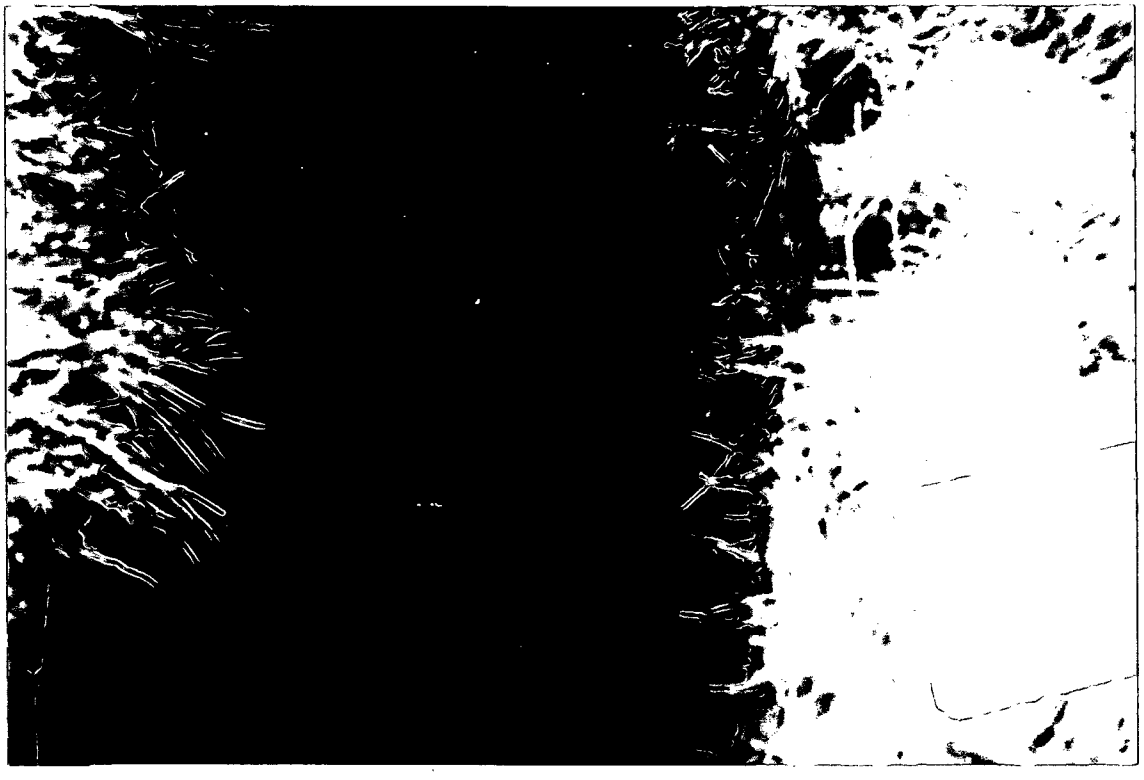
PHOTOGRAPHS

MAP

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



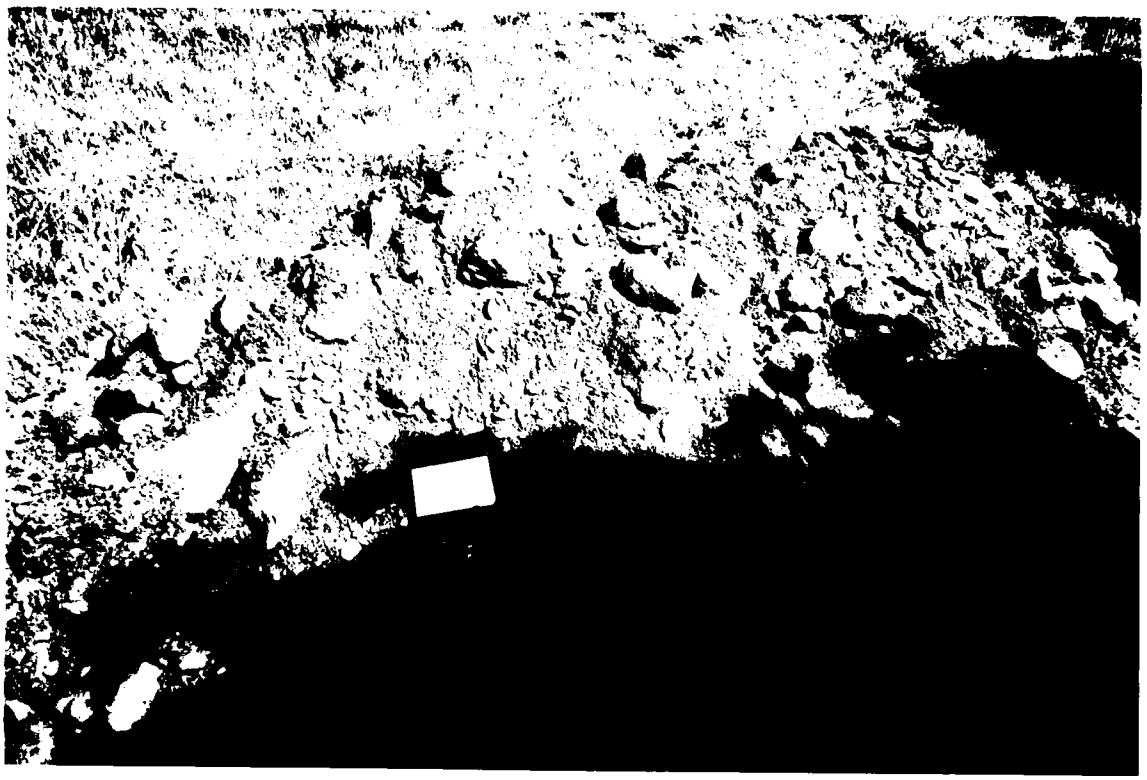
TP 40



TP 40

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

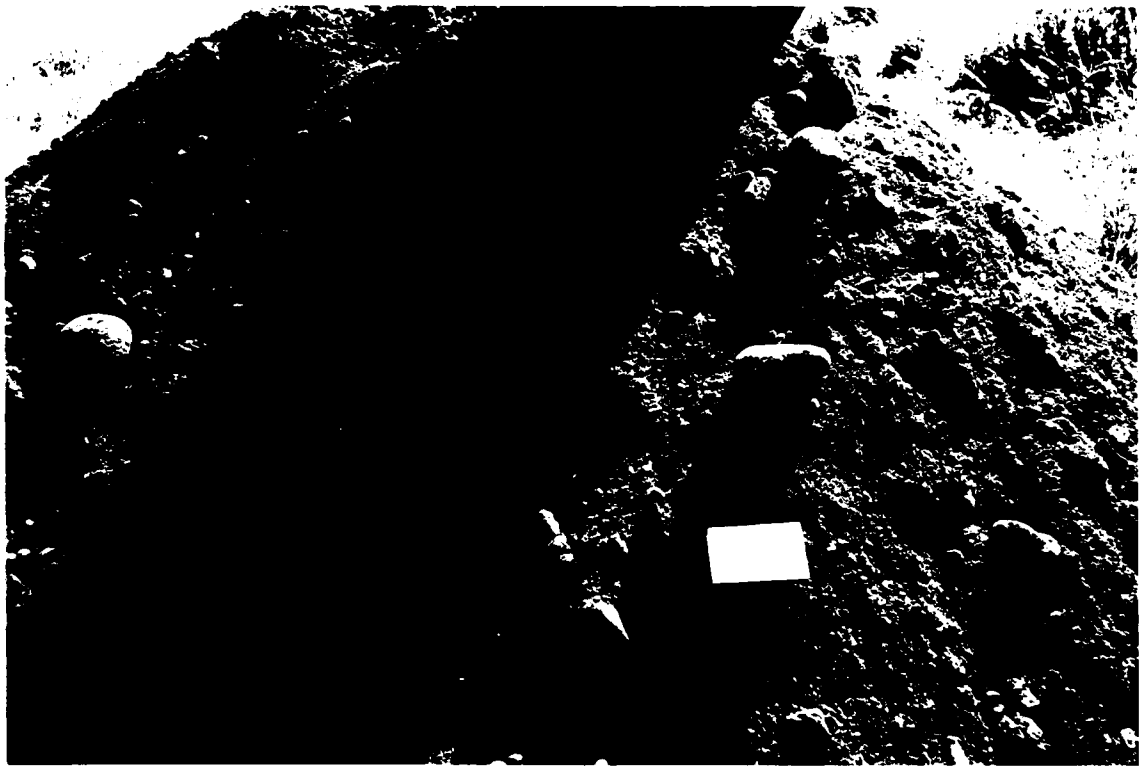
TP 41



TP 41

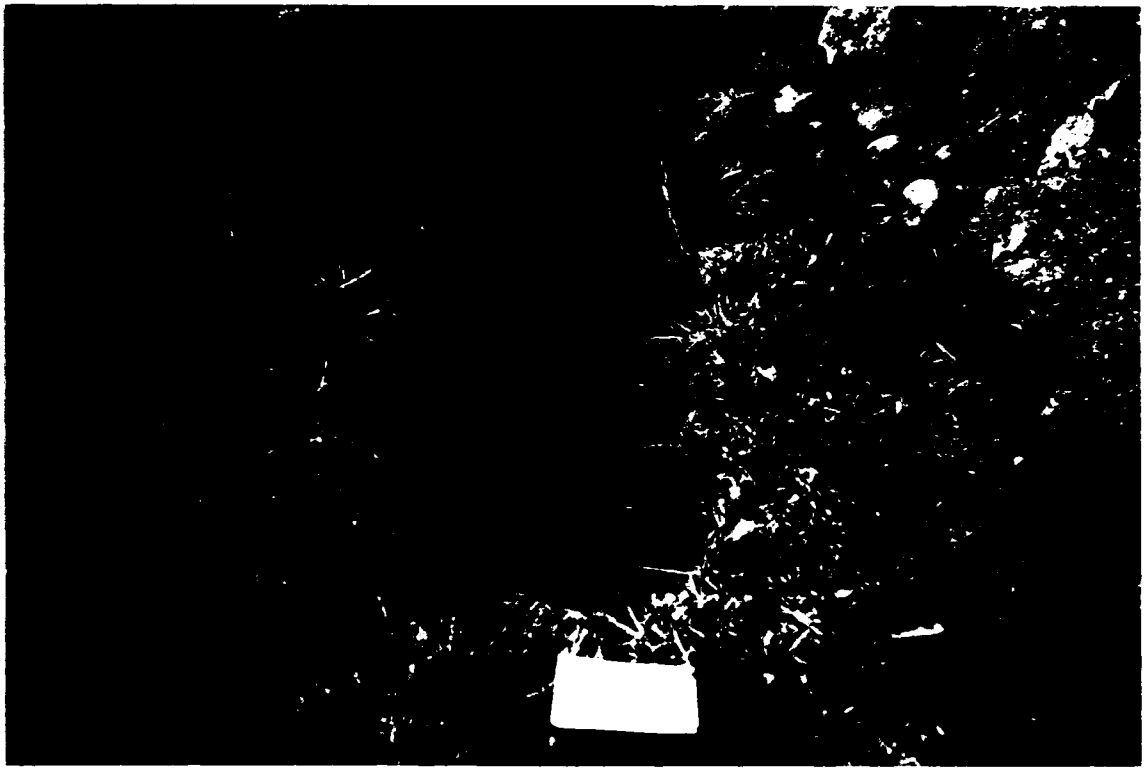
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

TP 42



TP 42

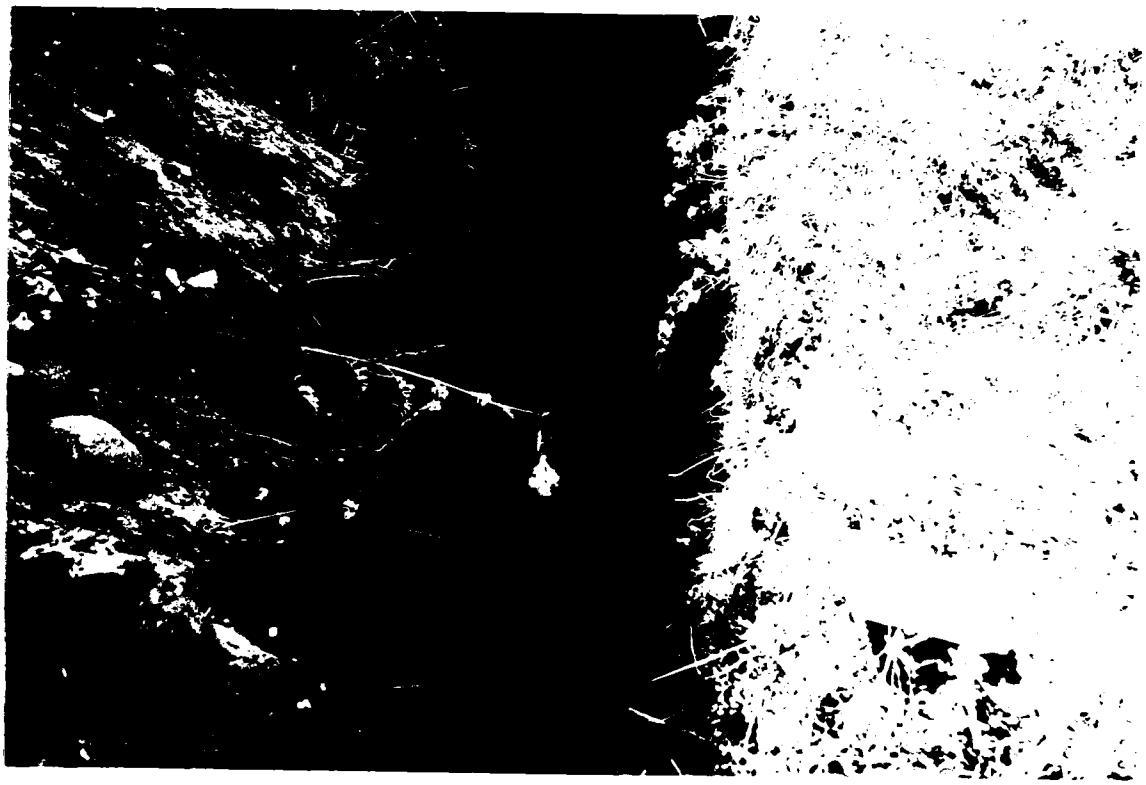
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



TP 44

TP 44

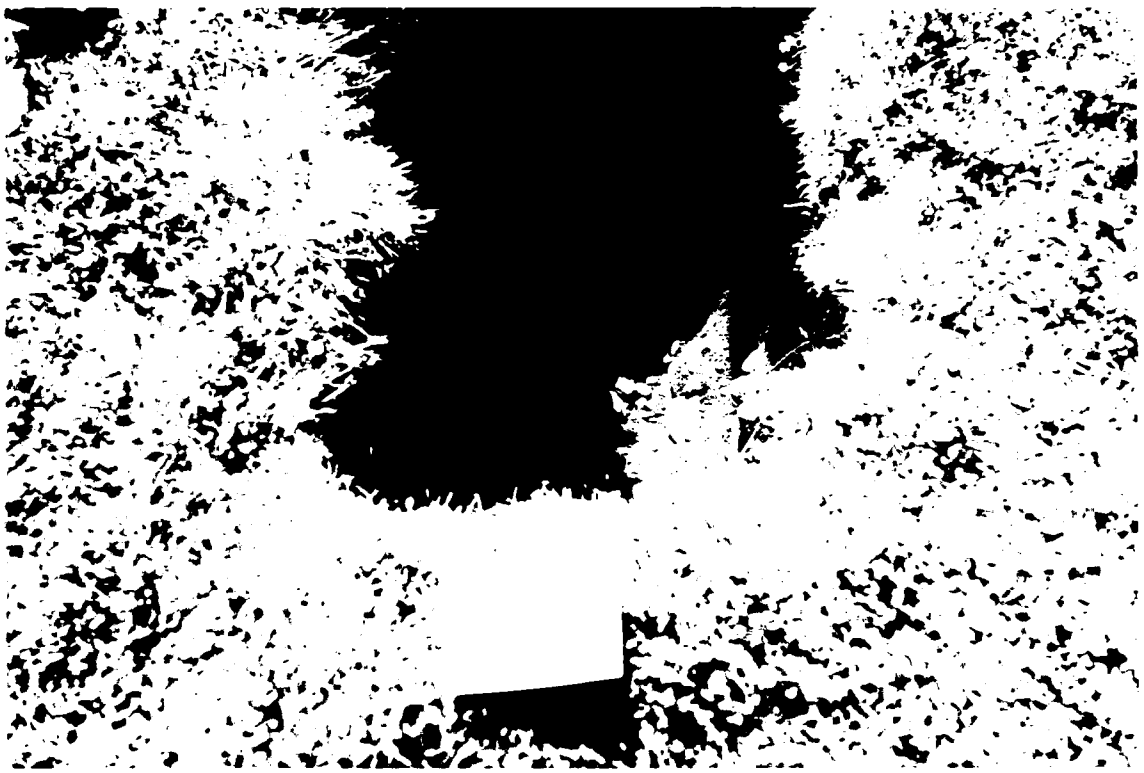
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



TP 45

TP 45

PROPOSED DEVELOPMENT AT
LA VALLEE, FASSAROE



TP 46

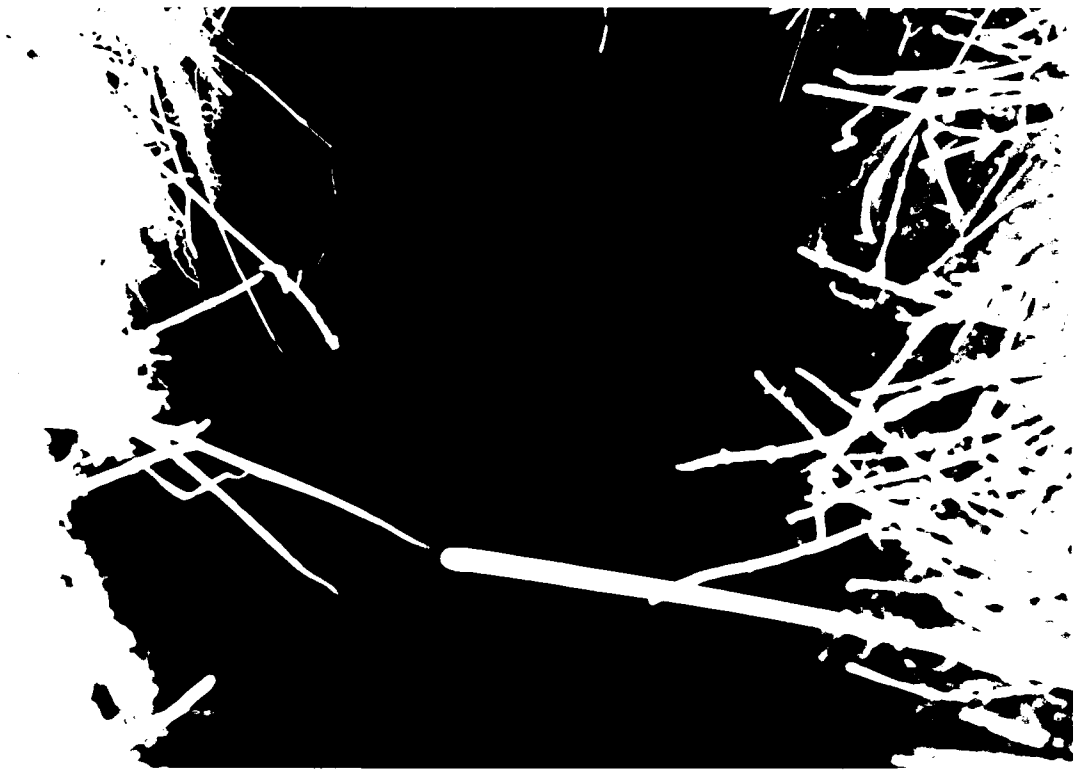
TP 46

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

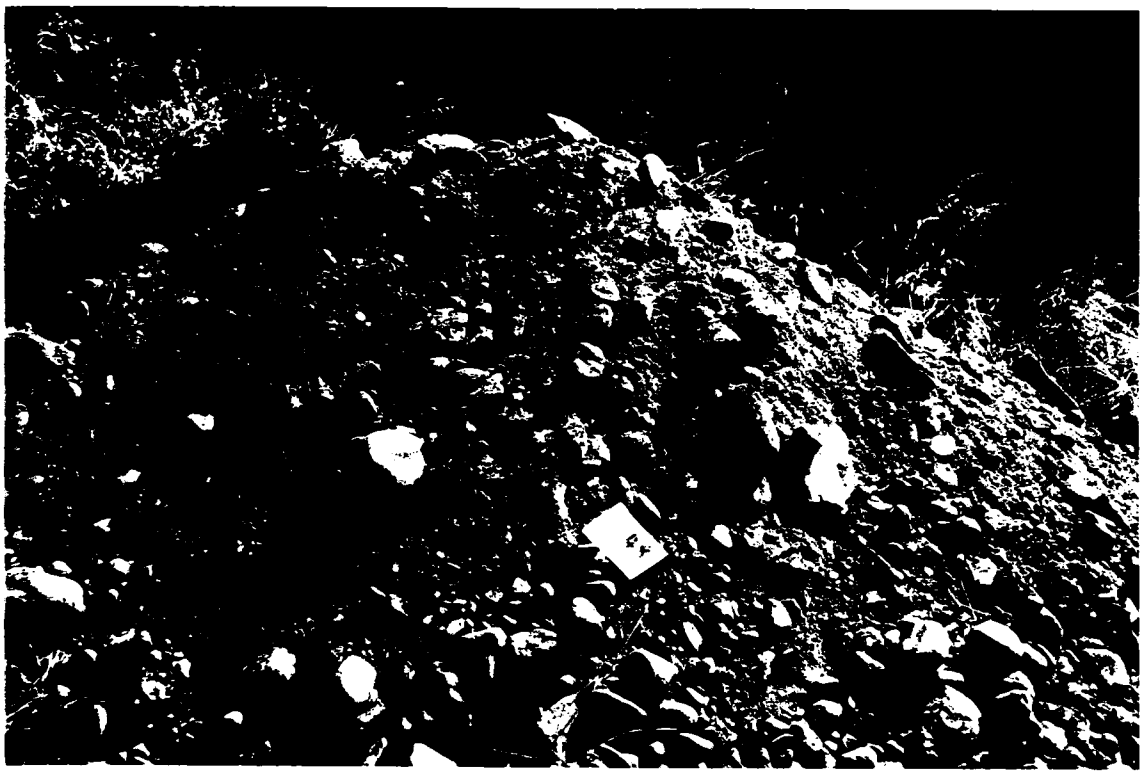
TP 47

TP 47

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



TP 48



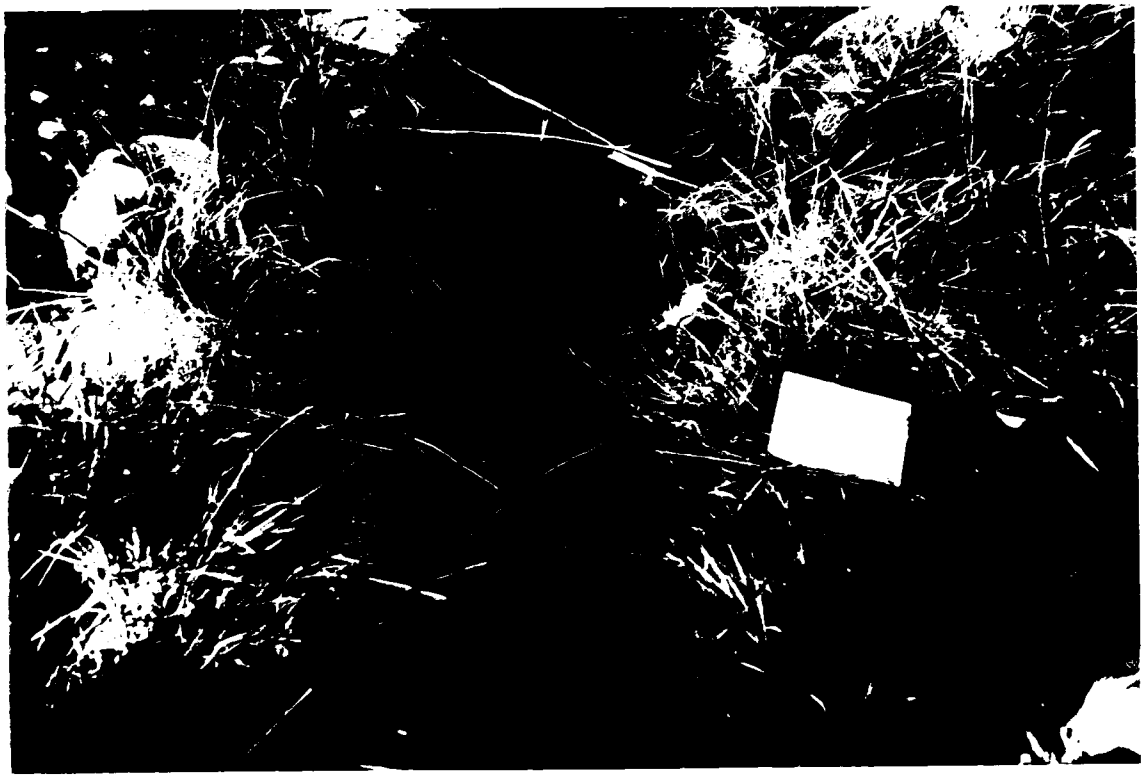
TP 48

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

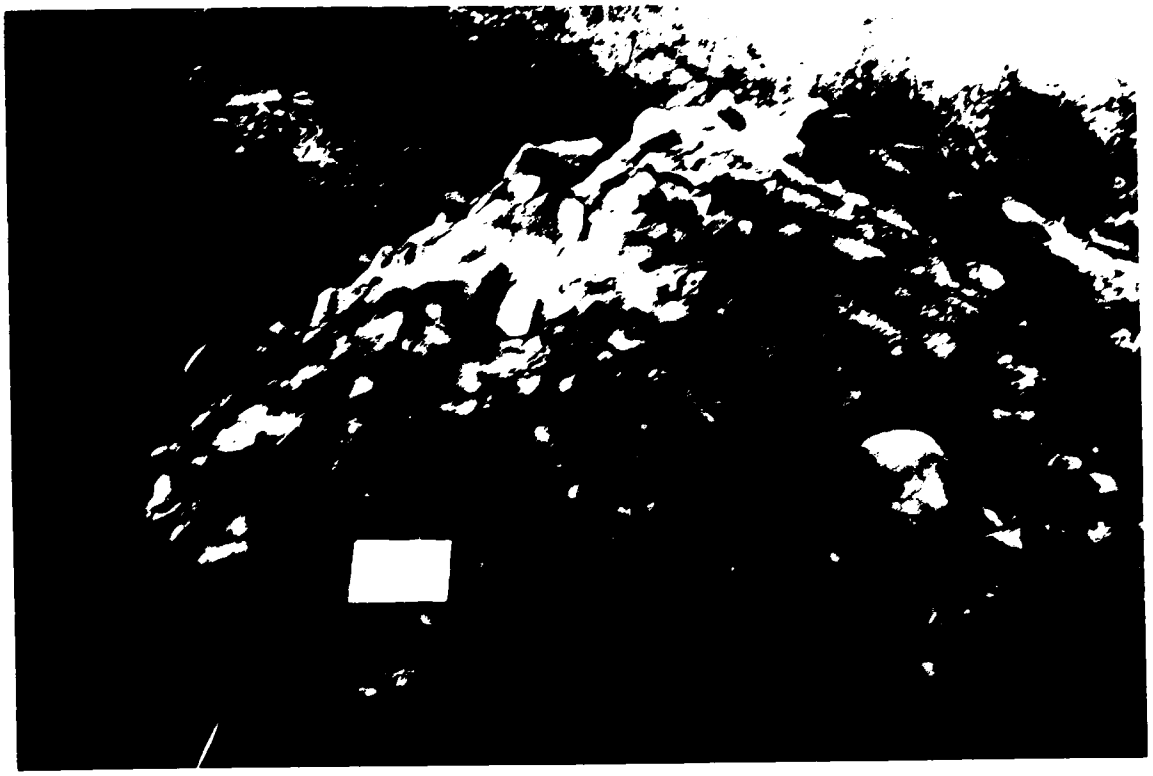
TP 49

TP 49

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

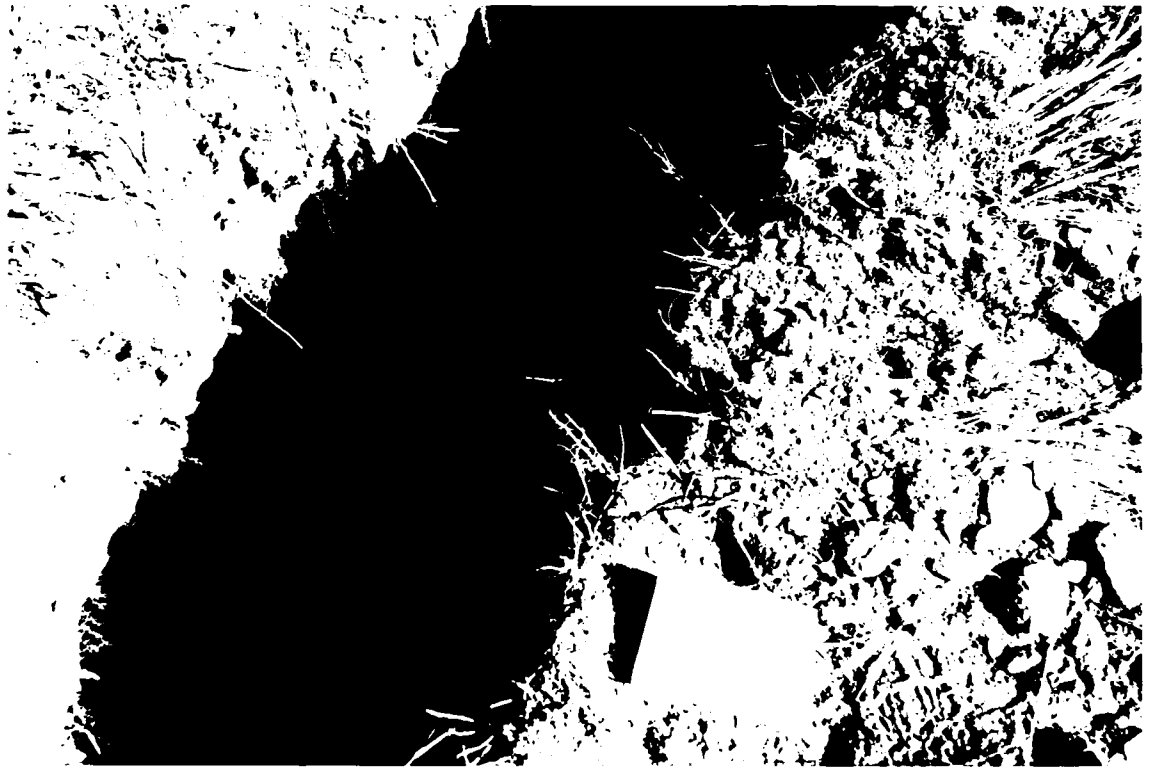


TP 50

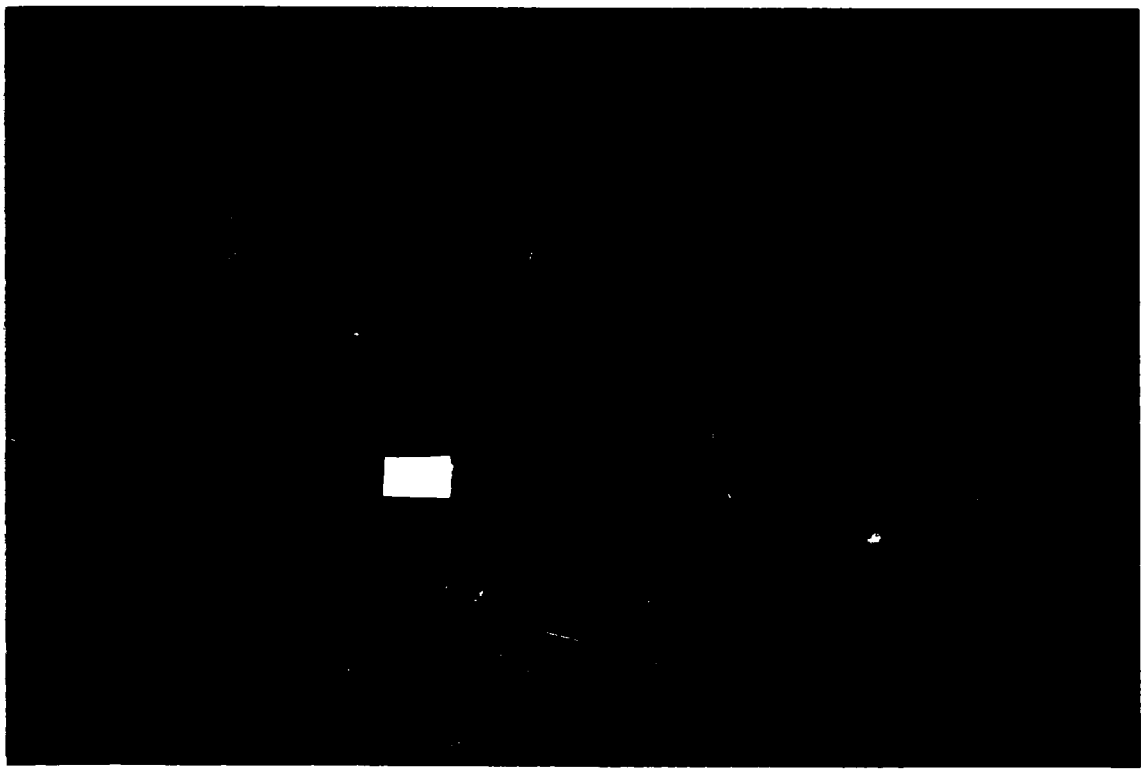


TP 50

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

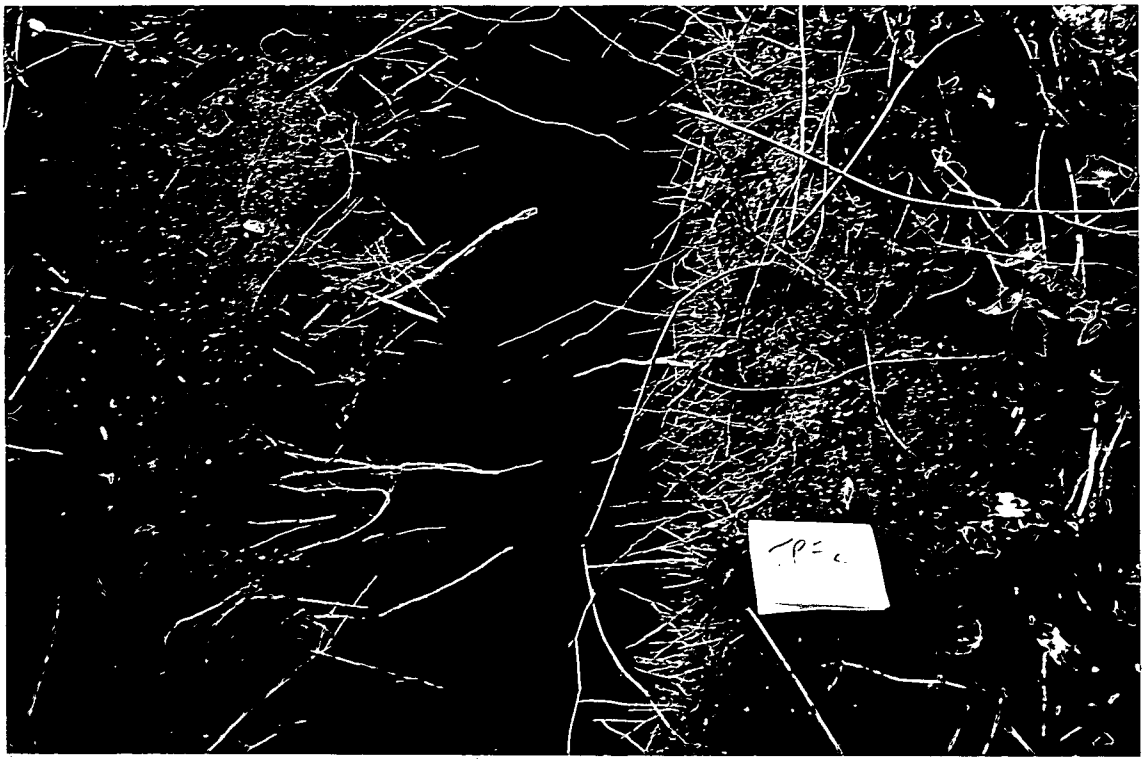


TP 51



TP 51

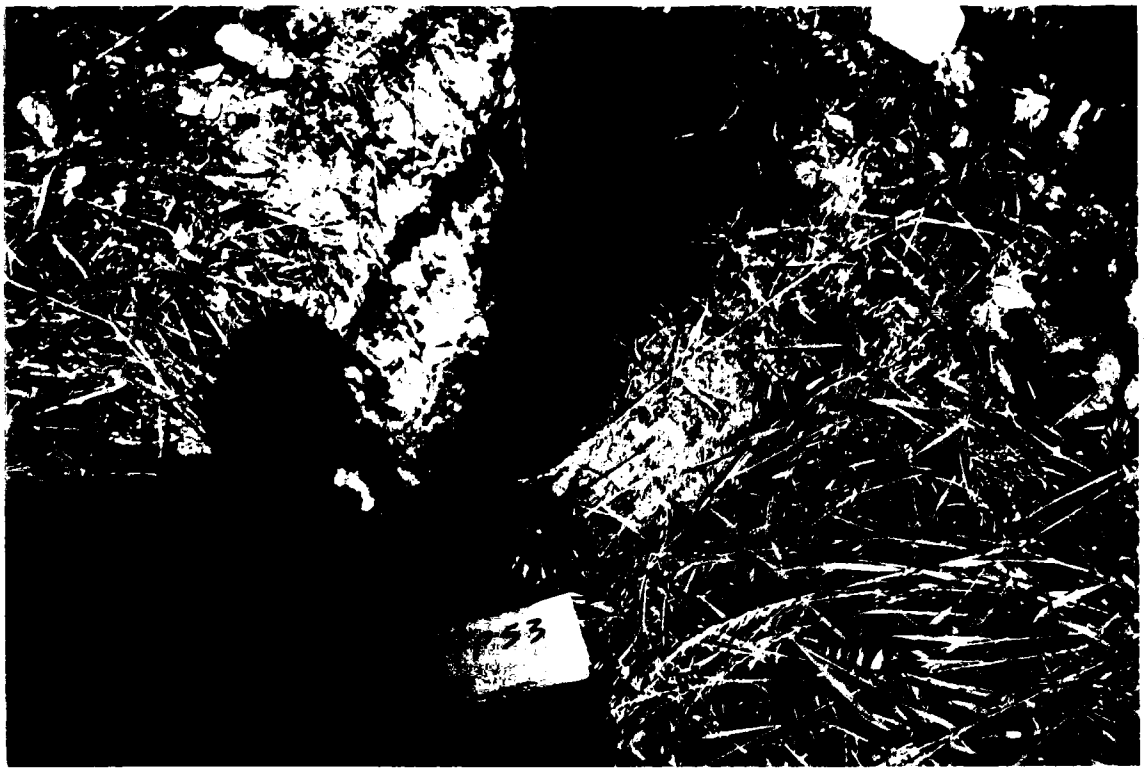
PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



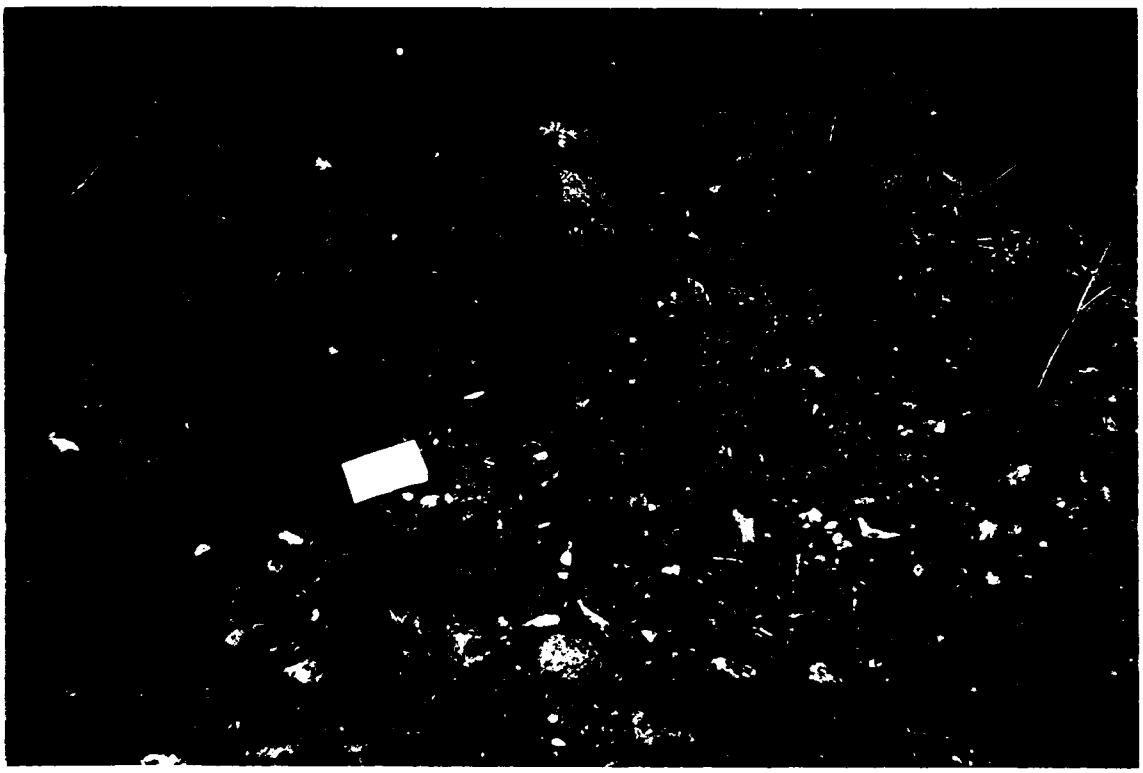
TP 52

TP 52

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE



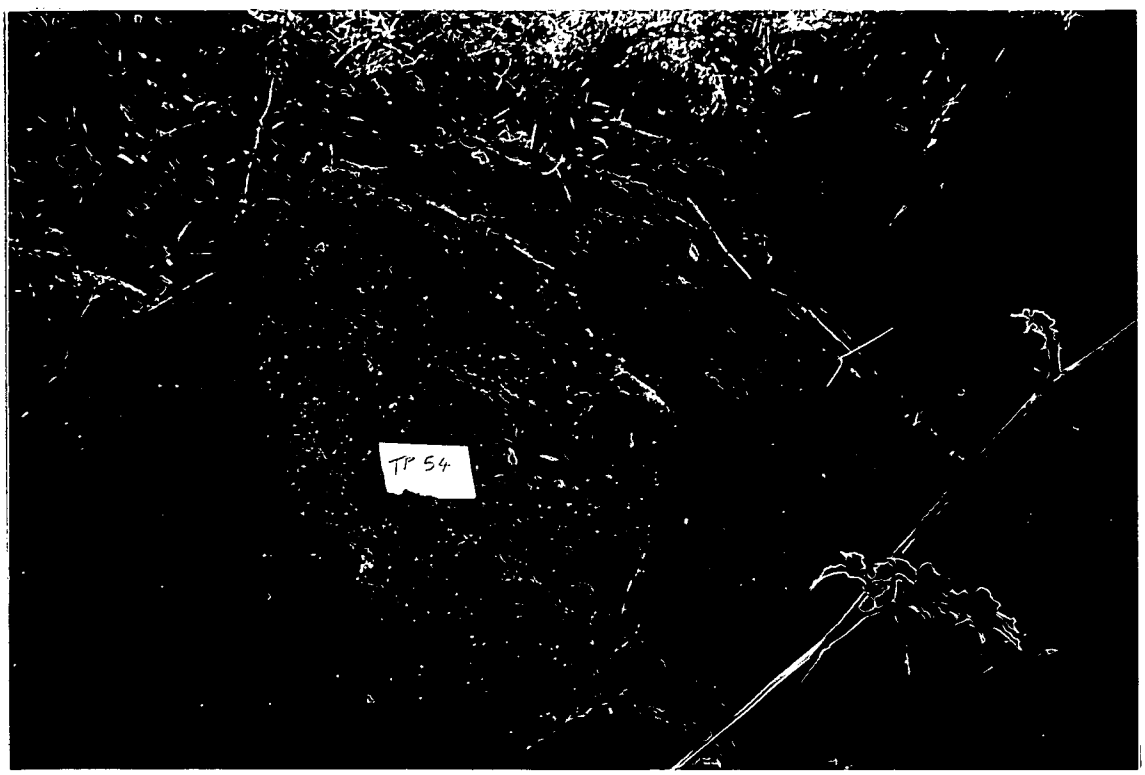
TP 53



TP 53

PROPOSED DEVELOPMENT AT LA VALLEE, FASSAROE

TP 54



TP 54

APPENDIX 4

INSITU TEST RESULTS

Incremental Loading Test

Test Location :	1A
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.6m
Date :	16th. August, 2001

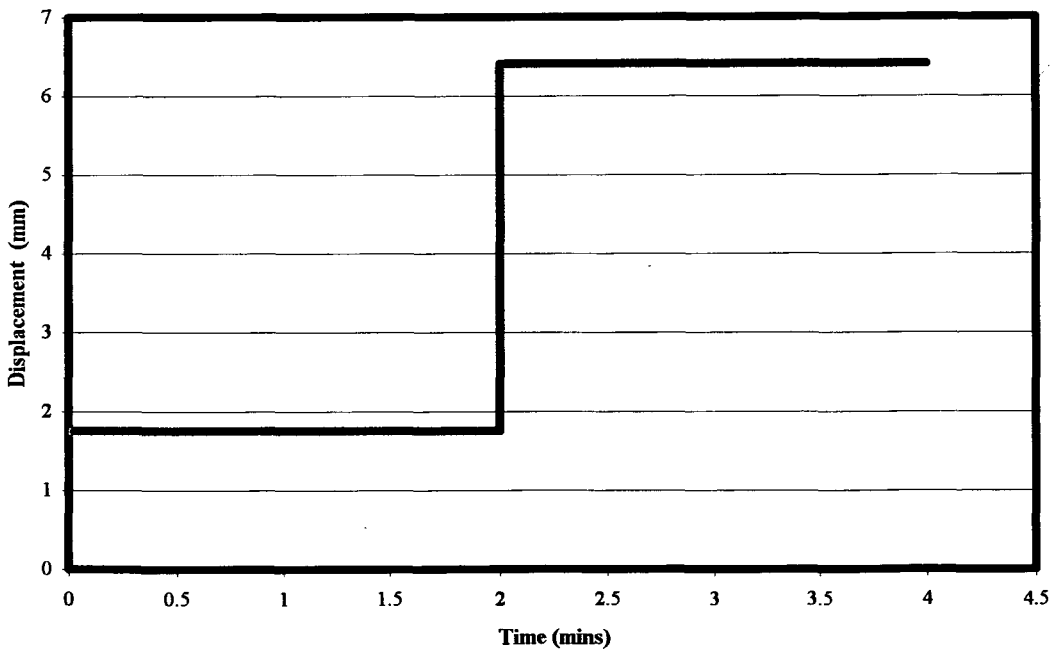


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	70 kPa	87.5 kPa
0.00		1.75		
0.50		1.75		
1.00		1.75		
2.00		1.75	6.40	
2.50			6.40	
3.00			6.40	
4.00			6.40	
4.50				Jacking up Excavator
5.00				
6.00				

Fig. 2 - Table of results

Incremental Loading Test

Test Location :	1B
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.55m
Date :	16th. August, 2001

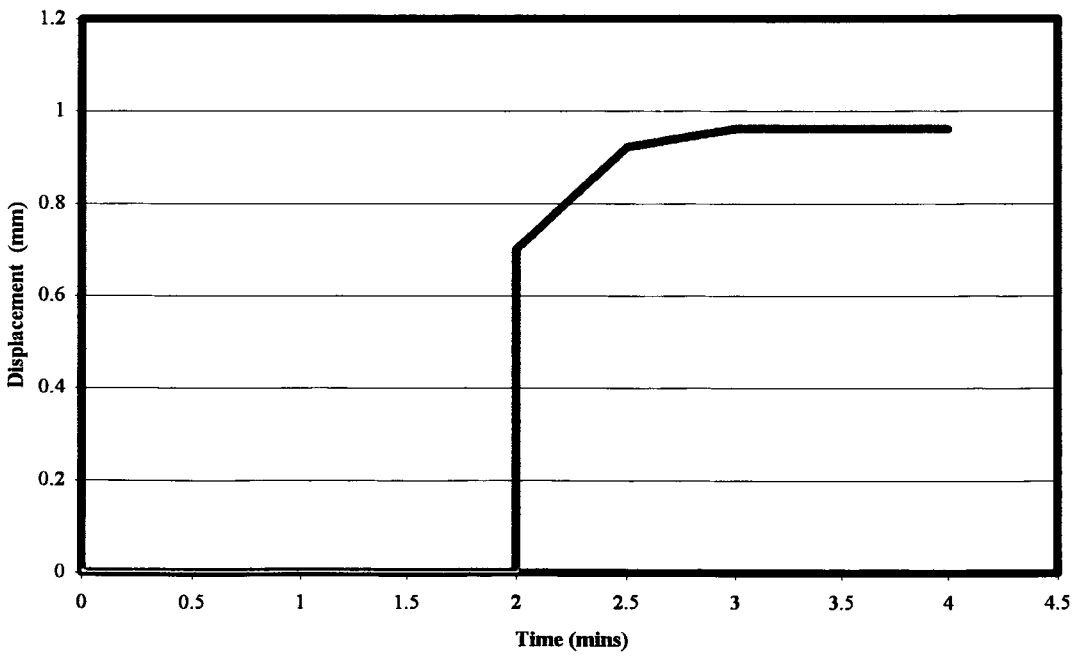


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	70 kPa	87.5 kPa
0.00		0.00		
0.50		0.00		
1.00		0.00		
2.00		0.00	0.70	
2.50			0.92	
3.00			0.96	
4.00			0.96	
4.50				Jacking
5.00				up
6.00				Excavator

Fig. 2 - Table of results

Incremental Loading Test

Test Location : 2
Plate Diameter : 0.6m
Reaction Load : JCB 3cx Excavator
Depth of test (bgl) : 0.6m
Date : 16th. August, 2001

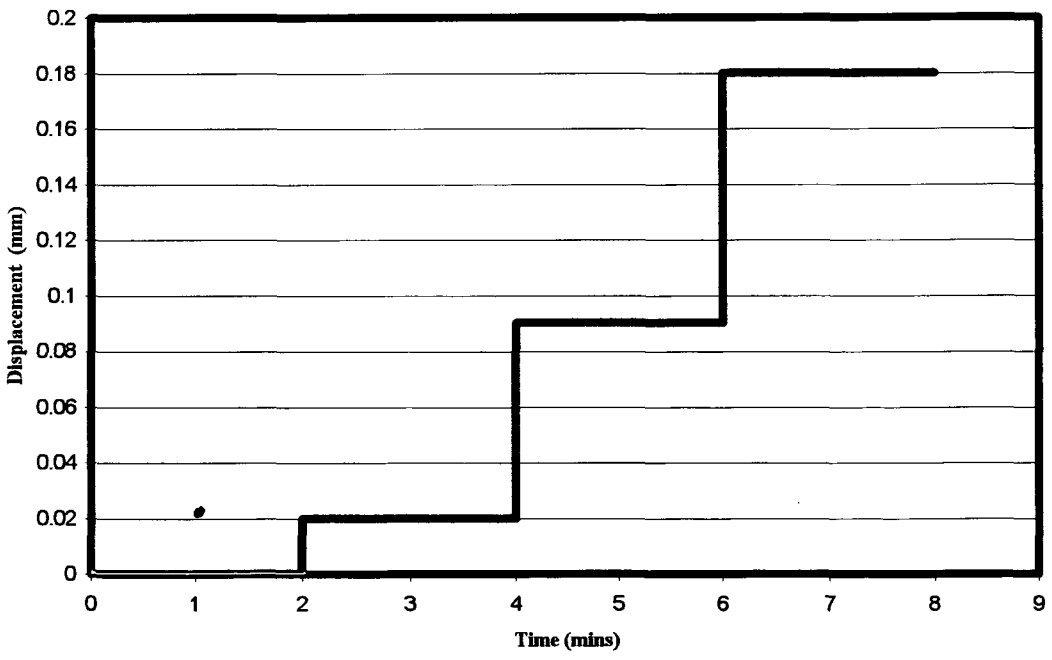


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	45.5 kPa	70 kPa	87.5 kPa
0.00		0.00			
0.50		0.00			
1.00		0.00			
2.00		0.00	0.02		
2.50			0.02		
3.00			0.02		
4.00			0.02	0.09	
4.50				0.09	
5.00				0.09	
6.00				0.09	0.18
6.50					0.18
7.00					0.18
8.00					0.18

Fig. 2 - Table of results

La Vallee – Fassaroe, Co. Wicklow

Incremental Loading Test

Test Location :	3
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.6m
Date :	16th. August, 2001

Note : The plate recovered to 0.25mm after the load was removed.

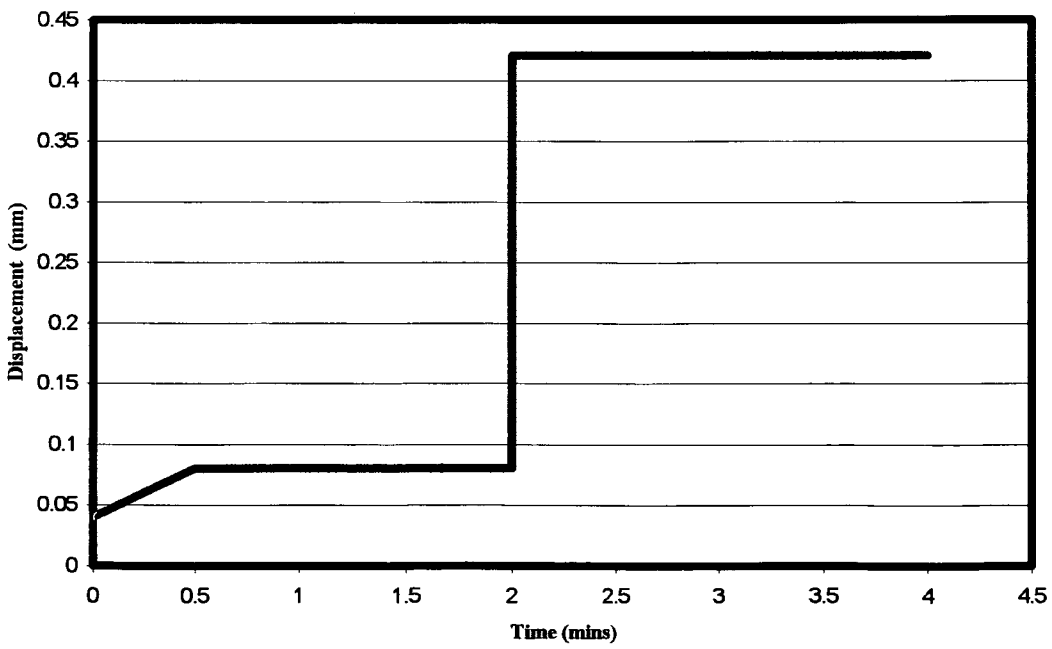


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	70 kPa
0.00		0.04	
0.50		0.08	
1.00		0.08	
2.00		0.08	0.42
2.50			0.42
3.00			0.42
4.00			0.42

Fig. 2 - Table of results

Incremental Loading Test

Test Location :	4
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.6m
Date :	16th. August, 2001

Note : The plate recovered to 0.00mm after the load was removed.

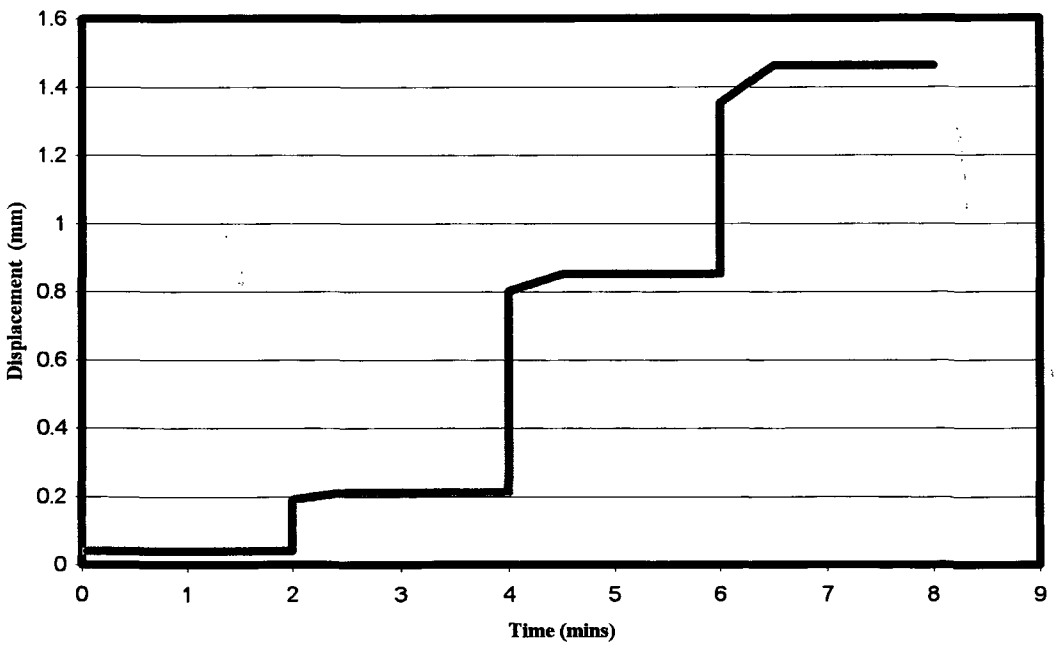


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	52.5 kPa	70 kPa	82.25 kPa
0.00		0.04			
0.50		0.04			
1.00		0.04			
2.00		0.04	0.19		
2.50			0.21		
3.00			0.21		
4.00			0.21	0.80	
4.50				0.85	
5.00				0.85	
6.00				0.85	1.35
6.50					1.46
7.00					1.46
8.00					1.46

Fig. 2 - Table of results

Incremental Loading Test

Test Location :	5
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.6m
Date :	16th. August, 2001

Note : The plate recovered to 1.10mm after the load was removed.

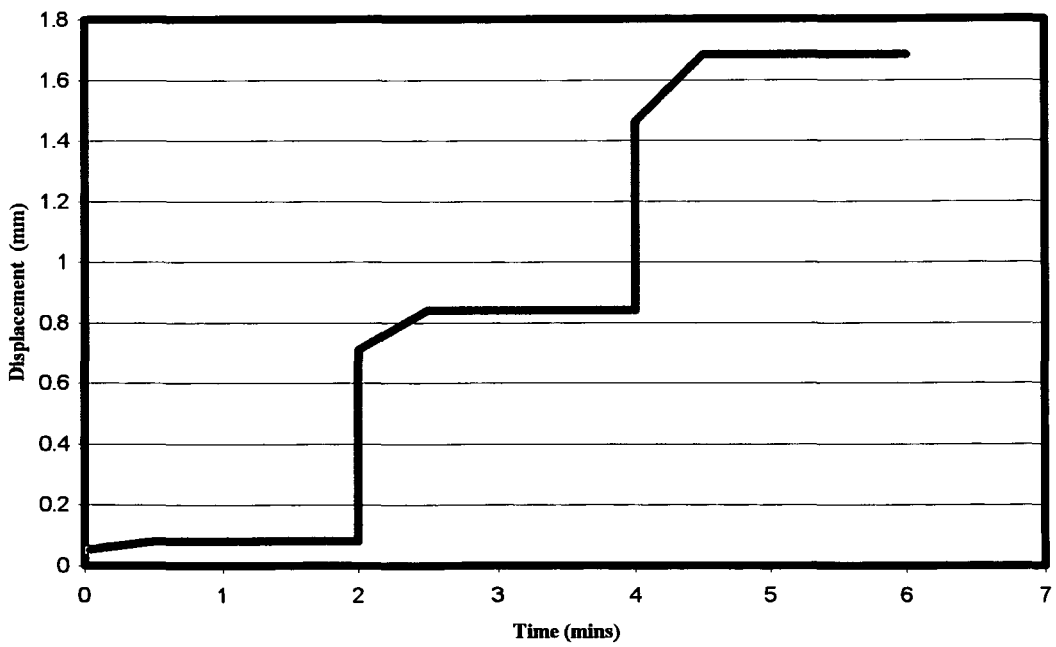


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	52.5 kPa	70 kPa	87.5 kPa
0.00		0.05			
0.50		0.08			
1.00		0.08			
2.00		0.08	0.71		
2.50			0.84		
3.00			0.84		
4.00			0.84	1.46	
4.50				1.68	
5.00				1.68	
6.00				1.68	
6.50					Jacking up Excavator
7.00					
8.00					

Fig. 2 - Table of results

Incremental Loading Test

Test Location :	6
Plate Diameter :	0.6m
Reaction Load :	JCB 3cx Excavator
Depth of test (bgl) :	0.6m
Date :	16th. August, 2001

Note : The plate recovered to 0.40mm after the load was removed.

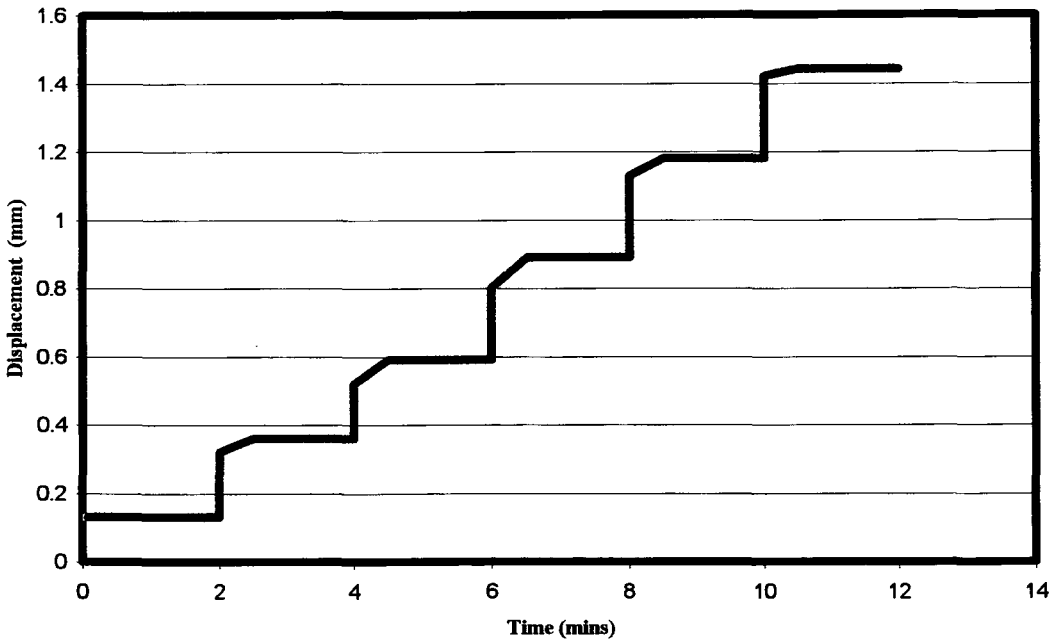


Fig. 1 - Showing Displacement (mm) against Time taken (mins)

Time (mins)		35 kPa	43.75 kPa	52.5 kPa	61.25 kPa	70 kPa	75.25 kPa
0.00		0.13					
0.50		0.13					
1.00		0.13					
2.00		0.13	0.32				
2.50			0.36				
3.00			0.36				
4.00			0.36	0.52			
4.50				0.59			
5.00				0.59			
6.00				0.59	0.80		
6.50					0.89		
7.00					0.89		
8.00					0.89	1.13	
8.50						1.18	
9.00						1.18	
10.00						1.18	1.42
10.50							1.44
11.00							1.44
12.00							1.44

Fig. 2 - Table of results

APPENDIX 5

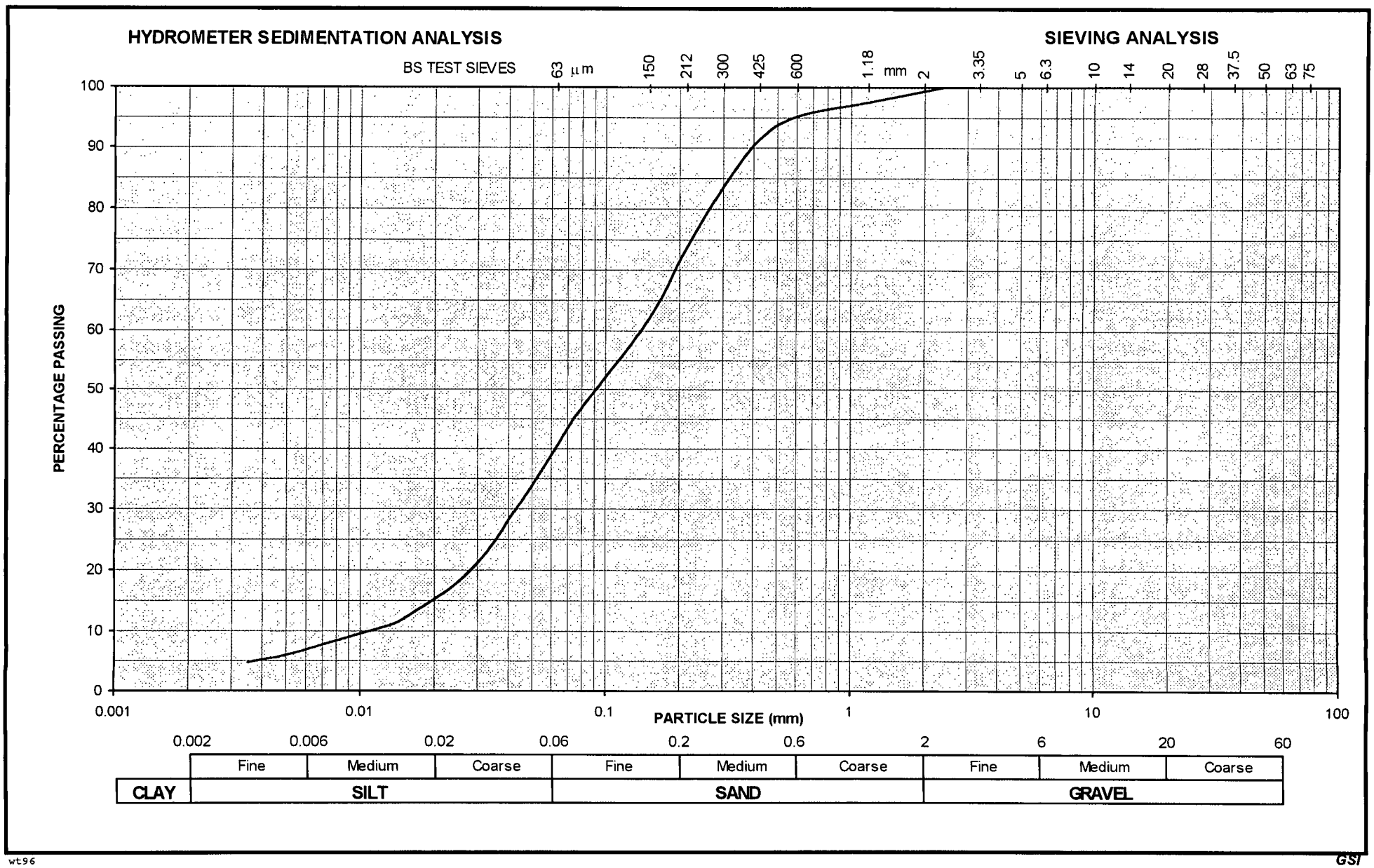
LABORATORY TEST RESULTS

PARTICLE SIZE DISTRIBUTION

CONTRACT: La Vallee, Fassaroe, Co.Wicklow.
TRIAL HOLE No.: TP40

SAMPLE No.: B1
SAMPLE DEPTH: 1.00m

Tests 9.2 & 9.5 of BS1377 : Part 2 : 1990



wt96

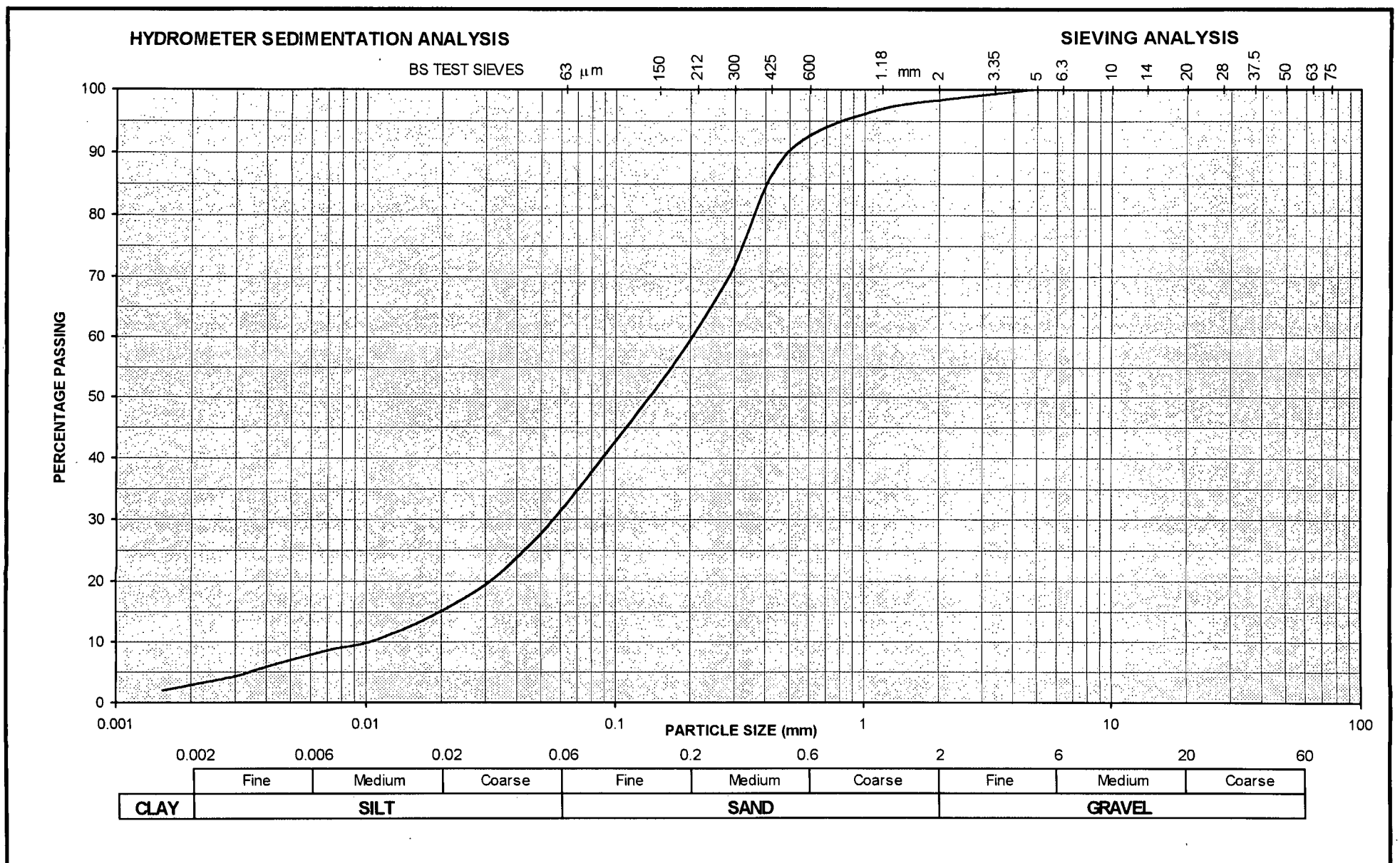
GSI

PARTICLE SIZE DISTRIBUTION

CONTRACT: La Vallee, Fassaroe, Co.Wicklow.
TRIAL HOLE No.: TP40

SAMPLE No.: B3
SAMPLE DEPTH: 2.50m

Tests 9.2 & 9.5 of BS1377 : Part 2 : 1990

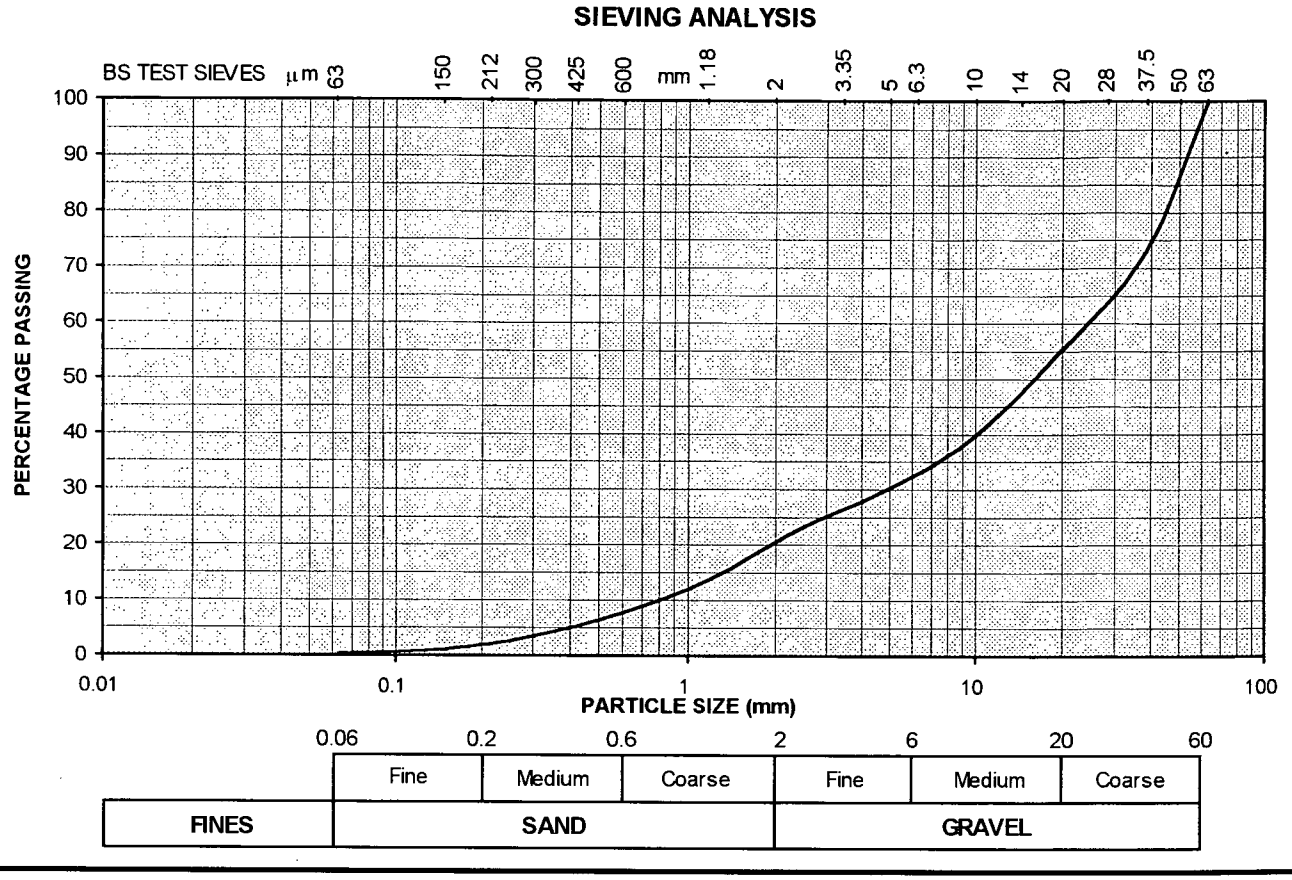


wt96

GSI

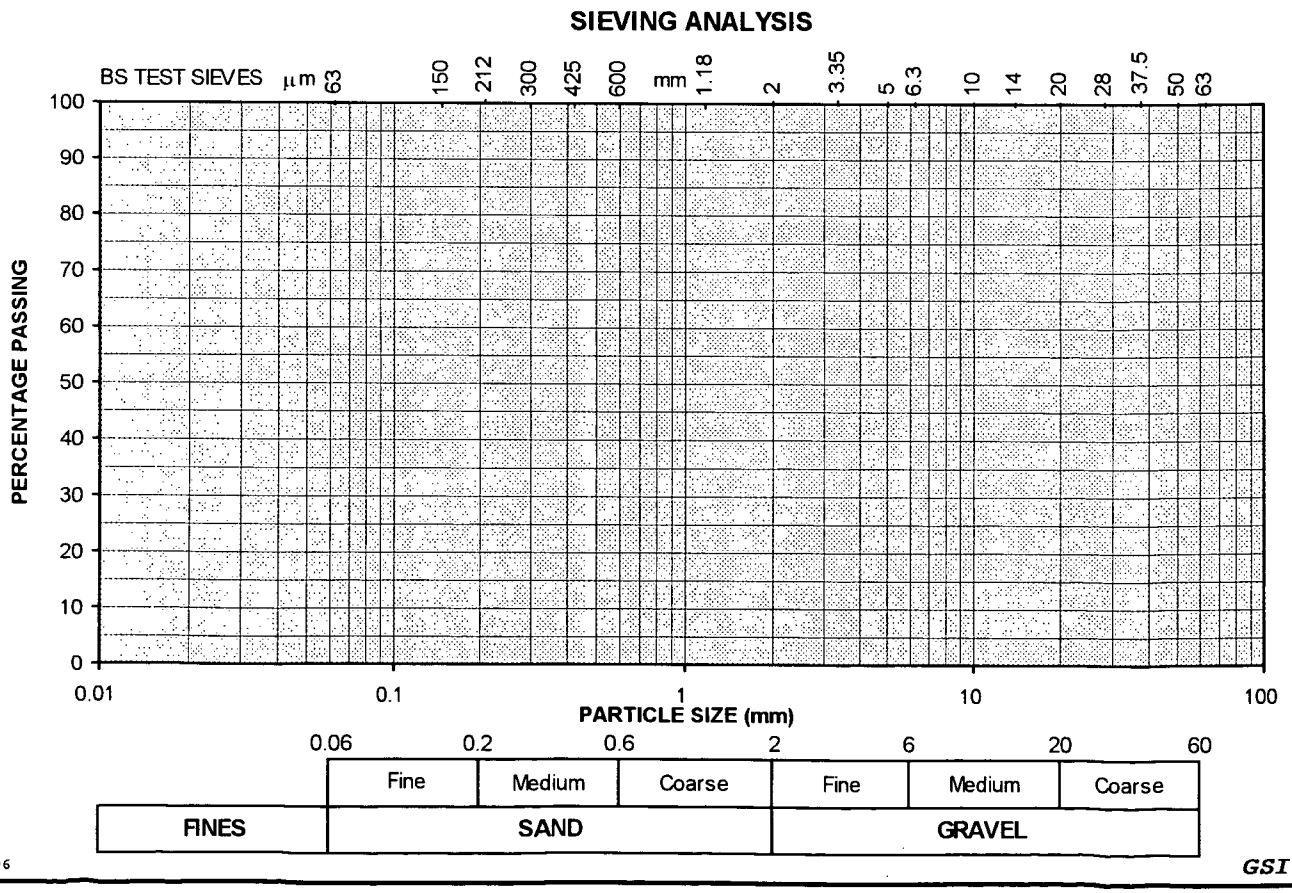
SIEVING ANALYSIS

CONTRACT: N6 KINNEGAD TO ATHLONE DUAL CARRIAGEWAY - PRELIMINARY G.I. **SAMPLE No.:** B2
TRIAL HOLE No.: TP41 **SAMPLE DEPTH:** 2.00m



Tests 9.2 & 9.3 of BS 1377 : Part 2 : 1990

CONTRACT: **SAMPLE No.:**
TRIAL HOLE No.: **SAMPLE DEPTH:**



wt96

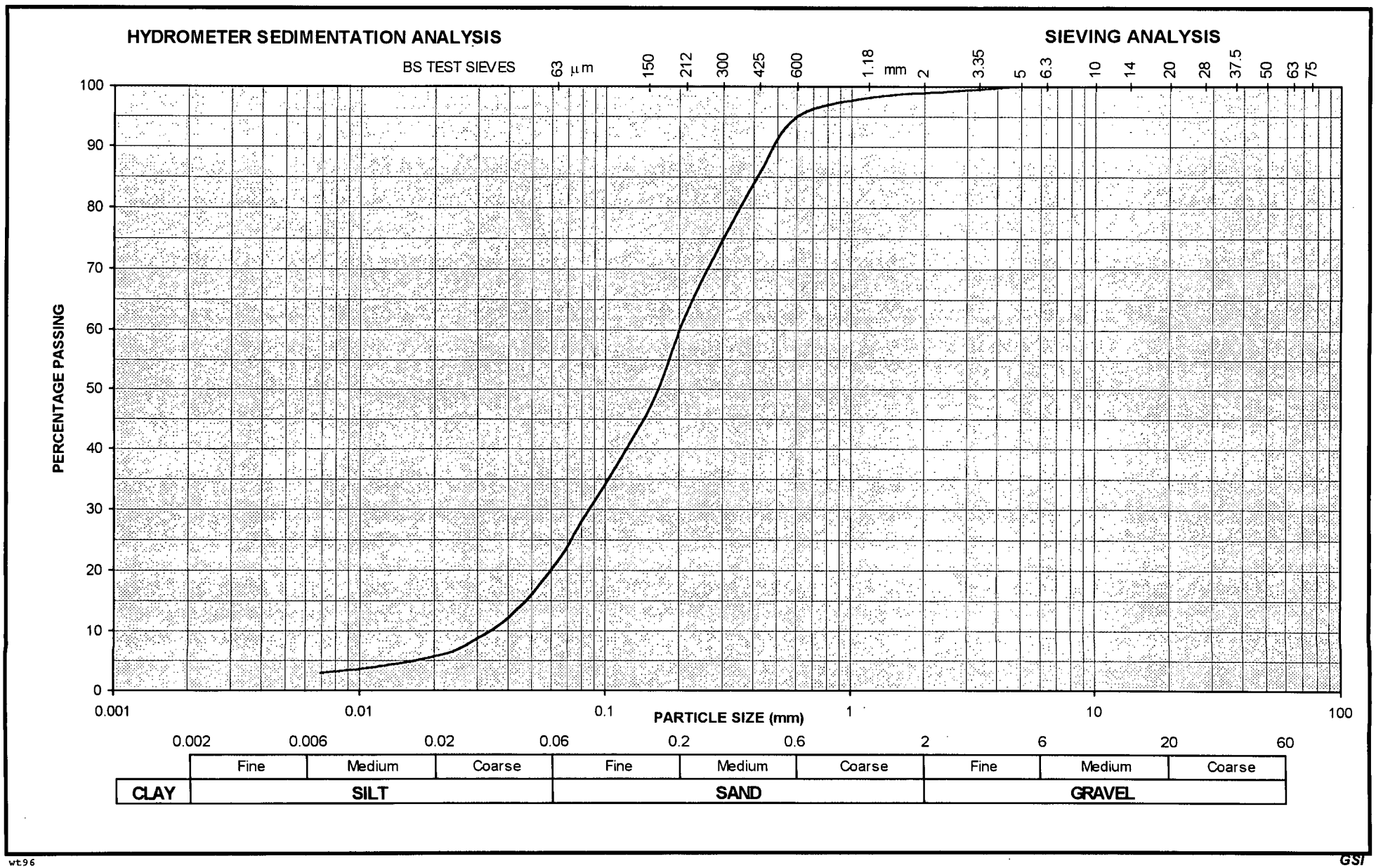
GSI

PARTICLE SIZE DISTRIBUTION

CONTRACT: La Vallee, Fassaroe, Co.Wicklow.
TRIAL HOLE No.: TP45

SAMPLE No.: B1
SAMPLE DEPTH: 1.00m

Tests 9.2 & 9.5 of BS1377 : Part 2 : 1990

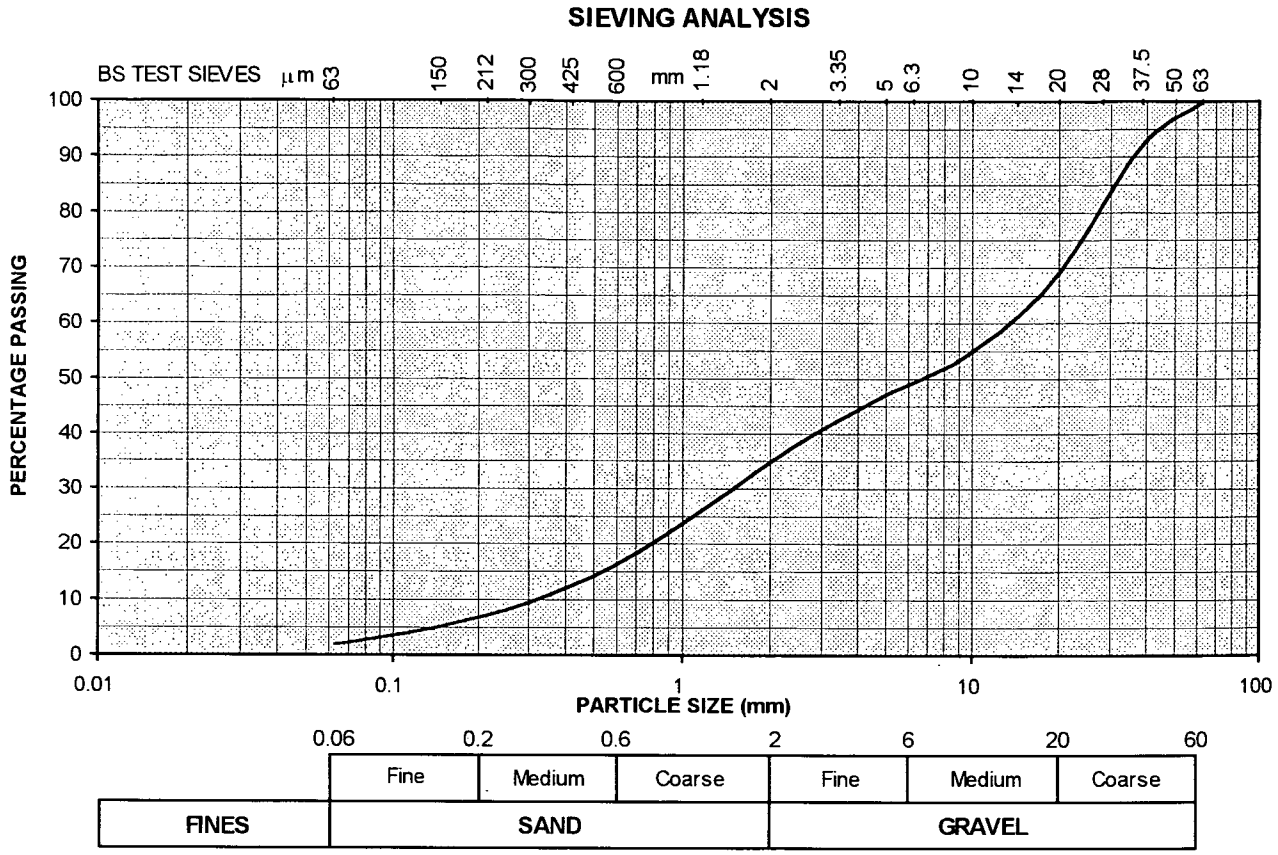


wt96

GSI

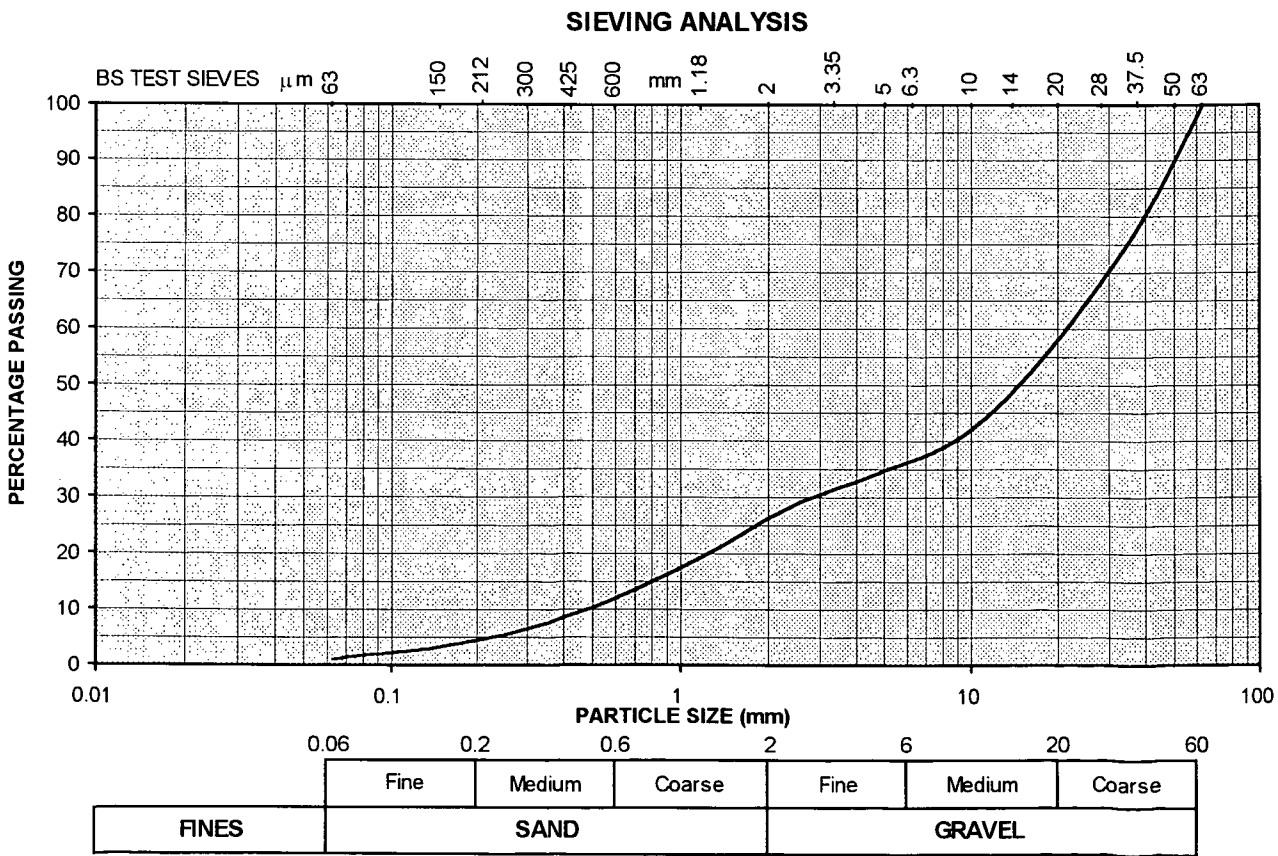
SIEVING ANALYSIS

CONTRACT: N6 KINNEGAD TO ATHLONE DUAL CARRIAGEWAY - PRELIMINARY G.I. **SAMPLE No.:** B1
TRIAL HOLE No.: TP49 **SAMPLE DEPTH:** 1.00m



Tests 9.2 & 9.3 of BS 1377 : Part 2 : 1990

CONTRACT: N6 KINNEGAD TO ATHLONE DUAL CARRIAGEWAY - PRELIMINARY G.I. **SAMPLE No.:** B2
TRIAL HOLE No.: TP50 **SAMPLE DEPTH:** 2.00m



wt96

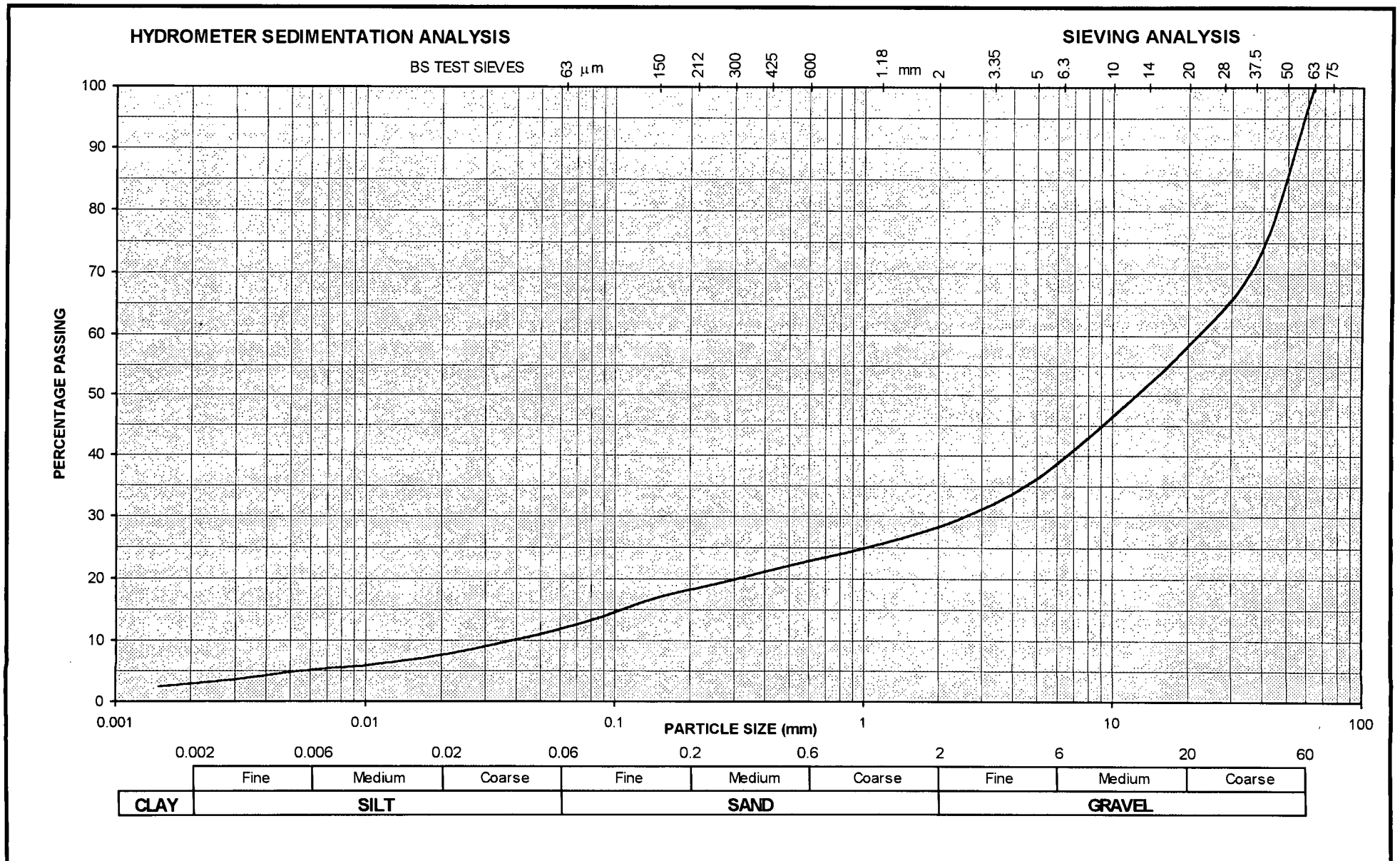
GSI

PARTICLE SIZE DISTRIBUTION

CONTRACT: La Vallee, Fassaroe, Co.Wicklow.
TRIAL HOLE No.: TP51

SAMPLE No.: B3
SAMPLE DEPTH: 2.80m

Tests 9.2 & 9.5 of BS1377 : Part 2 : 1990



wt96

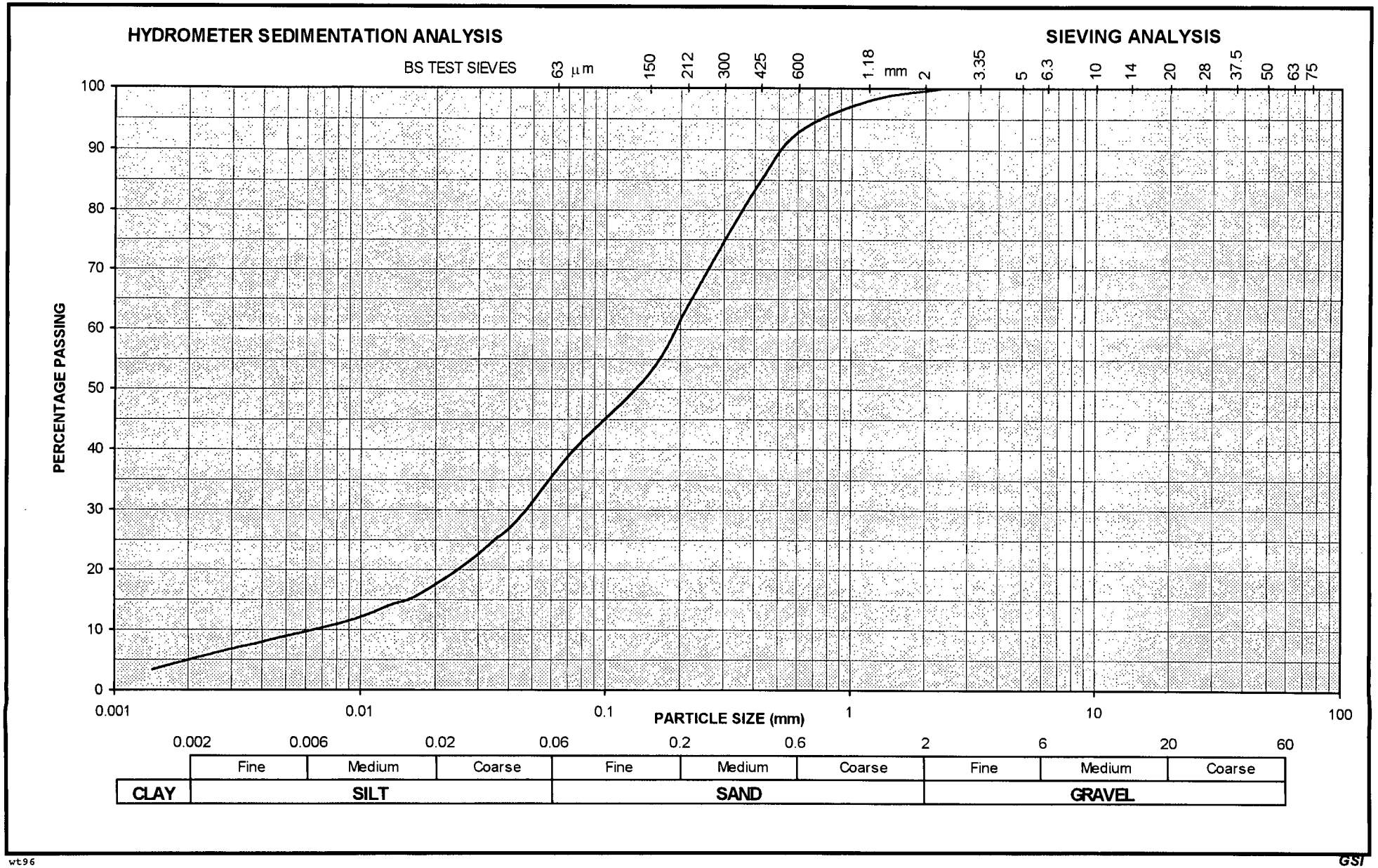
GSI

PARTICLE SIZE DISTRIBUTION

CONTRACT: La Vallee, Fassaroe, Co.Wicklow.
TRIAL HOLE No.: TP54

SAMPLE No.: B1
SAMPLE DEPTH: 1.00m

Tests 9.2 & 9.5 of BS1377 : Part 2 : 1990



wt96

GSI

PROPOSED DEVELOPMENT AT LA VALEE, FASSAROE
GEOTECHNICAL INVESTIGATION

CHEMICAL TESTS
Tests 3, 4, 5 & 9 of BS 1377 : Part 3 : 1990

T.H. No.	Sample Type	Sample No.	Sample Depth (m)	Passing 2mm Sieve (%)	Organic Matter Content * (%)	Mass Loss on Ignition # (%)	Sulphate Content SO_4		pH Value φ
							Soil/water extract $ (g/l)	Groundwater (g/l)	
TP 41	B	1	1.0				0.084		7.5
TP 51	J	1	0.5				0.048		7.5

* Walkley and Black's dichromate method in accordance with Clause 3 of BS 1377 : Part 3 : 1990.

\# Average of three specimens tested in accordance with Clause 4 of BS 1377 : Part 3 : 1990.

$ Water soluble sulphate from 2:1 water - soil extract in accordance with Clause 5.5 of BS 1377 : Part 3 : 1990.

φ Average of two/three specimens tested in accordance with Clause 9.5 of BS 1377 : Part 3 : 1990.

APPENDIX 6F

M11 Interchange SIGI N11 interch May 2000

N11 FASSAROE INTERCHANGE

PRELIMINARY GEOTECHNICAL INVESTIGATION

1.0 AUTHORITY

2.0 SCOPE

3.0 FIELD WORK

- 3.1 Shell and Auger Boreholes
- 3.2 Rotary Cored Boreholes
- 3.3 Trial Pits
- 3.4 Insitu Testing
- 3.5 Instrumentation
- 3.6 Photographs

4.0 LABORATORY WORK

REFERENCES

APPENDIX 1 SITE AND EXPLORATORY HOLE LOCATION PLAN

APPENDIX 2 EXPLORATORY HOLE LOGS

APPENDIX 3 LABORATORY TEST RESULTS

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T111

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	E324616 N217497	ATKINS McCARTHY	

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
Weak to moderately weak brown and grey thinly laminated fine grained SHALE. Highly to moderately weathered.	(1.20)			0.50	J			
				1.00	J			
END OF PIT 1.2m	1.20						dry:04/05/00	

Plan

Remarks

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3690.T111	T111

N11 FASSAROE INTERCHANGE

PRELIMINARY GEOTECHNICAL INVESTIGATION

1.0 AUTHORITY

On the instructions of Atkins McCarthy, Consulting Engineers, Glover Site Investigations Ltd, were appointed to undertake a preliminary geotechnical investigation at the N11 Fassaroe Interchange near Bray, Co. Wicklow (Appendix 1).

2.0 SCOPE

The main purpose of the ground investigation was to ascertain information on the engineering characteristics and distribution of the soil/rock deposit and groundwater conditions, by means of trial pits, shell and auger boreholes and rotary core holes, with associated soil sampling and testing.

A factual report only was specified.

The investigation was undertaken in accordance with guidance presented in the British Standard Codes of Practice BS 5930 (1999) and BS 1377 (1990).

3.0 FIELD WORK

The field work for the investigation was undertaken during the period 4 May to 11 May 2000 under the supervision of an engineer from Glover Site Investigations Ltd.

3.1 Shell & Auger Boreholes

A total of 3 No. 200mm diameter boreholes were excavated to a maximum depth of 9.0m by means of a Pilcon Wayfarer 1500 Soil boring rig.

Samples obtained for geotechnical testing included disturbed small jar and bulk bag samples and undisturbed U100 open tube samples.

APPENDIX 3

LABORATORY TEST RESULTS

3.2 Rotary Cored Boreholes

A total of 1 No. rotary cored borehole was drilled as a continuation of shell and auger BH 103, terminated within the weathered rockhead. Temporary casing was installed to allow rotary coring to start at the base of drift deposits.

Coring was undertaken using an Atlas Copco D750 coring rig, water flush and a metric T2 86 core barrel, to produce core of nominal diameter 72mm.

3.3 Trial Pits

A total of 11 No. trial pits were excavated to a maximum depth of 3.2m by means of mechanical excavator. Soil samples obtained took the form of disturbed small jar and large bulk bag samples.

3.4 Insitu Testing

Insitu testing in soils bores took the form of the Standard Penetration Test (SPT), using either a split barrel sampler (SPT) or solid 60º cone (CPT), to enable measurement of the penetration resistance (N) to be determined under dynamic loading.

An exploratory hole location plan is presented in Appendix 1 and exploratory hole logs for each borehole in Appendix 2.

3.5 Instrumentation

On the instructions of the Engineer standpipe piezometers were installed in each of the boreholes excavated.

Installation details and groundwater details as measured during and after the field work period are presented in instrumentation logs accompanying each borehole.

3.6 Photographs

Photographic plates of all trial pits and rock cores obtained are presented under separate cover.

N11 FASSAROE INTERCHANGE

POINT LOAD STRENGTH TEST RESULTS

BH/ TP	Core Run/Depth A=Axial D=Diametral I = Irregular	W (mm)	D (mm)	D' (mm)	P (kN)	D^2e (mm^2)	De (mm)	Is (MPa)	F	Is (50) (MPa)	Remarks
											Definition as per Broch and Franklin
TP 111	0.5 (I)	60	22	20	1.13	1527	39.1	0.74	0.89	0.66	Moderately weak
TP 111	0.5 (I)	70	25	23	1.21	2050	45.3	0.59	0.96	0.56	Moderately weak
BH 101	7.8 (I)	50	30	25	7.00	1250	35.3	5.60	0.85	4.78	Strong to very strong
BH 101	7.8 (I)	30	34	29	8.20	1108	33.3	7.4	0.83	6.16	Strong to very strong
BH 102	6.5 (I)	90	32	27	2.55	3093	55.6	0.82	1.04	0.86	Moderately strong
BH 103	10.6 (I)	72	55	52	2.5	4767	69.0	0.52	1.16	0.60	Moderately weak/Moderately strong
BH 103	10.6 (I)	72	55	52	1.2	4767	69.0	0.25	1.16	0.29	Moderately weak

W = core diameter (axial test) or specimen width (irregular lump test)

D = core diameter (diametral test) or specimen length (axial test/irregular lump test)

P = applied load for failure

(Diametral Test) $D^2e = D \times D'$ (D' is distance between platens at point of failure)

(Axial Test/Irregular lump test) $D^2e = {}^4/\pi\ (W \times D')$

Is = Uncorrected point load strength (P/D^2e)

Is(50) = Size corrected point load strength (Is x F)

$F = (De/50)^{0.45}$ Size correction factor for core other than 50mm diameter

4.0 LABORATORY WORK

All samples obtained during the ground investigation were transported to the soils laboratory of Glover Site Investigations Ltd in Ballymoney, Co. Antrim.

Laboratory testing scheduled by the Engineer comprised of;

Moisture Content Testing

Atterberg Limit Determination

Quick Undrained Triaxial Testing (Single and Multi-Stage)

Oedometer Consolidation Testing

Sieve and Sedimentation Analyses

Remoulded CBR Testing

Organic Content

Shear Box Testing (100mm Box)

Point Load Index Testing

All laboratory test results are presented in Appendix 3.

All rock cores obtained were logged by an experienced Engineering Geologist in accordance with the recommendations of BS 5930 (1999) and the Geological Society Engineering Group Working Party Report (1970). With respect to Solid Core Recovery (SCR) it should be noted that this index has been expressed in relation to solid core of full diameter, but not necessarily of full circumference. Fracture Index (FI), as recorded on the rotary borehole logs, has been expressed in terms of fracture frequency per metre length of core. The term non-intact is used for highly fractured of fragmented core where the rock material was recovered as fine to coarse gravel size angular fragments.

REFERENCES

1. British Standards Code of Practice for Site Investigations BS 5930 : 1981.

2. British Standards Method of Test for Soils for Civil Engineering Purposes, BS 1377 1990.

3. The logging of Rock Cores for Engineering Purposes, QJEG Vol 3 No.1 1970.

4. Broch, E and Franklin, JA The Point Load Strength Test Int.J. Rock Mech. Min Sci. Vol 9 (1972).

Glover Site Investigations Ltd

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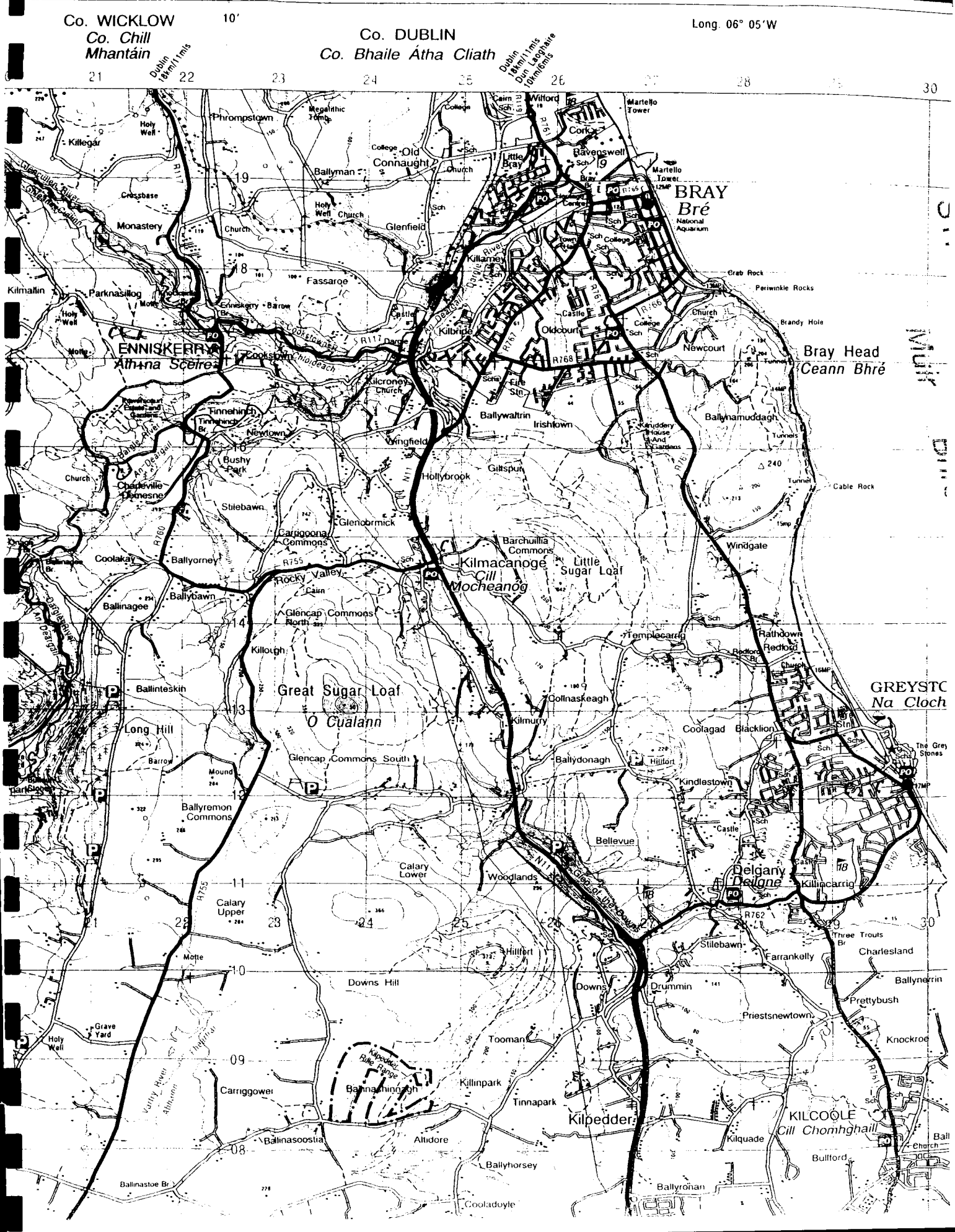
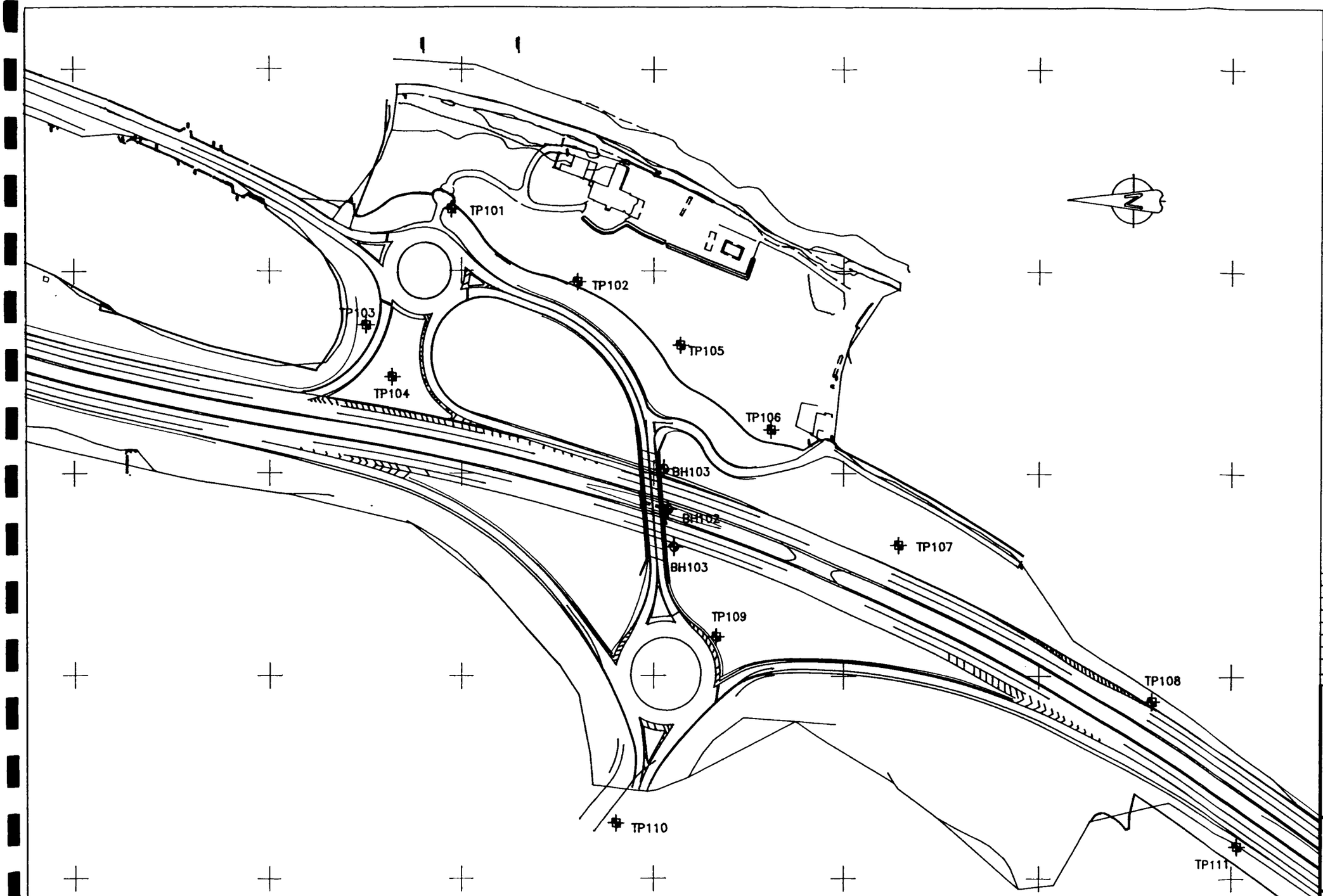
APPENDIX 1

SITE AND EXPLORATORY HOLE LOCATION PLANS


Co. WICKLOW
Co. Chill Mhantáin
Co. DUBLIN
Co. Bhaile Átha Cliath
Long. 06° 05'W
10'
Dublin 18Km/11mls
Dublin 18Km/11mls Dún Laoghaire 10Km/6mls
21
22
23
24
25
26
27
28
29
30
19
18
17
16
15
14
13
12
11
10
09
08
Killegar
Holy Well
Prompstown
Megalithic Tomb
Old Connaught
Ballyman
Cross base
Monastery
Church
Holy Well Church
Glenfield
Fassaroe
Kilmaflin
Parknasillog
Holy Well
ENNISKERRY
Áth na Sceire
Cookstown
Chibideach
Kilcroney Church
Powerscourt Estate and Gardens
Finnehinch
Tinnehinch Br.
Newtown
Bushy Park
Church
Charleville Demesne
Stilebawn
Glenormick
Carrigoona Commons
Coolakay
Ballyorney
Rocky Valley
Cairn
Ballybawn
Ballinagee
Glencap Commons North
Killough
Ballinteskin
Great Sugar Loaf
O Cualann
Long Hill
Barrow
Mound
Glencap Commons South
Ballyremon Commons
Calary Lower
Calary Upper
Motte
Downs Hill
Grave Yard
Holy Well
Carriggower
Ballinastoe Br.
Ballinasoostia
Ballyhorsey
Cooladoyle
Altidore
Kilpedder Rifle Range
Bannaghmonagh
Killinpark
Tinnapark
Kilpedder
Tooman
Hillfort
Downs
Drummin
Priestsnewtown
Kilquade
KILCOOLE
Cill Chomhghaill
Bullford
Ballyronan
Knockroe
Prettybush
Ballynerrin
Charlesland
Three Trouts Br.
Farrankelly
Stilebawn
Delgany
Deilgne
Killincarrig
Woodlands
Bellevue
Kindlestown
Hillfort
Ballydonagh
Kilmurry
Collnaskeagh
Coolagad
Blacklion
Templecarrig
Rathdown
Redford
Redford Br.
GREYSTC
Na Cloch
The Grey Stones
Windgate
Barchuillia Commons
Kilmacanoge
Cill Mocheanóg
Little Sugar Loaf
Hollybrook
Giltspur
Ballywaltrin
Irishtown
Wingfield
Ballynamuddagh
Knuddery House And Gardens
Tunnels
Cable Rock
Bray Head
Ceann Bhré
Newcourt
Brandy Hole
Crab Rock
Periwinkle Rocks
BRAY
Bré
National Aquarium
Martello Tower
Martello Tower
Ravenswell
Little Bray
Wilford
Cork
Killarney
Oldcourt
Kilbride
Castle
Fire Stn
Town Hall
College
Sch
Church
Cairn
Dargle River
An Deargáil
Bride River
Glencullen River
Owendoher River
Carrickmines River
Thingmote
Motte
Castle
Barrow
Mound
Hillfort
Tunnel
Tunnels
Fire Stn
Sch
College
Church
Grave Yard
Holy Well
Rifle Range
Bridge
Br.
Pier
Slip
Quay
Pk
Cem
Gdns
Ind Est
Sta
Stn
Ho
Mon
Obsv
Ruins
Tr Sta
Tramway
Viaduct
Aqueduct
Level Crossing
Ferry
Ford
Footbridge
Cutting
Embankment
Tunnel
Quarry
Pit
Spot Height
Boundary
Parish Boundary
County Boundary
Coastguard
Lighthouse
Lifeboat
Radio Station
Radio Mast
Radio Telescope
Windmill
Wind Pump
Water Tower
Pylon
Power Line
Pipeline
Antiquity
Site of Battle
Site of Castle
Site of Church
Site of Friary
Site of Monastery
Site of Tumulus
Site of Fort
Site of Enclosure
Site of Settlement
Site of Village
Site of Deserted Village
Site of Ring Barrow
Site of Ring Ditch
Site of Standing Stone
Site of Stone Circle
Site of Megalithic Tomb
Site of Cairn
Site of Souterrain
Site of Crannog
Site of Dun
Site of Rath
Site of Ringfort
Site of Promontory Fort
Site of Hillfort
Site of Earthwork
Site of Motte
Site of Motte and Bailey
Site of Moat
Site of Holy Well
Site of Well
Site of Spring
Site of Grave Yard
Site of Cross
Site of Cross Slab
Site of Cross Shaft
Site of Cross Base
Site of Cross Head
Site of Cross Socket
Site of Cross Fragment
Site of Cross Inscription
Site of Cross Carving
Site of Cross Relief
Site of Cross Figure
Site of Cross Animal
Site of Cross Human
Site of Cross Abstract
Site of Cross Geometric
Site of Cross Floral
Site of Cross Knotwork
Site of Cross Interlace
Site of Cross Spiral
Site of Cross Key Pattern
Site of Cross Step Pattern
Site of Cross Zigzag
Site of Cross Chevron
Site of Cross Lozenge
Site of Cross Diamond
Site of Cross Triangle
Site of Cross Square
Site of Cross Circle
Site of Cross Oval
Site of Cross Rectangle
Site of Cross Trapezium
Site of Cross Parallelogram
Site of Cross Rhombus
Site of Cross Kite
Site of Cross Hexagon
Site of Cross Octagon
Site of Cross Star
Site of Cross Crescent
Site of Cross Moon
Site of Cross Sun
Site of Cross Star
Site of Cross Comet
Site of Cross Meteor
Site of Cross Planet
Site of Cross Satellite
Site of Cross Spacecraft
Site of Cross Rocket
Site of Cross Missile
Site of Cross Bomb
Site of Cross Gun
Site of Cross Sword
Site of Cross Spear
Site of Cross Arrow
Site of Cross Bow
Site of Cross Shield
Site of Cross Armour
Site of Cross Helmet
Site of Cross Crown
Site of Cross Sceptre
Site of Cross Orb
Site of Cross Throne
Site of Cross Chair
Site of Cross Table
Site of Cross Bed
Site of Cross Lamp
Site of Cross Candle
Site of Cross Book
Site of Cross Scroll
Site of Cross Pen
Site of Cross Ink
Site of Cross Paper
Site of Cross Parchment
Site of Cross Vellum
Site of Cross Quill
Site of Cross Pencil
Site of Cross Eraser
Site of Cross Ruler
Site of Cross Compass
Site of Cross Protractor
Site of Cross Set Square
Site of Cross Calculator
Site of Cross Abacus
Site of Cross Slide Rule
Site of Cross Computer
Site of Cross Keyboard
Site of Cross Mouse
Site of Cross Monitor
Site of Cross Screen
Site of Cross Printer
Site of Cross Scanner
Site of Cross Camera
Site of Cross Lens
Site of Cross Film
Site of Cross Tripod
Site of Cross Flash
Site of Cross Battery
Site of Cross Charger
Site of Cross Cable
Site of Cross Wire
Site of Cross Plug
Site of Cross Socket
Site of Cross Switch
Site of Cross Button
Site of Cross Knob
Site of Cross Dial
Site of Cross Gauge
Site of Cross Meter
Site of Cross Clock
Site of Cross Watch
Site of Cross Timer
Site of Cross Alarm
Site of Cross Bell
Site of Cross Whistle
Site of Cross Horn
Site of Cross Drum
Site of Cross Cymbal
Site of Cross Guitar
Site of Cross Violin
Site of Cross Piano
Site of Cross Organ
Site of Cross Harp
Site of Cross Flute
Site of Cross Clarinet
Site of Cross Saxophone
Site of Cross Trumpet
Site of Cross Trombone
Site of Cross Tuba
Site of Cross Horn
Site of Cross Bassoon
Site of Cross Oboe
Site of Cross Recorder
Site of Cross Piccolo
Site of Cross Harmonica
Site of Cross Accordion
Site of Cross Concertina
Site of Cross Bagpipes
Site of Cross Uilleann Pipes
Site of Cross Tin Whistle
Site of Cross Bodhrán
Site of Cross Bones
Site of Cross Skull
Site of Cross Skeleton
Site of Cross Ribcage
Site of Cross Spine
Site of Cross Pelvis
Site of Cross Femur
Site of Cross Tibia
Site of Cross Fibula
Site of Cross Patella
Site of Cross Humerus
Site of Cross Radius
Site of Cross Ulna
Site of Cross Scapula
Site of Cross Clavicle
Site of Cross Sternum
Site of Cross Rib
Site of Cross Vertebra
Site of Cross Coccyx
Site of Cross Sacrum
Site of Cross Ilium
Site of Cross Ischium
Site of Cross Pubis
Site of Cross Femur
Site of Cross Tibia
Site of Cross Fibula
Site of Cross Patella
Site of Cross Tarsal
Site of Cross Metatarsal
Site of Cross Phalanx
Site of Cross Carpal
Site of Cross Metacarpal
Site of Cross Phalanx
Site of Cross Humerus
Site of Cross Radius
Site of Cross Ulna
Site of Cross Scapula
Site of Cross Clavicle
Site of Cross Sternum
Site of Cross Rib
Site of Cross Vertebra
Site of Cross Coccyx
Site of Cross Sacrum
Site of Cross Ilium
Site of Cross Ischium
Site of Cross Pubis



BOREHOLE LOCATIONS

TRIAL PIT LOCATIONS

Rev	Description	By	Date	Ckd'd/Auth

PURPOSE

Atkins McCarthy
Balgriffin House
Balgriffin
Dublin 17
Tel.(+353)01 8037400/8460000
Fax.(+353)01 8470310

Client
COSGRAVE PROPERTY GROUP
13 WENTWORTH TERRACE
EBLANA VILLAS

Project
N11 FASSAROE INTERCHANGE

PRELIMINARY GROUND INVESTIGATION
EXPLORATORY HOLE LOCATION PLAN

Scale
1:2000

Drawing Number
GSI/ 1739P101

Glover Site Investigations Ltd

Site: N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			Borehole Number: 101
Boring Method: Shell & Auger	Dates: 04/05/00 - 05/05/00	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Hole Diameters: 200mm Cased to 9.00m	Location: E324802 N217795	Engineer: ATKINS McCARTHY	Ground Level (mOD): 14.84

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
Dense brown and grey clayey GRAVEL containing occasional cobbles and boulders (FILL)	(1.40)			0.70-1.15 0.70 1.20	J J	CPT N=50		
Loose grey and brown clayey GRAVEL (FILL)	1.40 (1.10)		13.44	2.00-2.45 2.00-2.45	B	CPT N=5		
Stiff grey gravelly sandy friable CLAY (original TOPSOIL)	2.50 (0.50)		12.34					
Medium dense brown slightly gravelly fine to medium SAND containing decayed roots	3.00 (0.50)		11.84	3.00 3.00-3.55 3.10-3.55	J U B			
Medium dense coarse brown slightly gravelly medium to coarse SAND	3.50 (1.75)		11.34	3.60 3.70-4.15 3.70 4.70-5.15 4.70	J J J	CPT N=15 CPT N=15		
Medium dense brown very sandy fine to coarse GRAVEL containing occasional cobbles and boulders	5.25 (1.75)		9.59	5.30-5.75 5.30-5.75 6.50-6.95 6.50-6.95	B B	CPT N=18 CPT N=23	* Seepage. dry: 04/05/00 dry: 05/05/00	
Weak to moderately strong brown fine to medium grained SANDSTONE in light brown and mottled orange clay matrix	7.00 (2.00)		7.84	7.50-7.95 7.80-7.95	B	CPT N=39		
END OF BOREHOLE 9.0m	9.00		5.84	8.80-8.90 8.80-9.00	B	CPT (50)	05/05/00	

Remarks

Inspection pit excavated to 0.7m. Chiselling from 1.20m to 1.40m for 1 hour. Chiselling from 5.80m to 6.00m for 1 hour. Chiselling from 8.00m to 8.20m for 1 hour. Chiselling from 8.90m to 9.00m for 1 hour. Water added from 1.00m to 2.45m. Water added from 6.55m to 7.80m.

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale: 1:50	Logged By: RB
Figure No.: 3030.1.1	
Borehole Number: 101	

Glover Site Investigations Ltd

Site	Borehole Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	101

Installation Type	Dimensions	Client	Job Number
Standpipe Piezometer	Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 200 mm	COSGRAVE PROPERTY GROUP	3696

Location	Ground Level (mOD)	Engineer	Sheet
E324802 N217795	14.835	ATKINS McCARTHY	1/1

Legend	Inst. [A]	Level (mOD)	Depth (m)	Description
				Concrete
		13.84	1.00	
				Bent Cuttle Seal
	1	9.34	5.50	
				Sand Filter
		6.14	8.70	Piezometer Tip
		5.84	9.00	

Groundwater Strikes during Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		5.25		* Seepage					

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
04/05/00							6.00		DRY	
05/05/00				DRY			9.00			

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks
10/05/00	13.00	6.30	8.54	
11/05/00	08.30	6.30	8.54	
18/05/00	12.15	6.40	8.44	
22/05/00	13.00	6.40	8.44	

Remarks

Lockable flush cover installed.

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Glover Site Investigations Ltd

Site	Borehole Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	102

Boring Method	Dates	Client	Sheet
Shell & Auger	10/05/00 - 10/05/00	COSGRAVE PROPERTY GROUP	1/1

Hole Diameters	Location	Engineer	Ground Level (mOD)
200mm Cased to 6.50m	E324782 N217793	ATKINS McCARTHY	14.24

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
Loose to medium dense grey rounded GRAVEL (MADE GROUND - drainage layer)	(0.65)							
	0.65		13.59					
Dense brown very clayey angular GRAVEL containing cobbles and boulders (FILL)				1.00-1.45		CPT N=41		
				1.00-1.45	B			
	(1.80)							
				2.00-2.45		CPT N=42		
				2.00-2.45	B			
	2.45		11.79	2.50-2.95	U			
Firm grey brown CLAY containing thin beds of gravel				3.00	J			
				3.50-3.95	U			
	(2.75)			4.00	J			
				4.50-4.95		SPT N=13		
				4.50-4.95	J			
	5.20		9.04	5.20-5.65		CPT N=37		
Dense grey fine to coarse angular GRAVEL	(0.40)			5.20-5.65	B			
	5.60		8.64					
Weak to moderately strong brown fine to medium grained SANDSTONE								
	(0.90)			6.20-6.31		CPT (50)		
	6.50		7.74	6.50	B		dry:10/05/00	
END OF BOREHOLE 6.5m								

Remarks

Inspection pit excavated to 1.0m.
Chiselling from 1.55m to 1.95m for 1 hour. Chiselling from 6.31m to 6.50m for 1 hour. Water added from 0.65m to 2.45m. Water added from 5.20m to 6.50m.

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale	Logged By
1:50	RB

Figure No. 3696.102

Borehole Number 102

Glover Site Investigations Ltd

Site	Borehole Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	102

Installation Type	Dimensions	Client	Job Number
Standpipe Piezometer	Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 200 mm	COSGRAVE PROPERTY GROUP	3696

Location	Ground Level (mOD)	Engineer	Sheet
E324782 N217793	14.235	ATKINS McCARTHY	1/1

Legend	Inst. [A]	Level (mOD)	Depth (m)	Description
		13.24	1.00	Concrete
		9.74	4.50	Bentonite Seal
		8.54	5.70	Sand Filter
		8.24	6.00	Piezometer Tip
		7.74	6.50	Sand Filter

Groundwater Strikes during Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
10/05/00							6.50		DRY	

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks
10/05/00	13.00	DRY		
18/05/00	12.15	5.70	8.54	
22/05/00	13.00	5.70	8.54	

Remarks

Lockable flush cover installed.

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Glover Site Investigations Ltd

Site N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			**Borehole Number** 103
Boring Method Shell & Auger	**Dates** 06/05/00 - 11/05/00	**Client** COSGRAVE PROPERTY GROUP	**Sheet** 1/2
Hole Diameters 200mm Cased to 13.80m	**Location** E324763 N217790	**Engineer** ATKINS McCARTHY	**Ground Level (mOD)** 14.08

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
Dense brown and grey clayey GRAVEL containing occasional cobbles and boulders (FILL)	(1.60)			1.00-1.45 1.00-1.45	B	CPT N=48		
	1.60		12.48					
Medium dense very clayey GRAVEL (FILL)	(0.85)			2.00-2.45 2.00-2.45	B	CPT N=13		
	2.45		11.63	2.50	J			
Firm brown slightly sandy CLAY with silt on laminations and slight grey mottlings (due to decayed rootlets)				3.00-3.45	U			
	(2.15)			3.50	B			
	4.60		9.48	4.50 4.50-4.95	B U			
Firm grey laminated CLAY with silt on laminations .... becoming slightly gravelly and sandy below 5.5m	(1.95)			5.50 6.00-6.45	B U			
	6.55		7.53	6.50	J			
Weak fine grained brown thinly foliated SLATE	(1.25)			6.70-7.15 6.70-7.15 7.50-7.68 7.70	B B	CPT N=50 CPT (50)		
	7.80		6.28	7.80				
Moderately weak to weak fine to medium grained brown and black SANDSTONE. Completely to moderately weathered Locally slightly weathered. Core generally recovered non-intact as angular fine to coarse gravel sized fragments. Locally recovered as soft clay.	(2.20)			8.50 9.70			non-intact	
	10.00		4.08					

TCR	SCR	RQD	FI
93	14	0	
83	5	0	
78	0	0	

Remarks

Inspection pit excavated to 1.0m.
Slight seepages in FILL.
Chiselling from 1.50m to 1.65m for 1 hour. Chiselling from 7.68m to 7.80m for 1.5 hours. Water added from 1.25m to 2.55m. Water added from 3.45m to 6.00m.

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale 1:50	**Logged By** PB
Figure No. 360[illegible]	
Borehole Number 103	

Glover Site Investigations Ltd

Site	Borehole Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	103

Boring Method	Dates	Client	Sheet
Shell & Auger	06/05/00 - 11/05/00	COSGRAVE PROPERTY GROUP	2/2

Hole Diameters	Location	Engineer	Ground Level (mOD)
200mm Cased to 13.80m	E324763 N217790	ATKINS McCARTHY	14.08

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test		Water Level *	Daily Progress
Very weak fine to medium grained brown and black SANDSTONE. Completely to moderately weathered	(0.50) 10.50		3.58	10.15					
Moderately strong fine to medium grained SANDSTONE. Moderately to slightly weathered. Undulating rough vertical fracture evident from 10.9m - 11.1m	(0.60) 11.10		2.98	10.60	89	16	0		
Very weak brown fine to medium grained SANDSTONE. Recovered non-intact as fine to coarse angular gravel sized fragments	(2.70) 13.80		0.28	11.10	86	54	29	12	
				11.30	20	0	0	non-intact	
				12.80	30	0	0		
				13.80					

Remarks

Inspection pit excavated to 1.0m.
Slight seepages in FILL.

SAMPLE / TEST KEY

J	Disturbed Sample
B	Bulk Sample
U	Undisturbed Core Sample
P	Piston Sample
V	Field Vane Test
W	Water Sample
SPT	Standard Penetration Test
CPT	Cone Penetration Test
( )	Penetration < 300mm

Scale	Logged By
1:50	RB

Figure No. 3696.193

Borehole Number 103

Glover Site Investigations Ltd

Site	Borehole Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	103

Installation Type	Dimensions	Client	Job Number
Standpipe Installation	Internal Diameter of Tube (A) = 19 mm Diameter of Filter Zone = 86 mm	COSGRAVE PROPERTY GROUP	3696

Location	Ground Level (mOD)	Engineer	Sheet
E324763 N217790	14.075	ATKINS McCARTHY	1/1

Legend	Inst. [A]	Level (mOD)	Depth (m)	Description
				Concrete
		13.08	1.00	
				Bentonite Seal
		6.08	8.00	
				Sand Filter
		1.88	12.20	
		1.58	12.50	Piezometer Tip
				Sand Filter
		0.28	13.80	

Groundwater Strikes during Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks
11/05/00	16.40	6.70	7.38	
12/05/00	08.00	6.20	7.88	
18/05/00	12.15	3.35	10.73	
22/05/00	13.00	3.40	10.68	

Remarks

Lockable flush cover installed.

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Site N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			**Trialpit Number** T101
Boring Method RUBBER TYRED EXCAVATOR	**Dates** 04/05/00 - 04/05/00	**Client** COSGRAVE PROPERTY GROUP	**Sheet** 1/1
Plant	**Location** E324930 N217905	**Engineer** ATKINS McCARTHY	**Ground Level (mOD)** 12.23

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level	Daily Progress
TOPSOIL	(0.20)							
	0.20		12.03	0.25	J			
Loose grey and brown fine to medium GRAVEL containing tarmac (FILL)	0.30 (0.10)		11.93	0.35	J			
Stiff brown gravelly CLAY	0.40		11.83	0.50	B			
Medium dense brown very sandy GRAVEL	(0.55)							
	0.95		11.28	1.00	J			
Loose to medium dense brown slightly gravelly SAND	(0.25)							
	1.20		11.03					
Loose to medium dense brown very silty fine to medium SAND containing roots	(1.60)			1.50 2.00	B J			
	2.80		9.43	2.80	B			
Dense brown and light brown coarse rounded GRAVEL containing many cobbles and boulders	(0.20) 3.00		9.23				dry:04/05/00	
END OF PIT 3.0m								

Plan

Remarks

Over break of pit sides below 2.0m due to disturbance caused by removal of cobbles and boulders below 2.8m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3696.101	T101

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T102

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	E324304 N217836	ATKINS McCARTHY	12.23

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level	Daily Progress
TOPSOIL	(0.30)							
	0.30		11.93					
Loose brown slightly gravelly coarse SAND containing occasional cobbles and boulders	(0.35)			0.50	B			
	0.65		11.58					
Loose to medium dense brown silty SAND				0.70	J			
	(0.35)							
	1.00		11.23					
Medium dense very gravelly medium to coarse SAND containing occasional cobbles and boulders				1.50	B			
	(1.50)			2.00	J			
	2.50		9.73	2.50	B		dry:04/05/00	
END OF PIT 2.5m								

Plan

Remarks

Pit sides unstable and collapsing below 0.6m.
Pit terminated to restrict surface damage to garden.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3696.102	T102

Glover Site Investigations Ltd

Site: N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			Trialpit Number: T103
Boring Method: RUBBER TYRED EXCAVATOR	Dates: 04/05/00 04/05/00	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: E324867 N217950	Engineer: ATKINS McCARTHY	Ground Level (mOD): 14.89

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL containing roots	(0.30) 0.30		14.59					
Soft to firm brown gravelly CLAY containing roots and cobbles, boulders, brick (FILL)	(0.50) 0.80		14.09	0.40 0.50	J B			
Road Pavement	(0.10) 0.90		13.99					
Dense black HARDCORE	(0.20) 1.10		13.79	1.00 1.10	J B			
Stiff to very stiff grey brown gravelly CLAY (FILL)	(2.10)			1.50 2.00 2.50 3.00	J B J B			
END OF PIT 3.2m	3.20		11.69				dry:04/05/00	

Plan

Remarks

Pit sides stable.
Progress slow.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3696.103	T103

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T104

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1
Plant	**Location**	**Engineer**	**Ground Level (mOD)**
	E324840 N217936	ATKINS McCARTHY	14.41

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10		14.41					
Soft to firm brown friable gravelly sandy CLAY containing occasional pieces of plastic, decayed branches (MADE GROUND)	(1.50)			0.50	B			
				1.00	J			
				1.50	B			
Stiff brown and mottled grey gravelly sandy CLAY containing occasional small cobbles (MADE GROUND)	1.60		12.81	1.60	J			
	(1.40)			1.70	B			
				2.20	J			
				2.50	B			
Medium dense to dense grey GRAVEL	3.00 (0.20)		11.41	3.10	J		* Inflows.	
END OF PIT 3.2m	3.20		11.21				2.80m:04/05/00	

Plan

Remarks

Pit terminated at 3.2m due to ingress of water.

Scale	Logged By	Figure No.	Trialpit Number
1:25	BE	3696.104	T104

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Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T105

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	E324803 N217766	ATKINS McCARTHY	12.62

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.30)							
	0.30		12.32	0.30	J			
Loose to medium dense mottled wet very silty fine to coarse SAND				0.50	B			
	(0.80)							
				1.00	J			
	1.10		11.52	1.10	J			
Soft brown friable very sandy fine to coarse SILT								
	(0.70)			1.50	B			
	1.80		10.82	1.80	J			
Medium dense to dense brown slightly sandy GRAVEL containing occasional large boulders and cobbles								
	(0.70)							
	2.50		10.12	2.50	B			dry:04/05/00
END OF PIT 2.5m								

Plan

Remarks

Over break of pit sides below 1.8m due to removal of boulders.
Progress very slow below 1.8m.
Large concrete mass at 1.7m (possible cover to pipe).
Pit elongated in northerly direction.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RP	3606.105	T105

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Site: N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			Trialpit Number: T106
Boring Method: RUBBER TYRED EXCAVATOR	Dates: 04/05/00 - 04/05/00	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: E3,4621 N2777/9	Engineer: ATKINS McCARTHY	Ground Level (mOD): 13.23

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level	Daily Progress
TOPSOIL containing gravel	(0.30)							
	0.30		12.93					
Loose to medium dense red brown silty SAND containing rootlets				0.40	J			
	(0.60)			0.60	B			
	0.90		12.33					
Loose to medium dense brown very slightly gravelly medium to coarse SAND containing occasional rootlets and roots				1.00	B			
				1.50	J			
	(2.10)			2.00	B			
.... becoming damp below 2.5m				2.50	J			
	3.00		10.23	3.00	B		dry:04/05/00	
END OF PIT 3.0m								

Plan

Remarks

Pit sides unstable and collapsing below 1.1m.

Scale	Logged By	Figure No.	Trialpit Number
1:25	PF	360.2106	T106

Glover Site Investigations Ltd

Site: N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION			Trialpit Number: T107
Boring Method: RUBBER TYRED EXCAVATOR	Dates: 04/05/00 - 04/05/00	Client: COSGRAVE PROPERTY GROUP	Sheet: 1/1
Plant:	Location: E324764 N217672	Engineer: ATKINS McCARTHY	Ground Level (mOD): 15.67

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level	Daily Progress
TOPSOIL	(0.20)							
Loose brown clayey sandy GRAVEL containing small cobbles (MADE GROUND)	0.20		15.47	0.20	J			
				0.50	B			
	(0.60)							
Stiff brown sandy slightly gravelly CLAY (MADE GROUND)	0.80		14.87				* Slight Seepage.	
	(0.20)			0.90	J			
Road Pavement	1.00		14.67					
	(0.20)							
Firm to stiff grey very gravelly CLAY/very clayey GRAVEL (MADE GROUND)	1.20		14.47	1.20	B			
	(1.50)			2.00	J			
				2.50	B			
Very stiff/hard grey sandy slightly gravelly friable SILT containing decayed roots and grass (ORIGINAL TOPSOIL)	2.70		12.97	2.70	B			
	(0.30)							
Medium dense brown silty SAND	3.00		12.67	3.00	B			
	(0.20)							
END OF PIT 3.2m	3.20		12.47				Dry:04/05/00	

Plan

Remarks

Pit sides unstable.
0.5 hrs spent breaking through old road.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3696.T107	T107

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	**T108**

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	E324687 N217541	ATKINS McCARTHY	16.75

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
TOPSOIL	(0.10) 0.10		16.65					
Loose brown sandy GRAVEL (FILL)	(0.20) 0.30		16.45	0.20	J			
Road Pavement	(0.10) 0.40		16.35	0.35	J			
Dense dark grey HARDCORE	0.50		16.25	0.45	J			
				0.50	B			
Medium dense brown sandy GRAVEL containing occasional small cobbles and angular mudstone fragments with occasional plastic remnants (FILL)				1.00	J			
	(1.40)							
				1.50	B			
.... becoming damp 1.8m				1.70	J			
	1.90		14.85					
Dense brown very sandy GRAVEL	(0.30)			2.00	B		* Slight Seepage.	
	2.20		14.55				dry:04/05/00	
END OF PIT 2.2m								

Plan

Remarks

Pit sides unstable and collapsing below 0.4m.
Progress very slow.
Pit terminated at 2.2m due to collapse of pit sides.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3696.T108	**T108**

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T109

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1

Plant	Location	Engineer	Ground Level (mOD)
	E3 4[illegible] N21[illegible]	ATKINS McCARTHY	21.97

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level	Daily Progress
TOPSOIL	(0.40)							
Dense grey clayey very sandy fine to coarse GRAVEL containing cobbles and boulders. FILL	0.40 (0.80)		21.57	0.50	B			
				1.00	B			
Red brown fine grained MUDSTONE Recovered as coarse angular gravel and cobble sized fragments in a clay matrix (PREVIOUS ROCK FILL)	1.20 (1.00)		20.77	1.20	B			
				2.00	B			
END OF PIT 2.2m	2.20		19.77				dry:04/05/00	

Plan

Remarks

Pit sides stable.
Progress very slow below 1.2m.
Over break caused by removal of rock/rock fill.

Scale	Logged By	Figure No.	Trialpit Number
1:25	RB	3096.T1[illegible]	T109

Glover Site Investigations Ltd

Site	Trialpit Number
N11 FASSAROE INTERCHANGE - PRELIMINARY GEOTECHNICAL SITE INVESTIGATION	T110

Boring Method	Dates	Client	Sheet
RUBBER TYRED EXCAVATOR	04/05/00 - 04/05/00	COSGRAVE PROPERTY GROUP	1/1
Plant	**Location**	**Engineer**	**Ground Level (mOD)**
	E[illegible] N[illegible]	ATKINS McCARTHY	26.61

Description	Depth m (Thickness)	Legend	Level (mOD)	Samples / Tests: Depth (m)	Sample	Test	Water Level *	Daily Progress
Loose to medium dense brown coarse gravelly SAND containing occasional thin beds of stiff red brown silt				0.50	B			
	(1.90)			1.00	J			
				1.50	B			
.... becoming damp below 1.9m				1.80	J		* Slight Seepage.	
	1.90		24.71					
Stiff red brown slightly gravelly CLAY				2.00	J			
	(1.10)			2.50	B			
	3.00		23.61				dry:04/05/00	
END OF PIT 3.0m								

Plan

Remarks

Pit sides stable.
Pit excavated into side of existing slope.
Level taken at lower end of pit, ie. nearer to road.

Scale	Logged By	Figure No.	Trialpit Number
1:25	EB	4696.T110	T110

N11 FASSAROE INTERCHANGE

ATTERBERG LIMIT TESTS

B.H/ TP No.	Sample Depth (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Casagrande Classification
BH 101	3.0	16				
BH 101	5.3	3.1				
BH 102	2.5	23	31	17	14	CL
BH 102	3.5	22	29	16	13	CL
BH 103	3.0	16	30	12	18	CL
BH 103	6.0	27	51	19	32	CH
TP 101	1.5	17				
TP 102	1.5	6.5				
TP 103	0.5	23	41	21	20	CI
TP 103	1.1	13	34	13	21	CL
TP 104	0.5	19	32	13	19	CL
TP 104	1.7	15	33	13	20	CL
TP 105	0.5	16				
TP 105	1.5	17				
TP 106	1.0	7.4				
TP 107	0.5	20	33	19	14	CL
TP 107	1.2	22	40	24	16	CI
TP 108	0.5	6.6				
TP 109	0.5	2.5				
TP 110	0.5	7.6				
TP 110	2.5	14	28	18	10	CL/ML

SUMMARY OF TEST RESULTS

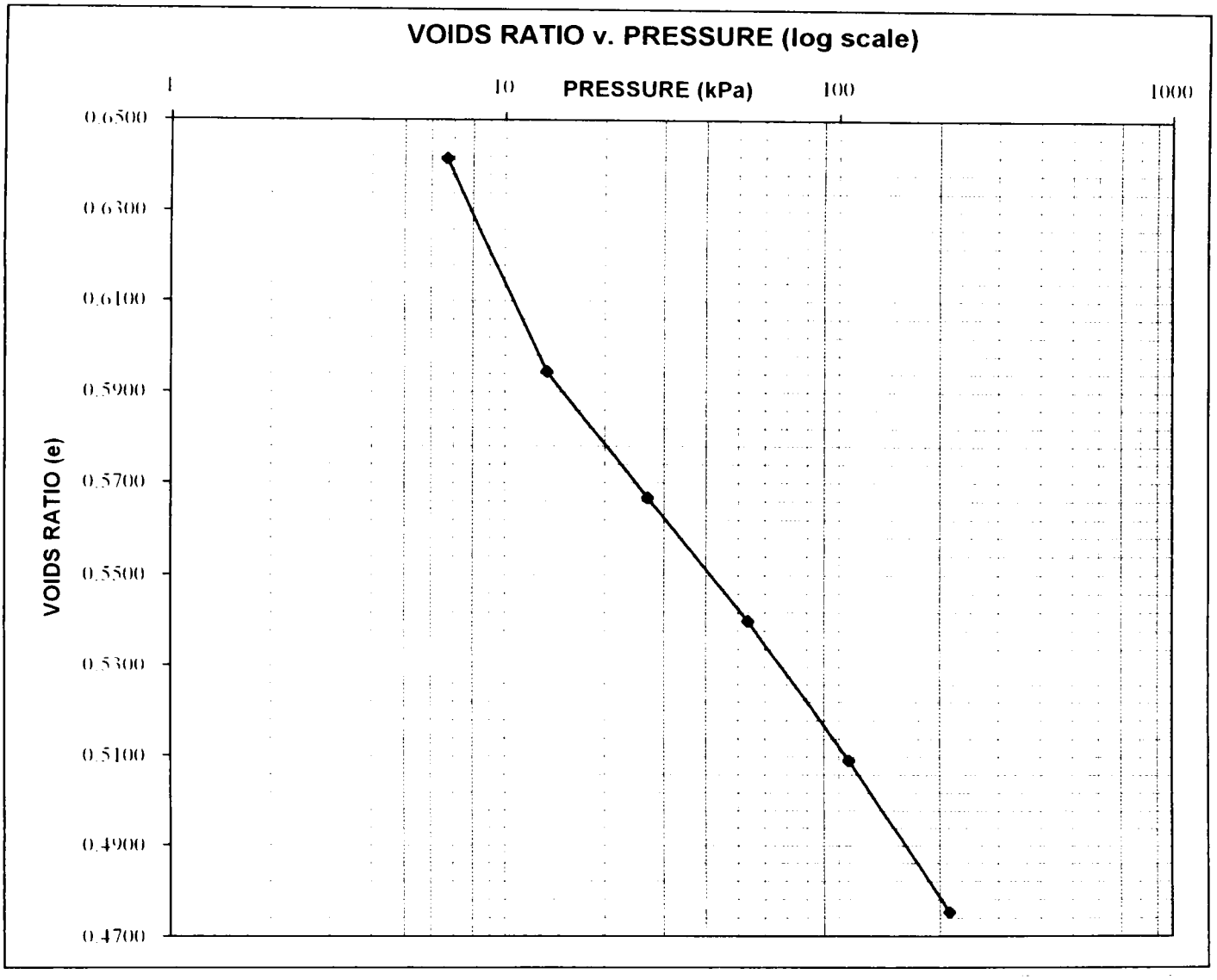
JOB: 3696 **SITE: N11 Fassaroe Interchange** **SHEET No.: 1**

B.H. No.	Depth (m)	Description	TRIAXIAL COMPRESSION TEST						CONSOLIDATION TEST		
			Lateral Pressure (kPa)	Compression Strength (kPa)	Bulk Density (kg/m³)	Moisture Content (%)	Cohesion (kPa)	Angle of Friction (degrees)	Pressure Range (kPa)	Coefficient of Consolidation (m^2/yr)	Coefficient of Compressibility ($X10^{-3}$ m^2/kN)
101	3.0	Medium dense brown slightly gravelly fine to medium SAND containing decayed roots. Bottom 50mm: Medium dense brown slightly gravelly medium to coarse SAND.	50	317	2064	16					
102	2.5	Firm grey brown CLAY containing occasional thin beds of fine gravel.	50 100 200	106 107 108	2005	23	53	0.3			
103	3.0	Firm brown with grey mottlings slightly sandy CLAY with silt on laminations and decayed rootlets.	50 100 200	109 111 116	1987	17	52	1.4			

OEDOMETER CONSOLIDATION TEST

CONTRACT: N11 Fassaroe.

BOREHOLE No.: 102
SAMPLE DEPTH: U2.50m



Initial Bulk Density: 1976 kg/m3
Final Bulk Density: 2064 kg/m3
Initial Voids Ratio e_o: 0.6514
Final Voids Ratio e_f: 0.5092
Initial Moisture Content: 25.5 %
Final Moisture Content: 19.8 %
Specific Gravity,G_s: 2.60 #
Degree of saturation,S: %
Depth below ground level: 2.80 m

Sample Description: Firm brown with grey mottlings very sandy gravelly CLAY

Notes:

#	Indicates	assumed value.
*	"	logarithmic time plot.
-	"	swelling.

Specimen dimensions: 76.2 mm dia. x
18.9 mm thick.

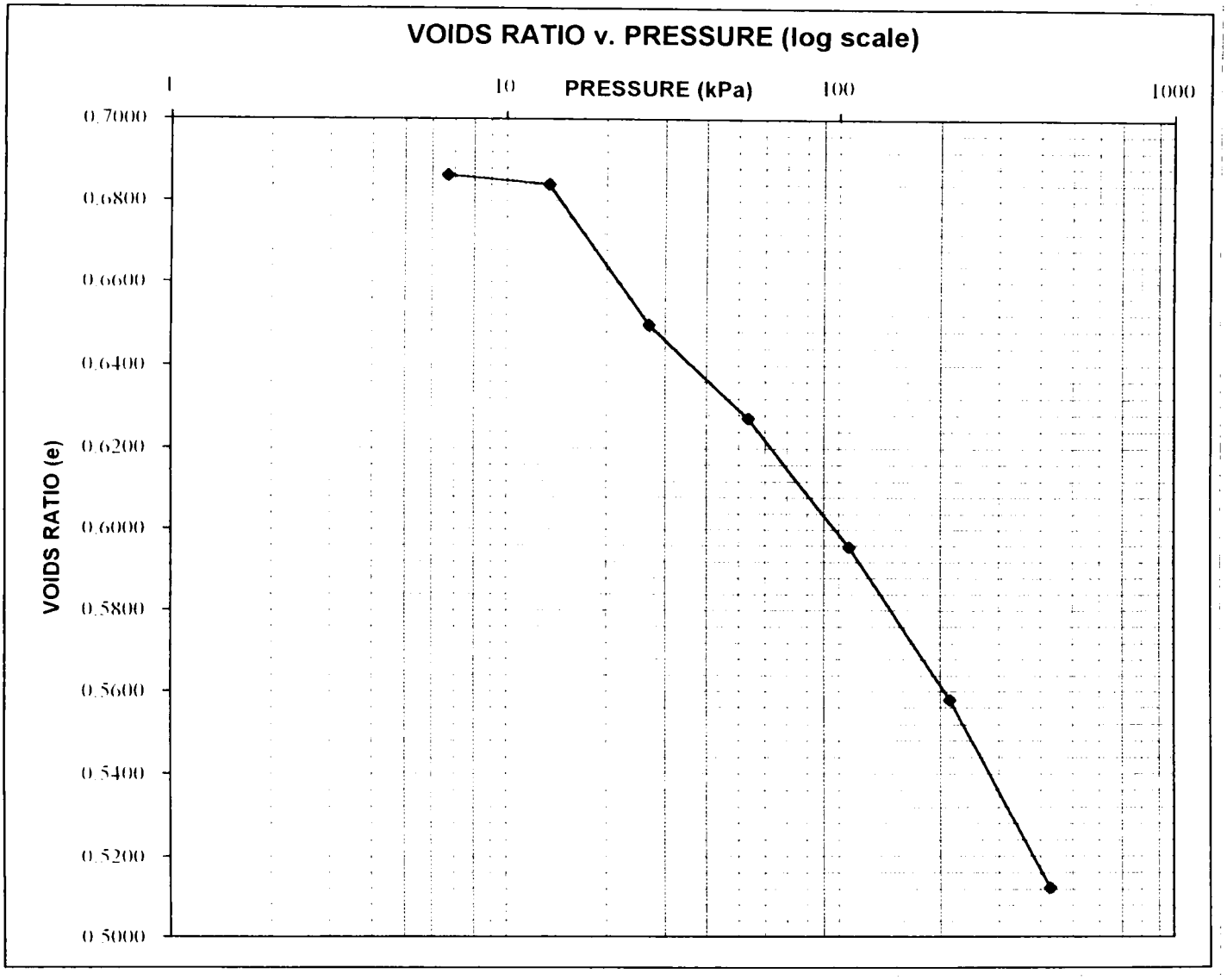
PRESSURE RANGE		CONSOLIDATION COEFFICIENTS *			
p_i (kPa)	p_f (kPa)	m_v (m^2/MN)	c_v (m^2/yr)	r_s	c_{sec}
0	7	Swelling	Swelling		
7	13	4.3318	2.17		
13	27	1.3072	4.05		
27	54	0.6384	3.16		
54	107	0.3795	4.52		
107	215	0.2119	6.59		

TUBE No.:

OEDOMETER CONSOLIDATION TEST

CONTRACT: N11 Fassaroe.

BOREHOLE No.: 103
SAMPLE DEPTH: U6.00m



Initial Bulk Density:	2031	**kg/m3**
Final Bulk Density:	2090	**kg/m3**
Initial Voids Ratio e_o:	0.6907	
Final Voids Ratio e_f:	0.5999	
Initial Moisture Content:	24.9	**%**
Final Moisture Content:	21.6	**%**
Specific Gravity,G_s:	2.75	**#**
Degree of saturation,S:		**%**
Depth below ground level:	6.30	**m**

Sample Description: Firm brownish grey slightly gravelly sandy CLAY.

Notes:

#	Indicates	**assumed value.**
*	"	logarithmic **time plot.**
-	"	**swelling.**

Specimen dimensions: 76.2 **mm dia. x**
18.5 **mm thick.**

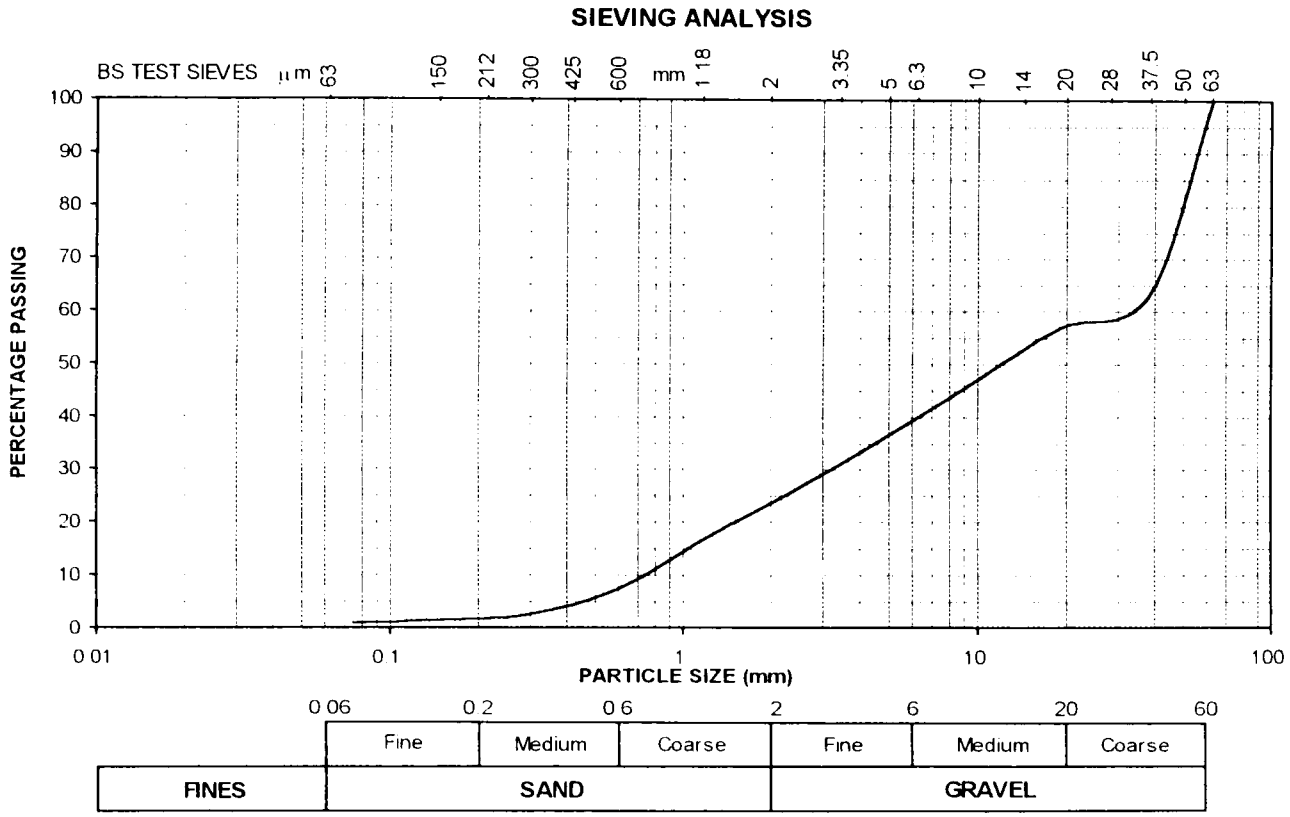
PRESSURE RANGE		CONSOLIDATION COEFFICIENTS *			
p_i (kPa)	p_f (kPa)	m_v (m^2/MN)	c_v (m^2/yr)	r_s	c_{sec}
0	7	Swelling	Swelling		
7	13	Swelling	Swelling		
13	27	1.5335	0.72		
27	54	0.5112	1.05		
54	107	0.3644	1.16		
107	215	0.2232	1.94		
215	429	0.1385	2.45		

TUBE No.:

SIEVING ANALYSIS

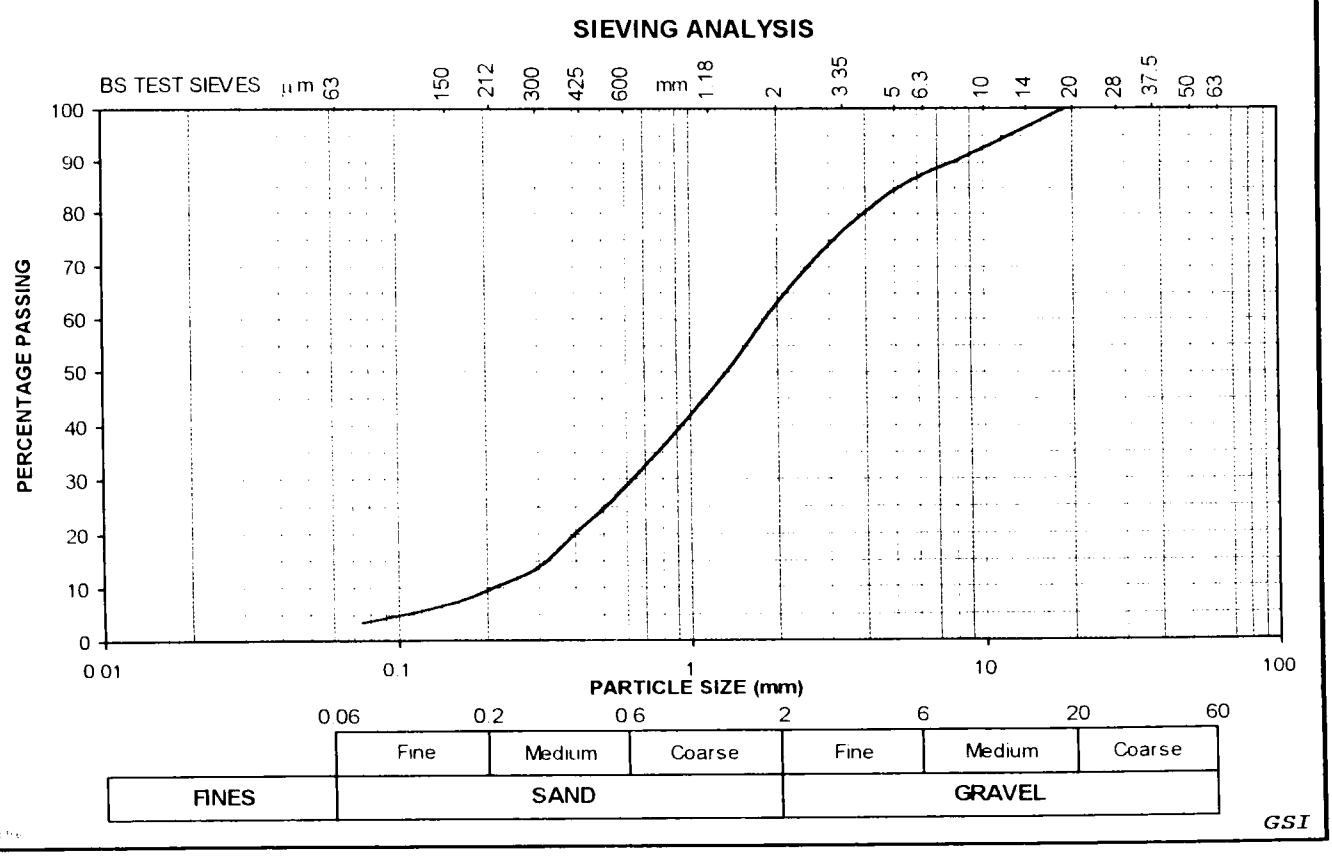
CONTRACT: N11 Fassaroe.

BOREHOLE No.: 101
SAMPLE DEPTH: B5.3m



CONTRACT: N11 Fassaroe.

TRIAL PIT No.: 102
SAMPLE DEPTH: B1.5m

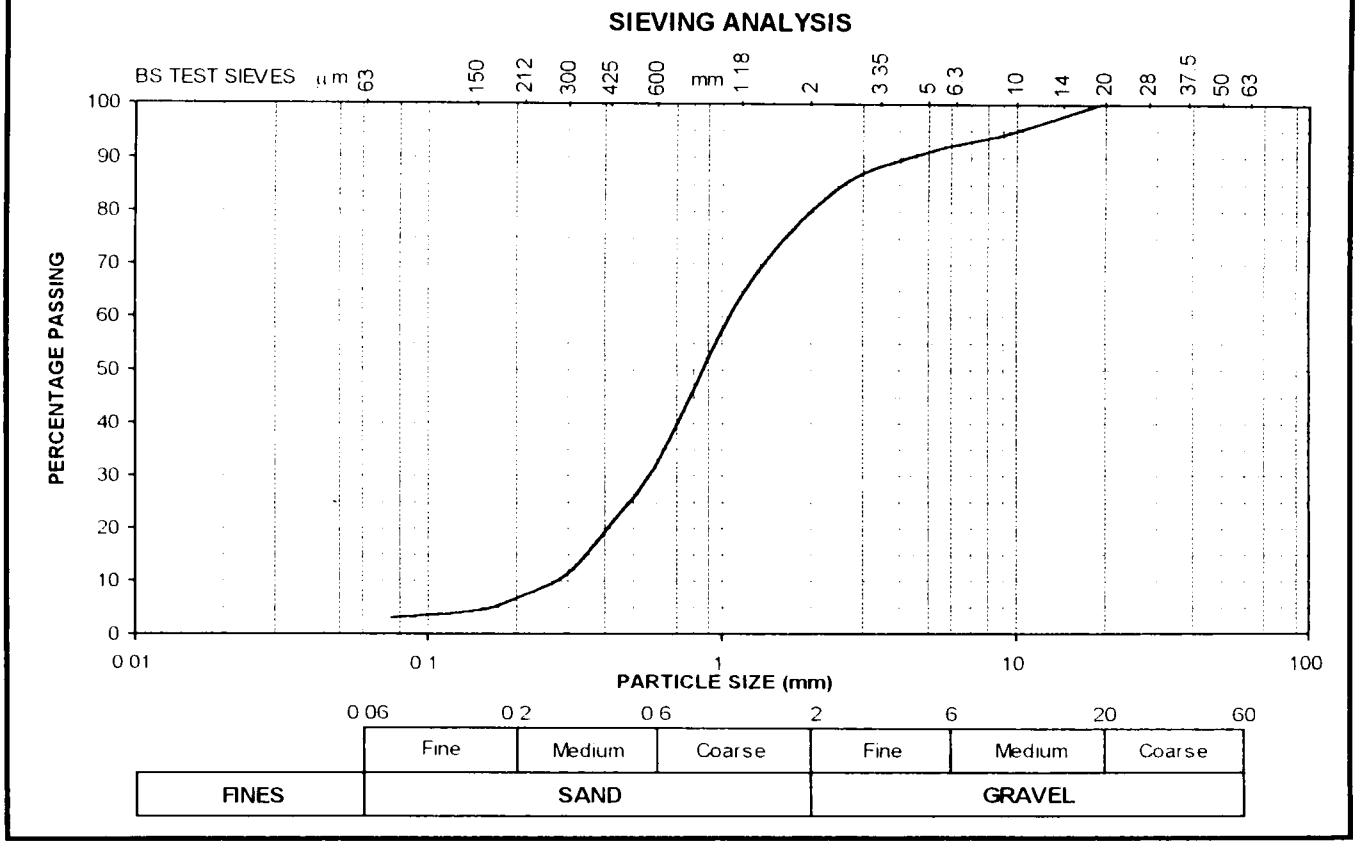


GSI

SIEVING ANALYSIS

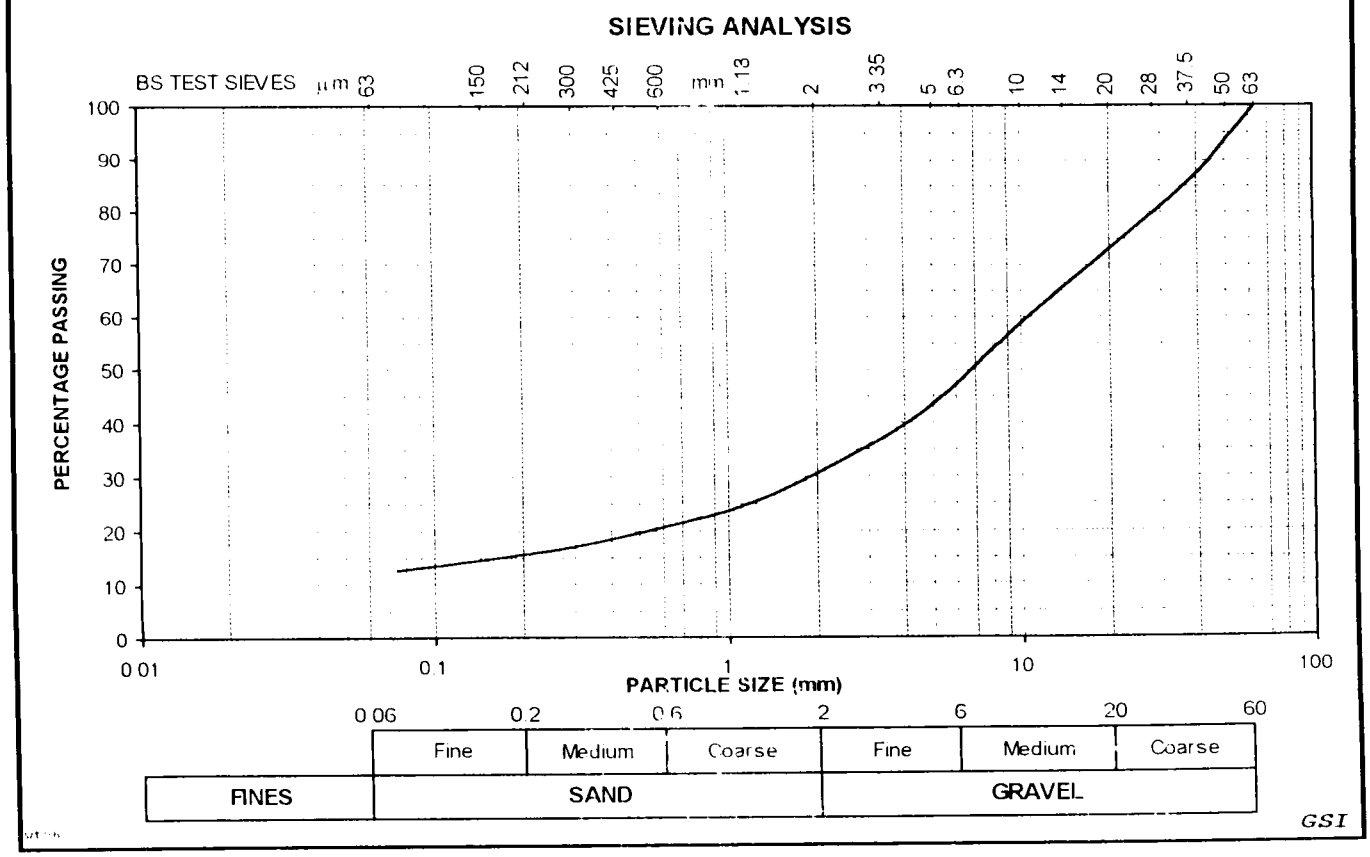
CONTRACT: Nil Fassaroe.

TRIAL PIT No.: 106
SAMPLE DEPTH: B1.0m



CONTRACT: Nil Fassaroe.

TRIAL PIT No.: 109
SAMPLE DEPTH: B0.5m



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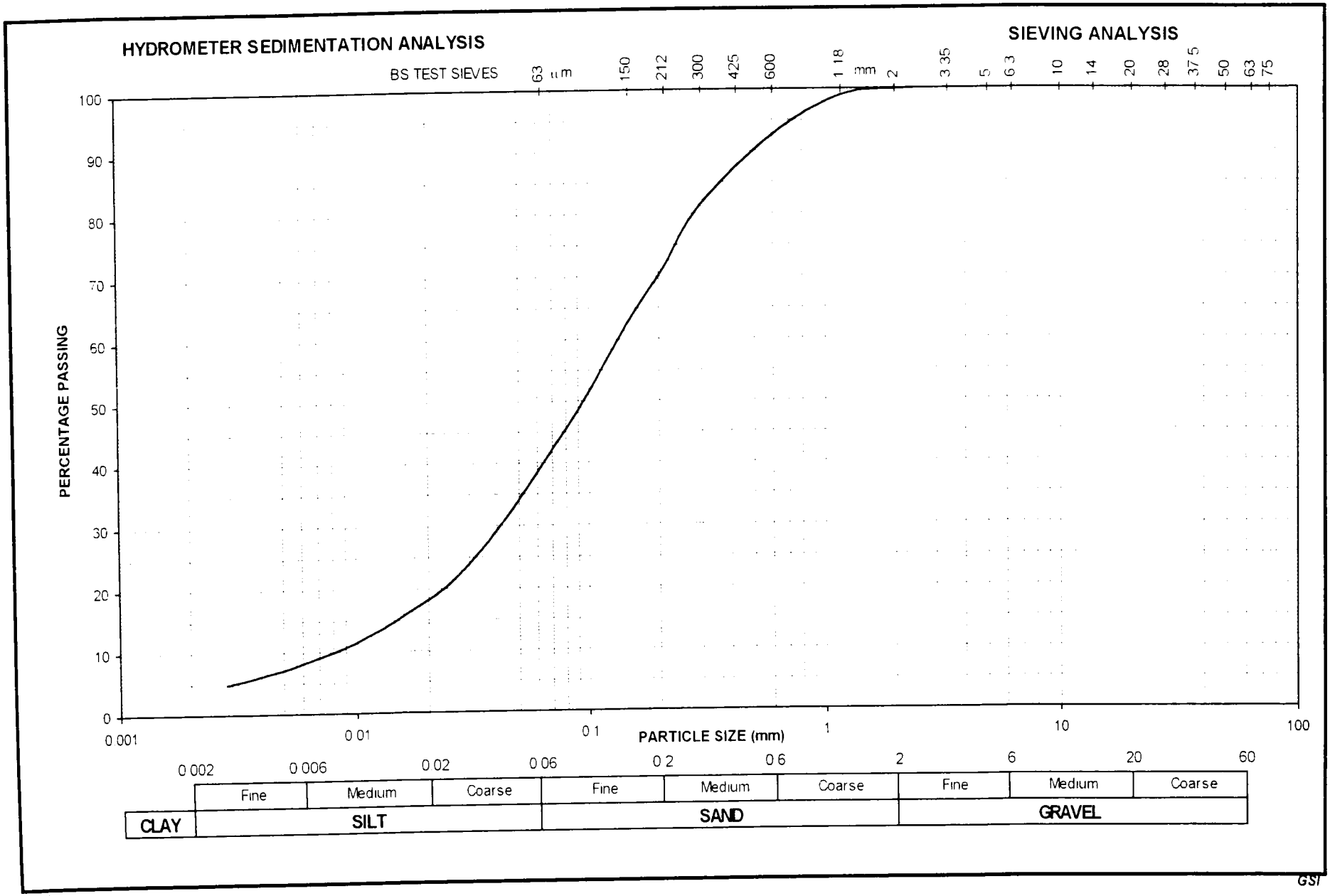
PARTICLE SIZE DISTRIBUTION

CONTRACT: N11 Fassaroe.

TRIAL PIT No.: 101
SAMPLE DEPTH: (B)1.50m



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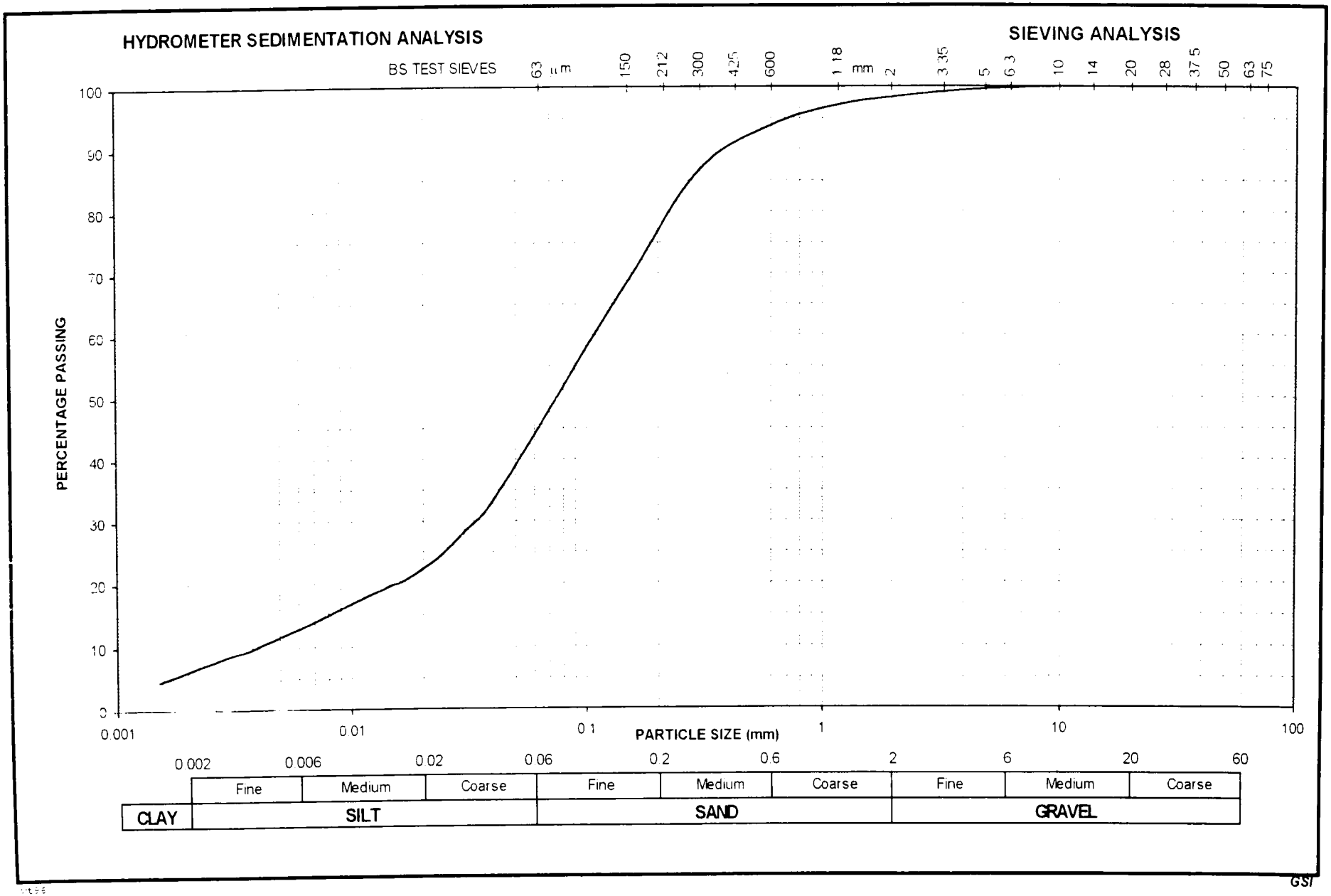
PARTICLE SIZE DISTRIBUTION

CONTRACT: N11 Fassaroe.

TRIAL PIT No.: 101
SAMPLE DEPTH: (U)3.00m



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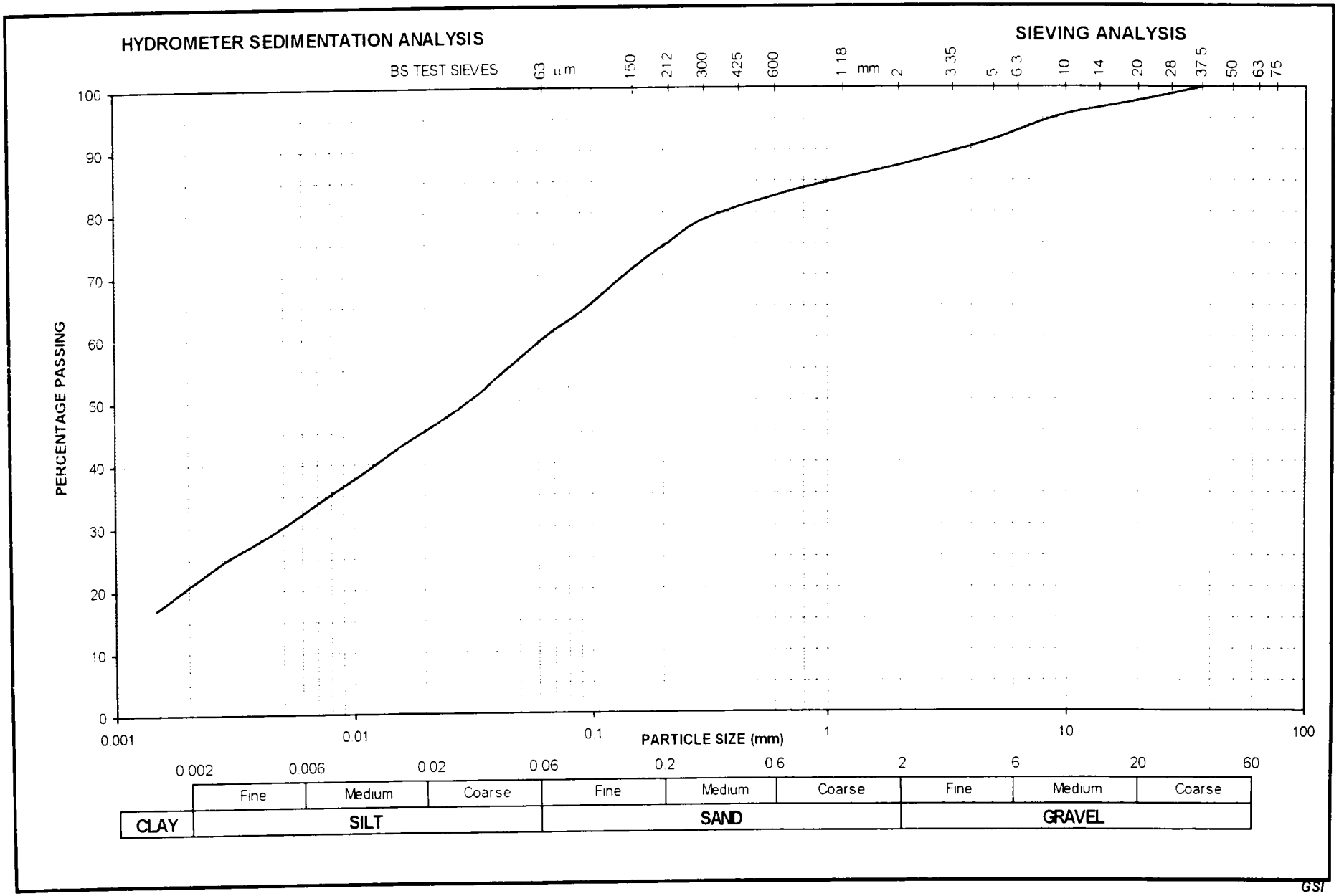
PARTICLE SIZE DISTRIBUTION

CONTRACT: N11 Fassaroe.

TRIAL PIT No.: 104
SAMPLE DEPTH: (B)1.70m



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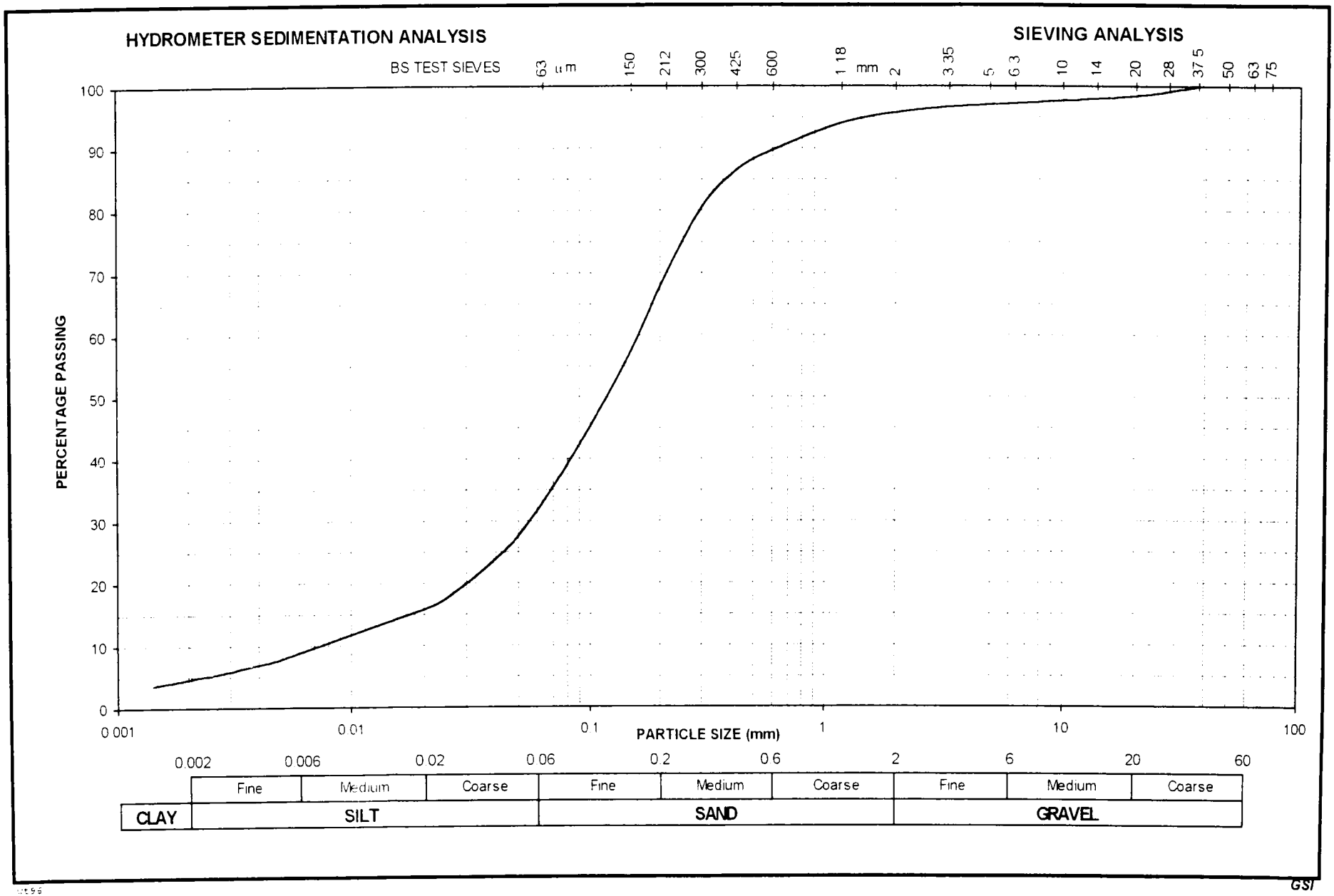
PARTICLE SIZE DISTRIBUTION

CONTRACT: Nll Fassaroe.

TRIAL PIT No.: 105
SAMPLE DEPTH: (B)0.5m



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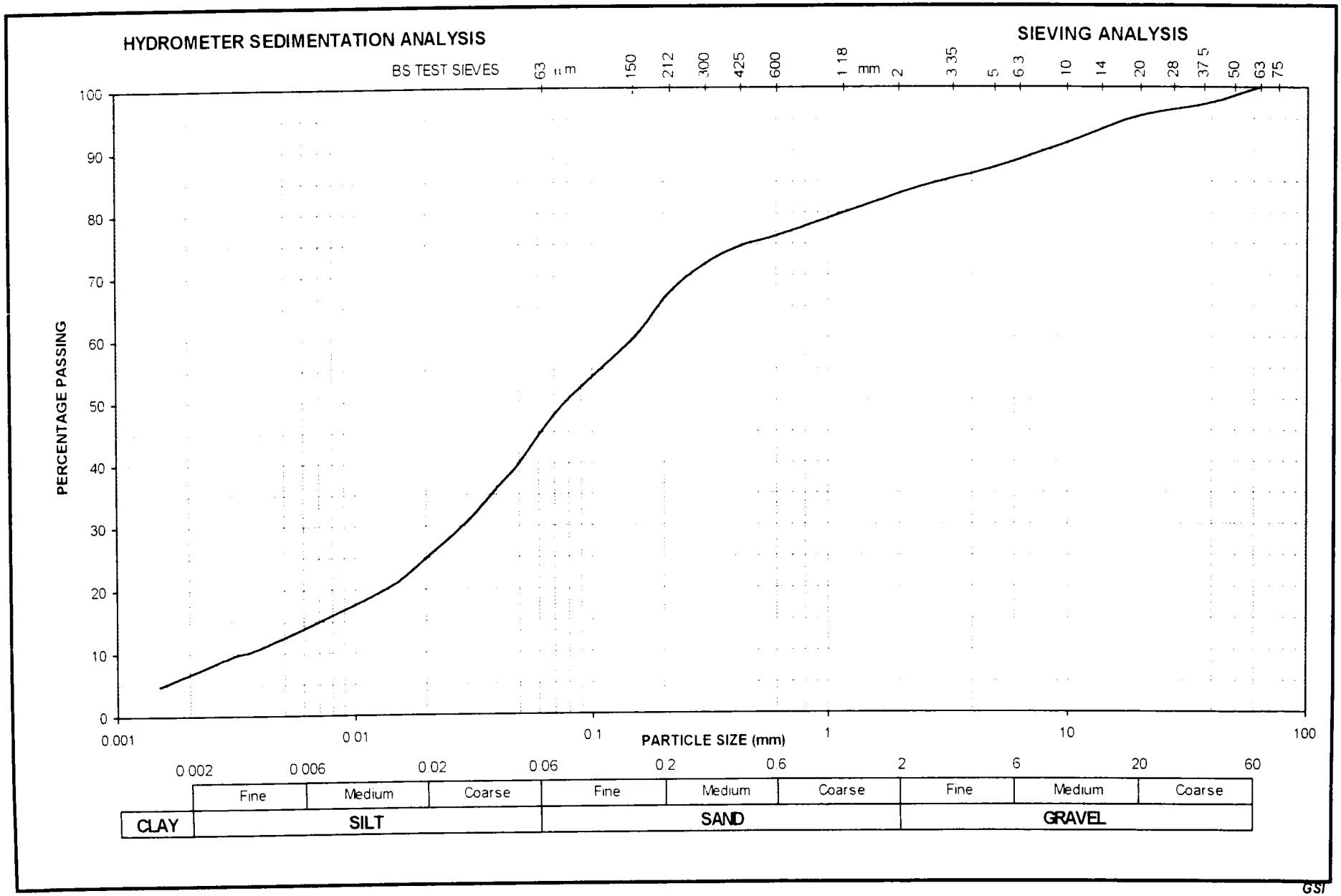
PARTICLE SIZE DISTRIBUTION

CONTRACT: N11 Fassaroe.

TRIAL PIT No.: 105
SAMPLE DEPTH: (B)1.50m



GSI

N11 FASSAROE INTERCHANGE

LABORATORY CALIFORNIA BEARING RATIO RESULTS

TP No.	Sample Depth	CBR			Bulk Density Mg/m^3	Initial Moisture Content	Final Moisture Content		% Passing 20mm Sieve
		Top	Bottom	Average			Top	Bottom	
101	1.5	10.38	7.10	8.8	2029	15	15	15	100
102	1.5	34.31	41.61	38.0	1947	6.0	6.0	6.0	100
105	0.5	0.89	1.13	1.0	2037	18	18	17	98.5
105	1.5	1.13	1.33	1.2	2093	18	18	18	95.9
109	0.5	35.62	38.85	37.2	2331	8.7	8.6	8.6	74.1

N11 FASSAROE INTERCHANGE

ORGANIC MATTER CONTENT

TP	Depth (m)	Organic Matter Content %	% sample < 2mm
103	0.5	7.59%	85.6
104	0.5	2.22%	91.9
107	0.5	2.07%	79.7

THE NORTHERN IRELAND
Technology Centre
THE QUEEN'S UNIVERSITY OF BELFAST

CONSTRUCTION DIVISION
MATERIALS TESTING STATION
DAVID KEIR BUILDING
BELFAST BT9 5AG
TEL: 028-9033-5435
028-9027-4022
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E-MAIL:qubtest@qub.ac.uk

Mr Bill Tumelty
Glover Site Investigation Ltd
8 Drumahiskey Road
Balnamore
Ballymoney
Co. Antrim
BT53 7QL

Date : 14/6/00

Report No. SM00/10

Job : N11

Sample 1 : T110 Depth 0.5 m Sand

Moisture Content = 7.6 %

c = 0 $\phi' = 30.7^{\circ}$

Sample 2 : T110 Depth 2.5 m Silt

Moisture Content	=	14.1
Liquid Limit	=	27.5
Plastic Limit	=	17.6

c = 0 $\phi' = 32.9^{\circ}$

Report No. : SM00/10

Dr. S.J. Cummings

Particle Size Analysis

BS Test Sieve Size Mm	Cumulative Percentage Passing %
37.5	100
28	98
20	93
14	89
10	86
6.3	83
5	81
3.35	78
2.36	76
1.7	74
1.18	70
0.85	66
0.60	59
0.425	50
0.300	35
0.212	22
0.150	13
0.075	5

Table 1 Grading of Sample 1
T110 D=0.5 m Sand

Particle Size Analysis

BS Test Sieve Size Mm	Cumulative Percentage Passing %
37.5	100
28	96.5
20	86.1
14	81.2
10	77.3
6.3	71.8
5	69.3
3.35	68.4
2.00	65.2
1.18	61.4
0.600	57
0.425	54.3
0.300	51.6
0.212	45.1
0.150	39.1
0.063	33.9
0.0483	32.0
0.0352	28.1
0.0254	26.2
0.0175	21.4
0.0142	19.5
0.009	17.6
0.0064	15.8
0.0035	12.2
0.003	11.3
0.0028	10.5
0.0015	7.2

Table 2 Grading of Sample 2 T110 D=2.5 m Silt

Sample 1 T110 Depth = 0.5 m Sand

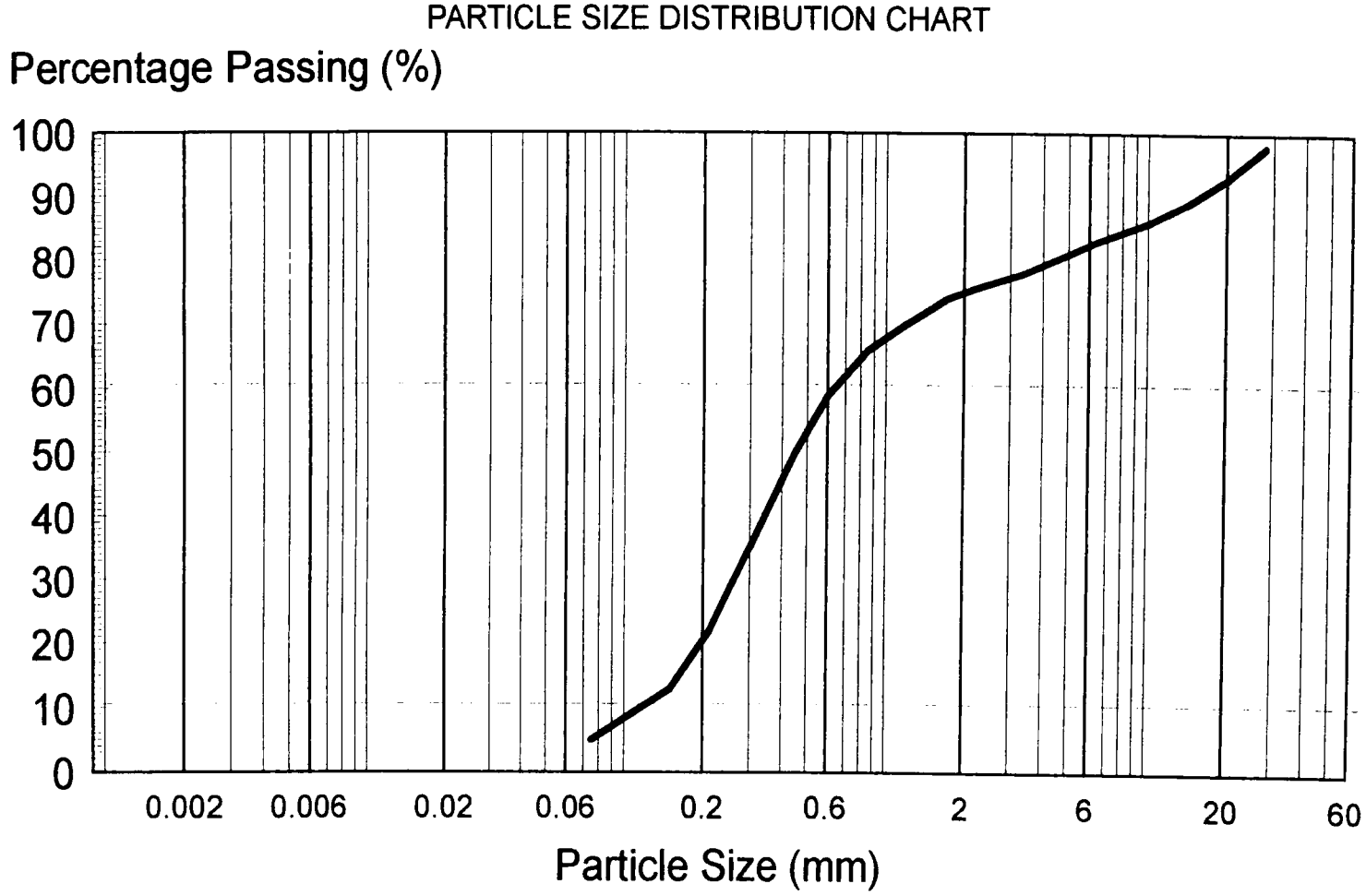


Figure 1

Sample 2 T110 Depth = 2.5 m Silt

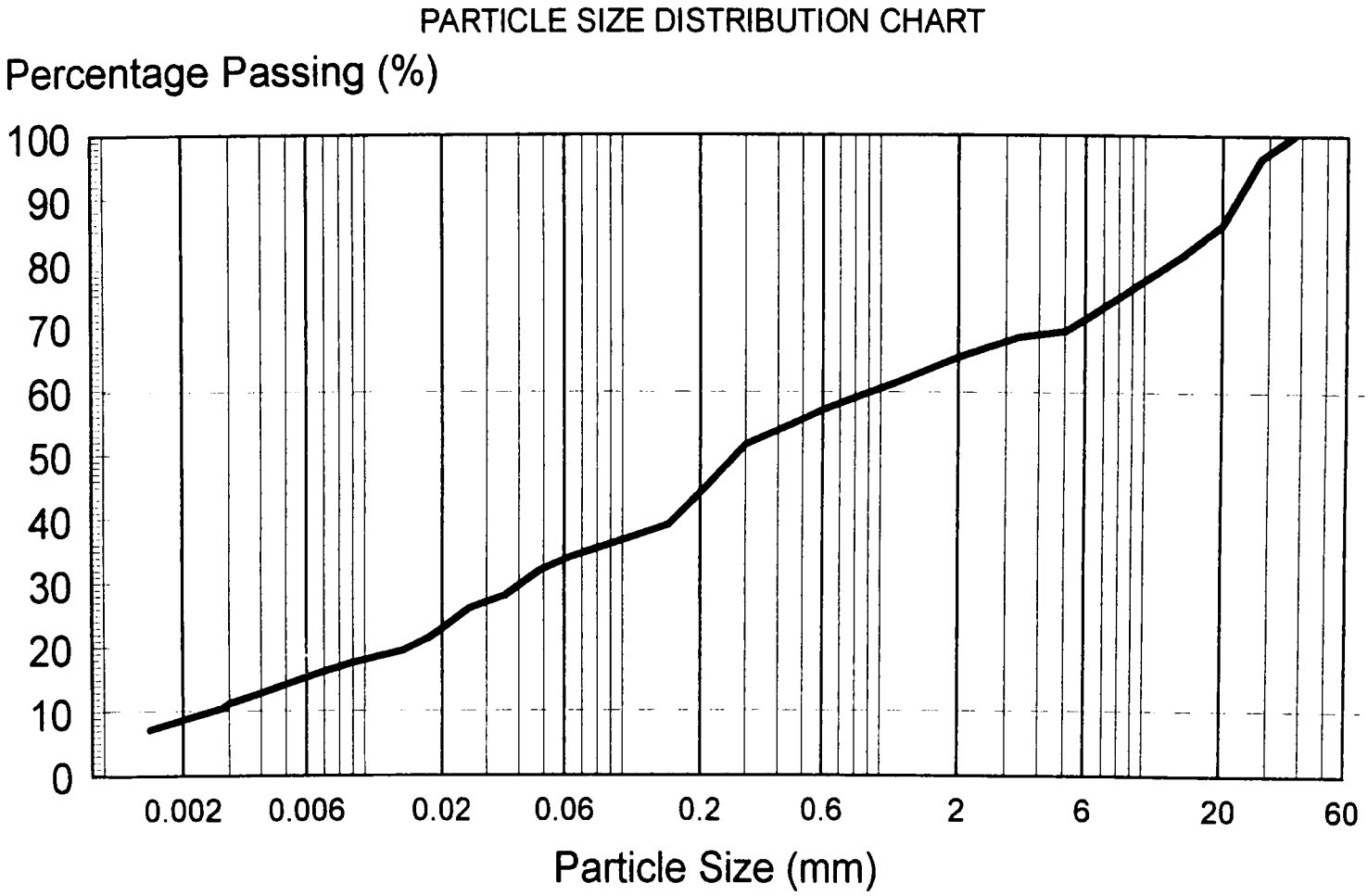


Figure 2

60 x 60 mm Shear Box Test

Type of Test	Quick
Nominal Size	60 x 60 mm
Type of Specimen	Compacted
Specimen Preparation	Placed in 3 layers
Rate of Displacment	1.2 mm/min
Moisture Content	7.6 %

Initial Bulk Density

Point 1= 1853 kg/m^3 Point 2 = 1861 kg/m^3 Point 3 = 1877 kg/m^3

Normal Stress (kN/m2)	Shear Stress at Failure (kN/m2)
20.4	12.2
39.9	23.4
81.5	49.0

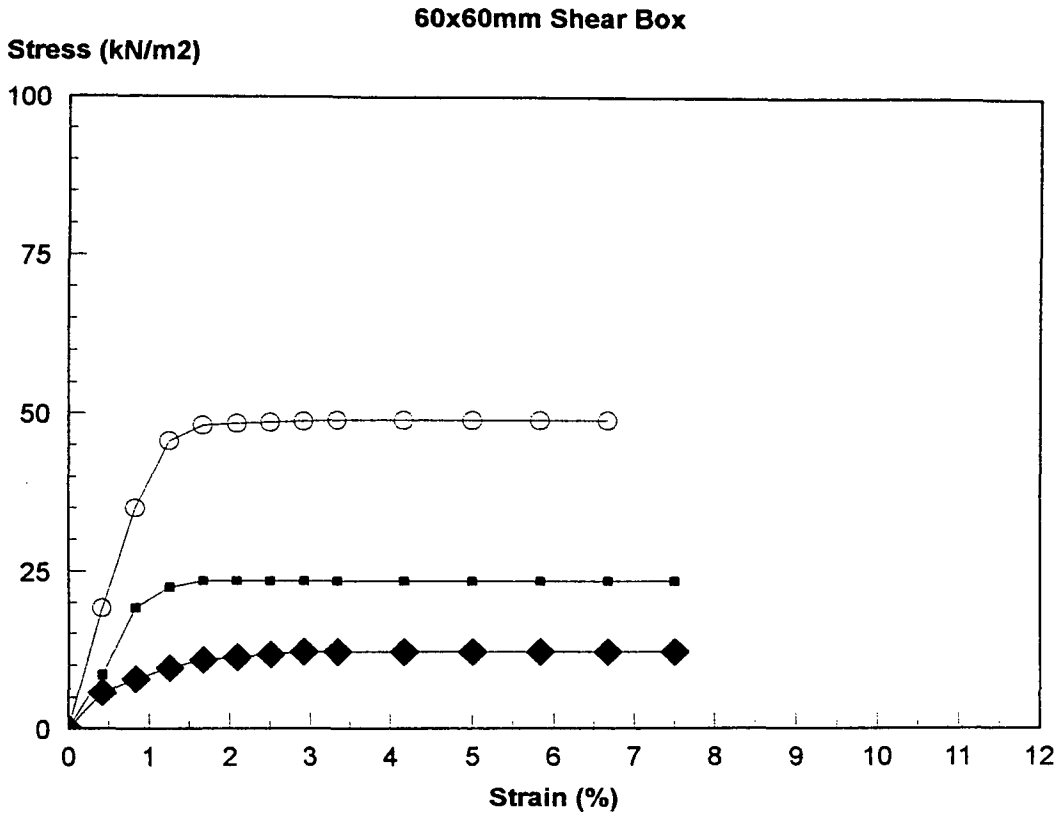
Result

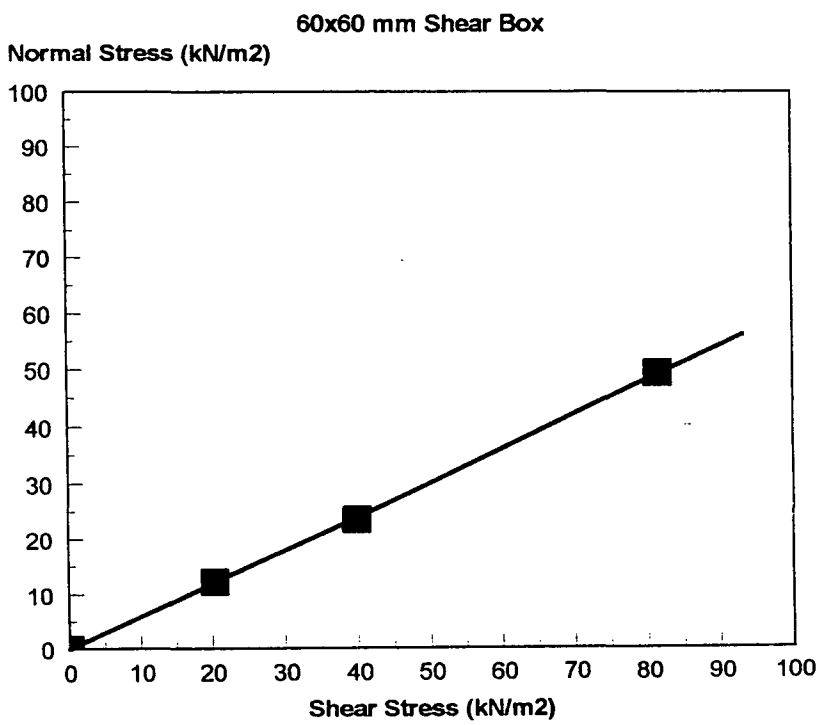
Apparent Cohesion **c = 0**

Angle of shearing resistance **ϕ' = 30.7°**

N11 T110 Sand
Depth = 0.5 m

N11 Sam T110
Depth = 0.5 m Sand





C = 0 $\phi' = 30.7^{O}$

60 x 60 mm Shear Box Test

Type of Test	Consolidated Drained
Nominal Size	60 x 60 mm
Type of Specimen	Compacted
Specimen Preparation	Placed in 3 layers
Rate of Displacment	0.012 mm/min
Moisture Content	14.1 %

Initial Bulk Density

Point 1= 2245 kg/m^3 Point 2 = 2267 kg/m^3 Point 3 = 2276 kg/m^3

Normal Stress (kN/m2)	Shear Stress at Failure (kN/m2)
40	23.9
80	54.4
163.5	108.6

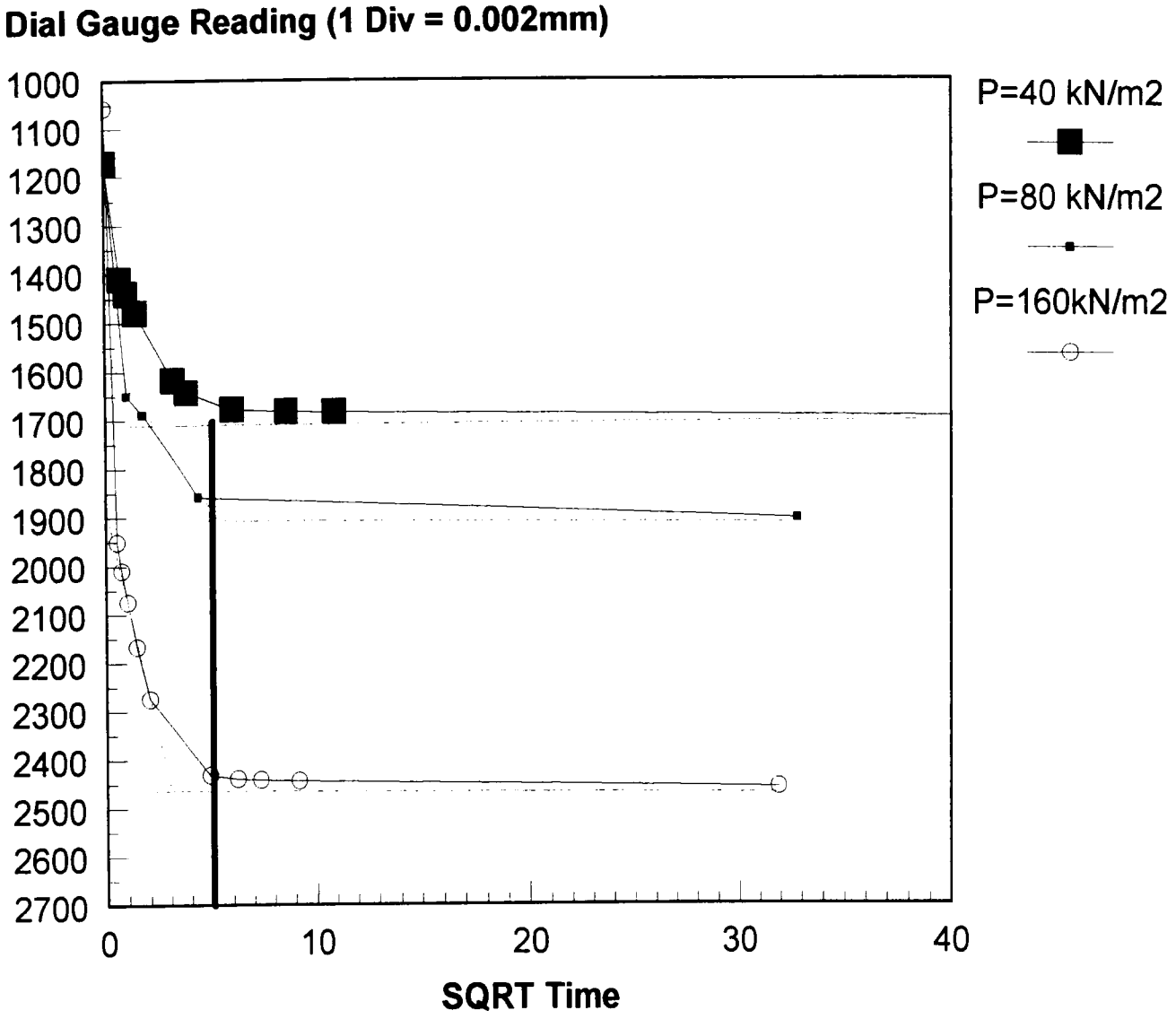
Result

Apparent Cohesion **c = 0**

Angle of shearing resistance **$\phi' = 32.9^o$**

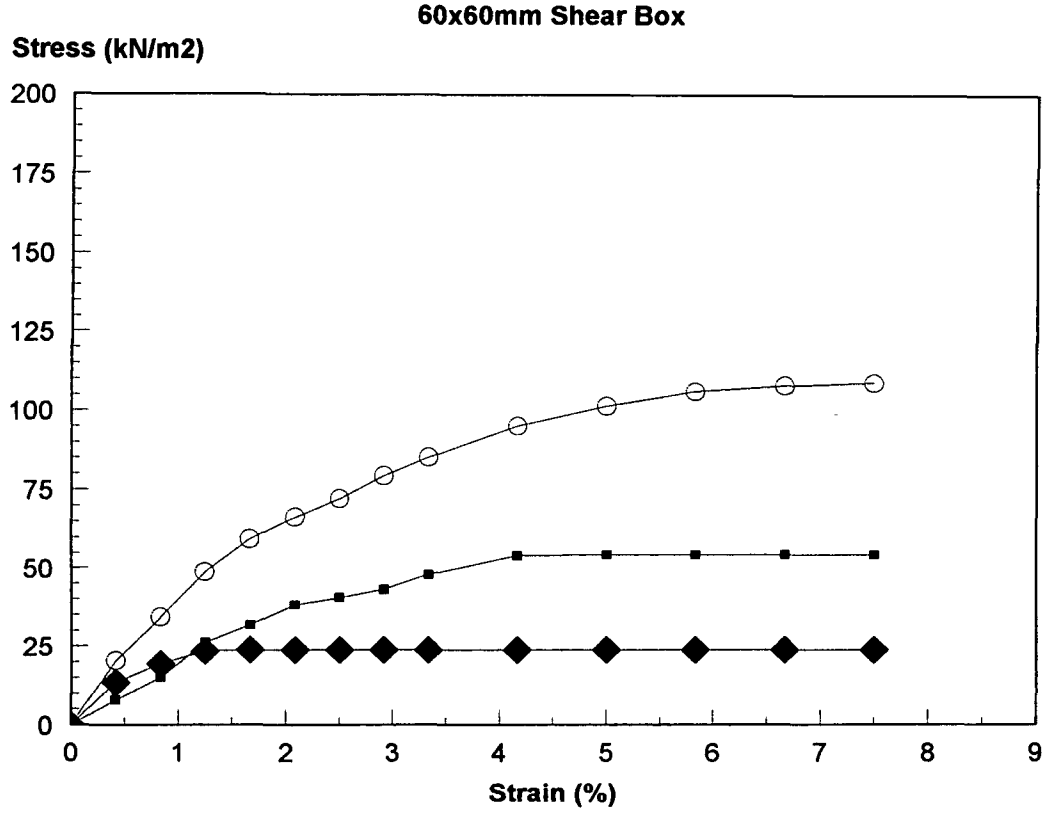
N11 T110 Silt
Depth = 2.5 m

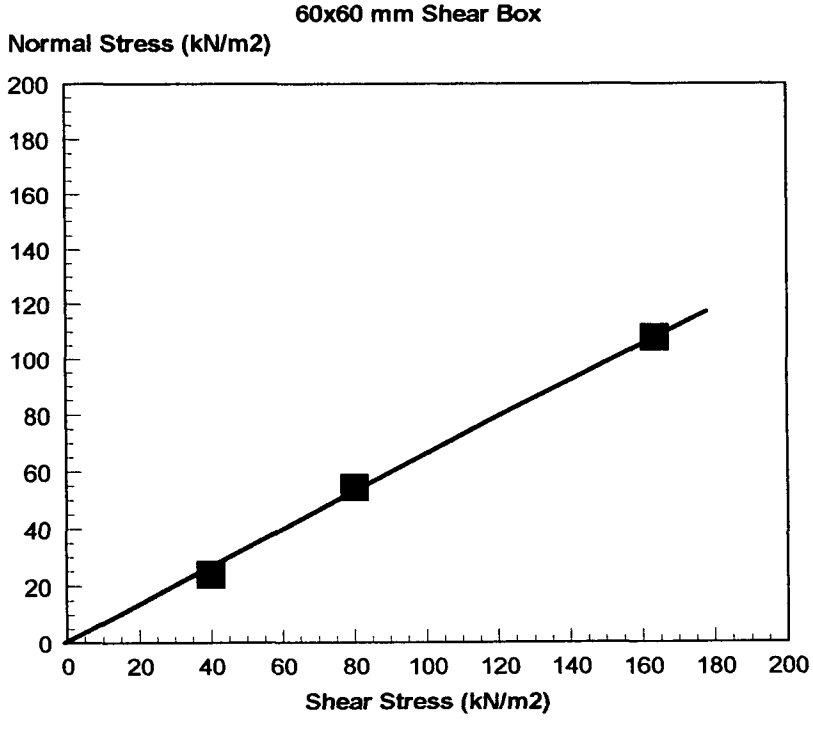
Consolidation Stage



SQRT $t_{100}=5$ $t_{100}=25$ $t_f=12.7 \times 25$

N11 Sam T110
Depth = 2.5 m Silt





C = 0 $\phi' = 32.9^{O}$

APPENDIX 7A

Criteria For Rating The Magnitude And Significance Of Impacts At EIA Stage National Roads Authority (NRA, TII, 2009)

Table 1 Criteria for Rating Site Attributes – Estimation of Importance of Hydrological Attributes (NRA)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a 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 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 >2500 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 >1000 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, Q2- 3). 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.

Table 2 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrological Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10mm. Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm. Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Table 3 Rating of Significant Environmental Impacts at EIS Stage (NRA)

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

APPENDIX 9A

Receptor Details

Appendix 9A – Receptor Details

Receptor ID	Description	Easting	Northing
R2	Residential	724458	717517
R3	Residential	724460	718123
R8	Residential	724172	717557
R11	Residential	722331	718617
R17	Residential and Commercial	724884	717929
R18	Residential	724359	717458
R20	Residential	722273	718617
R27	Residential	723659	718051
R28	Residential	724354	718067
R30	Residential	724891	718000
R31	Residential	722385	718705
R32	Industrial	724223	718093
R33	Residential	723578	718108
R33	Residential	723592	718111
R33	Residential	723594	718098
R35	Residential	724225	717529
R36	Residential	724426	718085
R43	Residential	724422	717385
R46	Residential	724456	718112
R49	Residential	723769	718001
R50	Residential	724386	718100
R51	Residential	722514	718577
R55	Residential	724192	717361
R56	Residential	723565	717388
R57	Residential	723933	717256
R58	Residential	724095	717285
R63	Residential	722332	718593
R67	Residential	724226	717451
R70	Residential	724377	718090
R74	Residential	724398	718114
R76	Residential	724272	717478
R81	Residential	723856	717943
R84	Residential	723744	718018
R86	Residential	724458	717595
R94	Residential	724406	718124
R98	Residential	724033	717280
R101	Residential	724206	717165
R102	Residential	723006	718245
R103	Residential	724400	718059
R109	Commercial	724417	717408
R110	Residential	724413	718071

Receptor ID	Description	Easting	Northing
R112	Residential	723604	717377
R115	Residential	724872	717879
R118	Residential	724371	718024
R119	Residential	722230	718553
R121	Residential	722394	718701
R122	Residential	723686	717247
R123	Residential	722271	718588
R124	Residential	723844	717953
R125	Residential	724793	717756
R126	Residential	724406	718065
R127	Residential	722267	718639
R130	Residential	724452	718101
R131	Residential	724227	717502
R134	Residential	724205	717499
R136	Commercial	723830	717963
R139	Pre-Primary Education	724742	717731
R140	Residential	722207	718615
R142	Residential	724832	717792
R148	Residential	723604	718112
R148	Residential	723610	718102
R148	Residential	723607	718097
R152	Residential	723652	717337
R155	Residential	724770	717691
R156	Residential	724491	717551
R157	Residential	724734	717670
R158	Residential	724198	717611
R159	Residential	723685	718040
R160	Residential	724864	717859
R164	Residential	724887	717985
R165	Residential	724689	717645
R166	Residential	724880	717899
R173	Residential	723157	718199
R174	Residential	723831	717962
R176	Residential	724889	717993
R177	Residential	722424	718618
R178	Residential	722394	718626
R182	Residential	724896	718015
R186	Residential	722349	718643
R187	Residential	723702	718034
R189	Residential	724841	717811
R190	Residential	724429	717419
R191	Residential	724404	718063
R197	Residential	724262	717635

Receptor ID	Description	Easting	Northing
R198	Commercial	723629	717558
R199	Residential	724885	717978
R206	Residential	722368	718635
R207	Residential	724167	717189
R211	Residential	722471	718630
R212	Commercial	724413	718076
R215	Residential	724882	718038
R216	Residential	724893	718007
R217	Residential	722579	718627
R218	Residential	722535	718643
R219	Residential	722568	718666
R220	Residential	722532	718580
R221	Residential	722520	718680
R222	Residential	722522	718645
R223	Residential	722546	718611
R224	Residential	722554	718624
R225	Residential	722582	718515
R226	Residential	722464	718108

APPENDIX 9B

Equipment Calibration Certificates

Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

DANAK
CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: CDK2078796

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250	No: 3002367	Id: - 3002367
Microphone:	Brüel & Kjær Type 4950	No: 2745852	
Preamplifier:	Brüel & Kjær Type ZC-0032	No: 16743	
Supplied Calibrator:	Brüel & Kjær Type 4231	No: 3005620	

Software version:	BZ7222 Version 4.5.2	Pattern Approval:	PTB1.63-40478500 / 1.63-4078502
Instruction manual:	BE1712-22		

CUSTOMER

Enfonic Ltd
Unit 2A, Century Business Park
Dublin
D11 T0HV
Ireland

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in **Environmental conditions** sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC6162-1:2013 class 1. Proceedures from IEC 61672-3:2013 were used perform the periodic tests. The accreditation assures the traceability of the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 7.3 - DB: 7.30) by using procedure B&K proc 2250, 4189 (IEC61672:2013)

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2020-08-21

Date of issue: 2020-08-21

M. Önder
Mikail Önder
Calibration Technician

Susanne Jørgensen
Susanne Jørgensen
Approved Signatory

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Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

DANAK
CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: CDK2005832

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250-Light	No: 2580156	Id: -
Microphone:	Brüel & Kjær Type 4950	No: 2737145	
Preamplifier:	Brüel & Kjær Type ZC-0032	No: 10190	
Supplied Calibrator:	None		
Software version:	BZ7222 Version 4.5.2	Pattern Approval:	PTB1.63-40478500 / 1.63-4078502
Instruction manual:	BE1712-22		

CUSTOMER

Enfonic Ltd
Unit 2A, Century Business Park
Dublin
D11 T0HV
Ireland

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in **Environmental conditions** sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC6162-1:2013 class 1. Proceedures from IEC 61672-3:2013 were used perform the periodic tests. The accreditation assures the traceability of the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 7.3 - DB: 7.30) by using procedure B&K proc 2250, 4189 (IEC61672:2013)

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2020-09-07

Date of issue: 2020-09-07

M. Önder

Mikail Önder
Calibration Technician

Susanne Jørgensen

Susanne Jørgensen
Approved Signatory

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Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

DANAK CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: CDK2106286

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250-Light	No: 3008423	Id: -
Microphone:	Brüel & Kjær Type 4950	No: 2697054	
Preamplifier:	Brüel & Kjær Type ZC-0032	No: 18175	
Supplied Calibrator:	None		
Software version:	BZ7222 Version 4.5.2	Pattern Approval:	PTB1.63-40478500 / 1.63-4078502
Instruction manual:	BE1712-22		

CUSTOMER

Enfonic Ltd
Unit 2A, Century Business Park
Dublin
D11 T0HV
Ireland

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in **Environmental conditions** sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC6162-1:2013 class 1. Proceedures from IEC 61672-3:2013 were used perform the periodic tests. The accreditation assures the traceability of the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 7.3 - DB: 7.30) by using procedure B&K proc 2250, 4189 (IEC61672:2013)

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2021-05-21

Date of issue: 2021-05-21

M. Önder

Mikail Önder
Calibration Technician

Susanne Jørgensen

Susanne Jørgensen
Approved Signatory

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HBK HOTTINGER BRÜEL & KJÆR
The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

ilac-MRA DANAK
CAL Reg.No. 307
Member of EA MLA

CERTIFICATE OF CALIBRATION

No: CDK2103317

CALIBRATION OF

Supplied Calibrator:	Brüel & Kjær Type 4231	No: 2460008 Id: -
½ Inch adaptor:	Brüel & Kjær Type UC-0210	
Pattern Approval:	PTB-1.61-4057176	

CUSTOMER

Enfonic Ltd.
Unit 2A
Century Business Park
D11 T0HV Dublin
Ireland

CALIBRATION CONDITIONS

Preconditioning:	4 hours at 23°C ± 3°C
Environment conditions:	Pressure: 99.81 kPa. Humidity: 42 % RH. Temperature: 23.1 °C.

SPECIFICATIONS

The Supplied Calibrator Brüel & Kjær Type 4231 has been calibrated in accordance with the requirements as specified in IEC60942:2003 Annex B Class 1. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 (version 2.5) by using procedure P_4231_D07.

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2021-05-17

Date of issue: 2021-05-17

Morten Høngård Hansen
Calibration Technician

Susanne Jørgensen
Approved Signatory

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Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

DANAK
CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: CDK2101007

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250-Light	No: 3008590	Id: - 3008590
Microphone:	Brüel & Kjær Type 4952	No: 2788845	

Supplied Calibrator:	None		
Software version:	BZ7222 Version 4.5.2	Pattern Approval:	PTB1.63-40478500 / 1.63-4078502
Instruction manual:	BE1712-22		

CUSTOMER

Enfonic Ltd
Unit 2A, Century Business Park
Dublin
D11 T0HV
Ireland

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in **Environmental conditions** sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC6162-1:2013 class 1. Proceedures from IEC 61672-3:2013 were used perform the periodic tests. The accreditation assures the traceability of the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 7.3 - DB: 7.30) by using procedure B&K proc 2250, 4189 (IEC61672:2013)

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2021-06-24

Date of issue: 2021-06-24

M. Önder

Mikail Önder
Calibration Technician

Susanne Jørgensen

Susanne Jørgensen
Approved Signatory

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HBK HOTTINGER BRÜEL & KJÆR
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Skodsborgvej 307, DK-2850 Nærum, Denmark

ilac-MRA DANAK CAL Reg.No. 307 Member of EA MLA

CERTIFICATE OF CALIBRATION

No: CDK2102651

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250	No: 2690265	Id: -
Microphone:	Brüel & Kjær Type 4189	No: 2748694	
PreAmplifier:	Brüel & Kjær Type ZC-0032	No: 15279	
Supplied Calibrator:	Brüel & Kjær Type 4231	No: 2389038	
Software version:	BZ7224 Version 4.7.5	Pattern Approval:	PTB1.63-4093056 / 1.63-4093058
Instruction manual:	BE1712-22		

CUSTOMER

RPS Group Ltd.
Mervue
G1 Galway
Ireland

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC 61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 8.2 - DB: 8.20) by using procedure B&K proc 2250, 4189 (IEC 61672:2013).

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2021-04-12

Date of issue: 2021-04-13

Lene Petersen
Calibration Technician

Erik Bruus
Approved Signatory

Reproduction of the complete certificate is allowed. Parts of the certificate may only be reproduced after written permission.

HBK HOTTINGER BRÜEL & KJÆR
The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

ilac-MRA DANAK
CAL Reg.No. 307
Member of EA MLA

CERTIFICATE OF CALIBRATION

No: CDK2102594

CALIBRATION OF

Supplied Calibrator:	Brüel & Kjær Type 4231	No: 2389038 Id: -
½ Inch adaptor:	Brüel & Kjær Type UC-0210	
Pattern Approval:	PTB-1.61-4057176	

CUSTOMER

RPS Group Ltd.
Mervue
G1 Galway
Ireland

CALIBRATION CONDITIONS

Preconditioning:	4 hours at 23°C ± 3°C
Environment conditions:	Pressure: 100.07 kPa. Humidity: 41 % RH. Temperature: 22.9 °C.

SPECIFICATIONS

The Supplied Calibrator Brüel & Kjær Type 4231 has been calibrated in accordance with the requirements as specified in IEC60942:2003 Annex B Class 1. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 (version 2.5) by using procedure P_4231_D07.

RESULTS

Calibration Mode: **Calibration after repair/adjustment.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2021-04-09

Date of issue: 2021-04-09

Rikke Hansen
Calibration Technician

Erik Bruus
Approved Signatory

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APPENDIX 9C

Baseline Noise Graphs

Appendix 9C – Baseline Noise Graphs

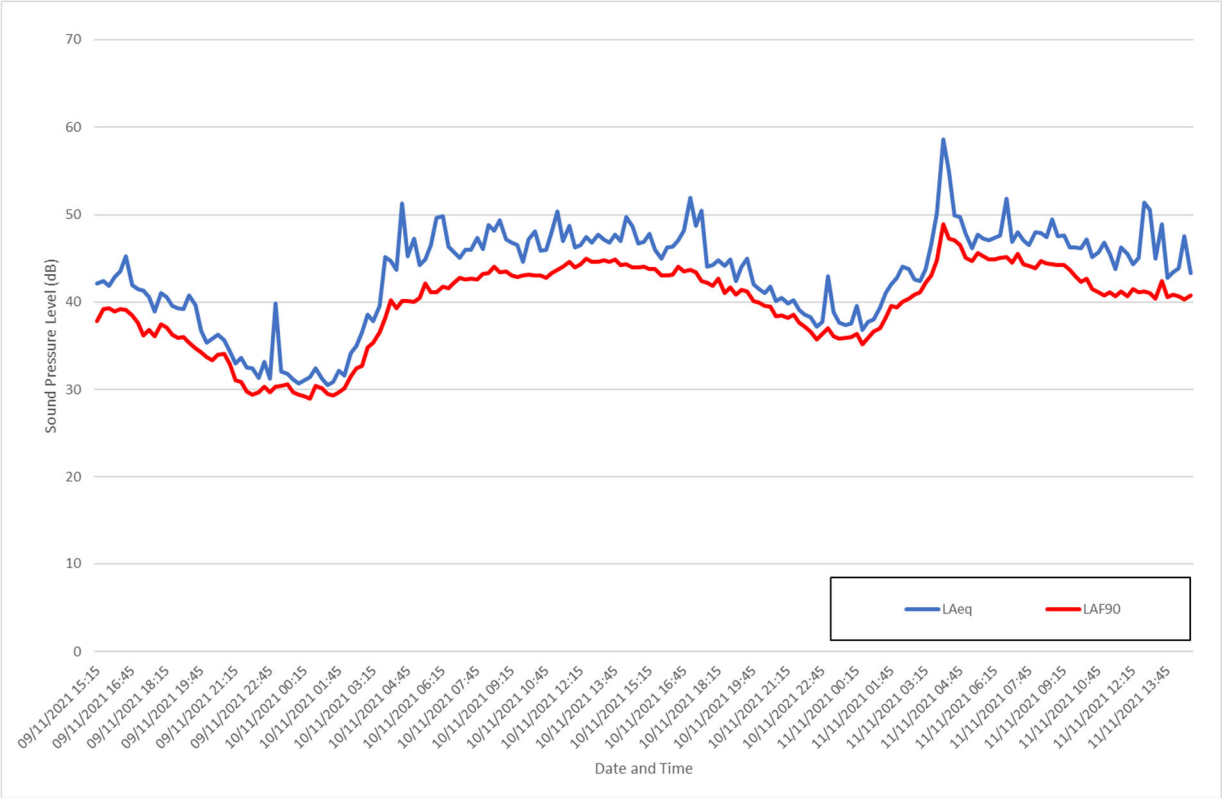


Figure 1: Baseline Noise Survey Data - Noise Monitoring Locations NML1

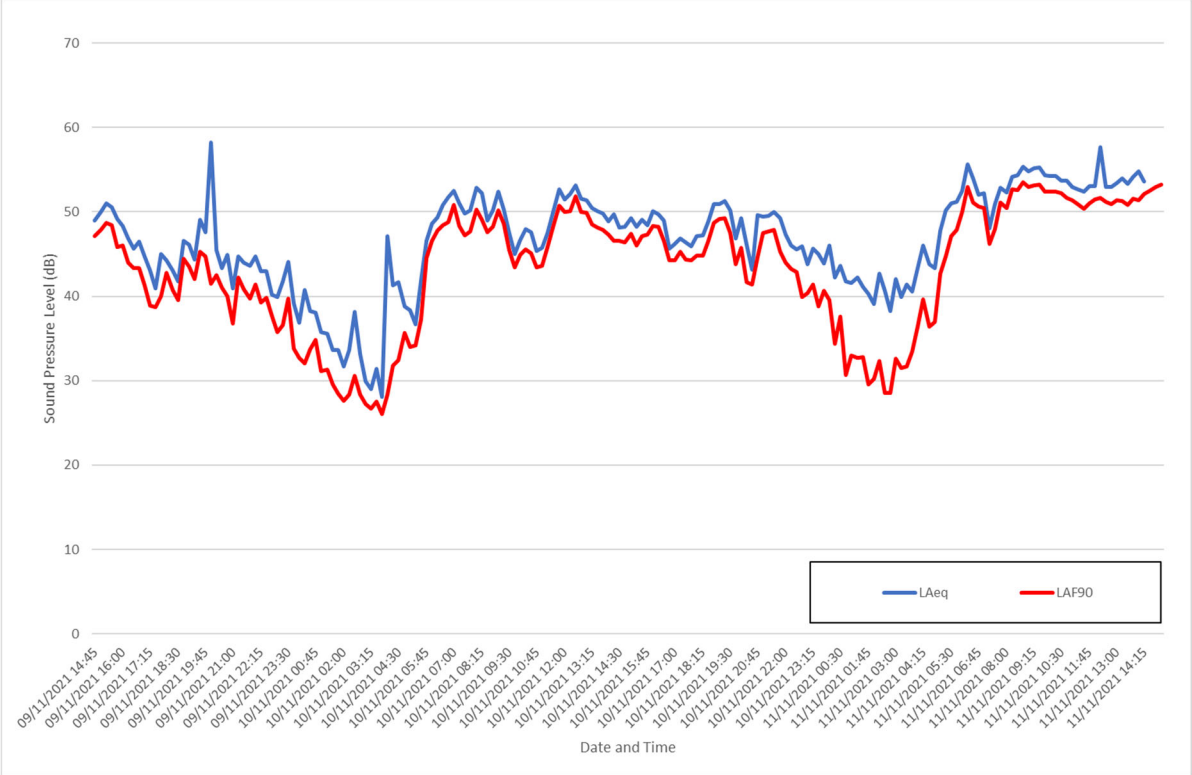


Figure 2: Baseline Noise Survey Data - Noise Monitoring Location NML2

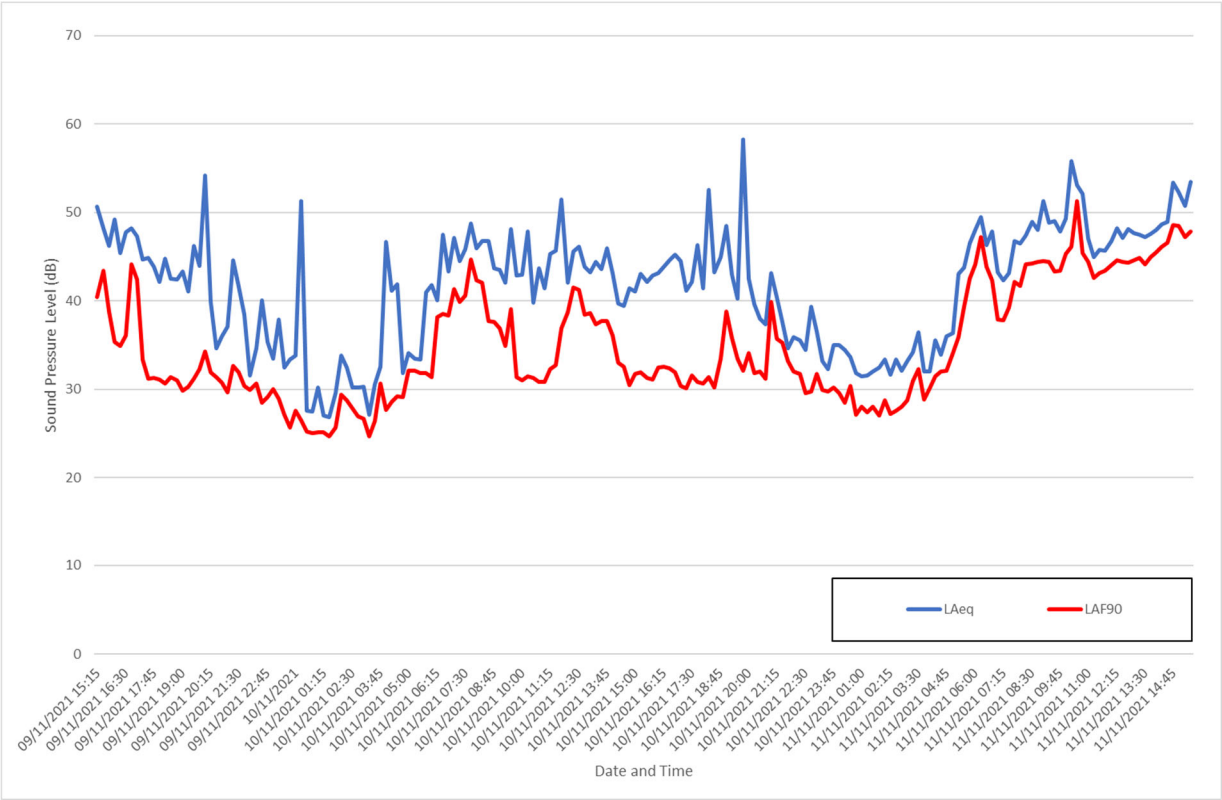


Figure 3: Baseline Noise Survey Data - Noise Monitoring Location NML3

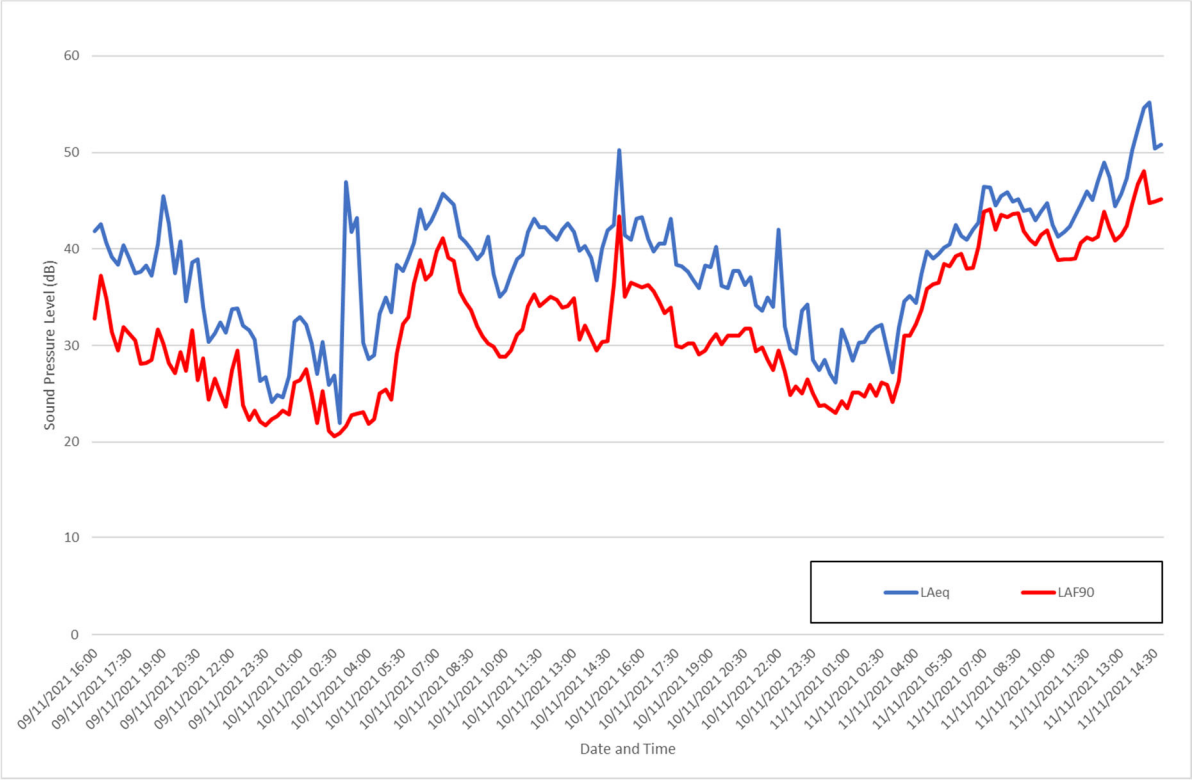


Figure 4: Baseline Noise Survey Data - Noise Monitoring Location NML4

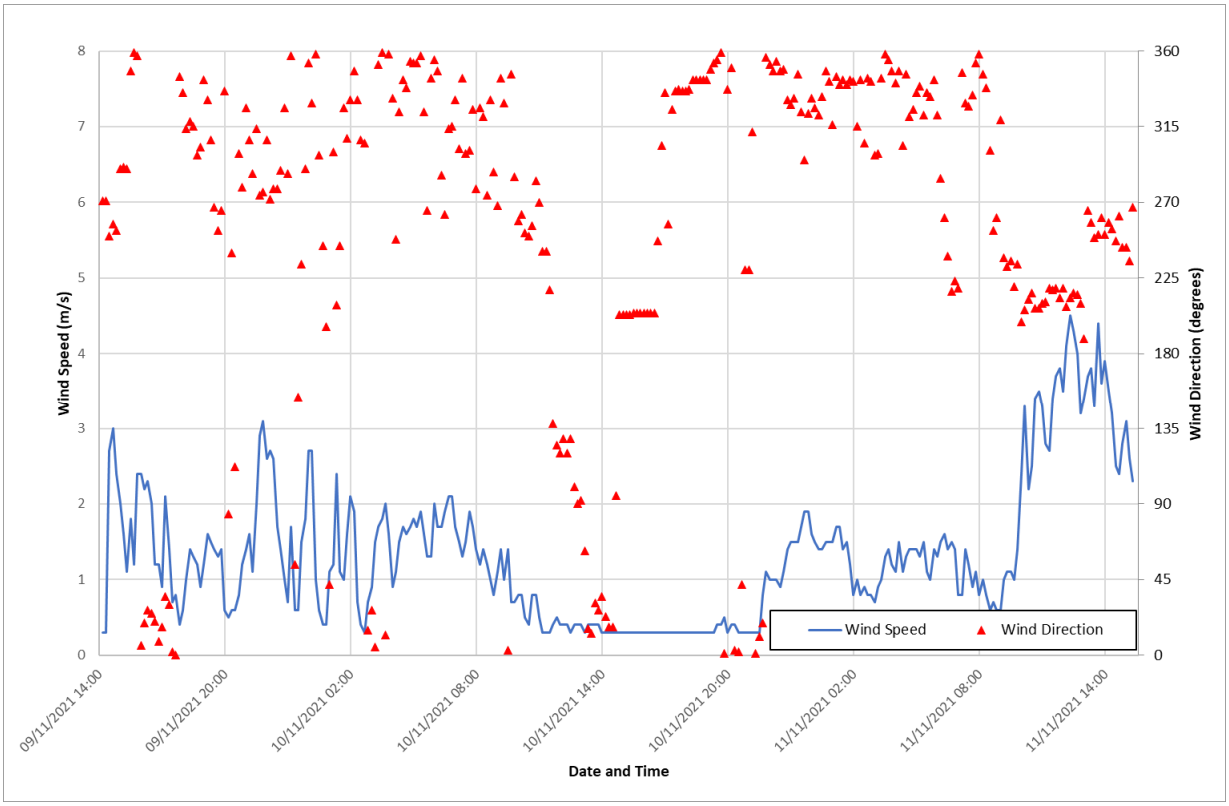


Figure 5: Wind Speed and Direction during Baseline Noise Survey

APPENDIX 10A

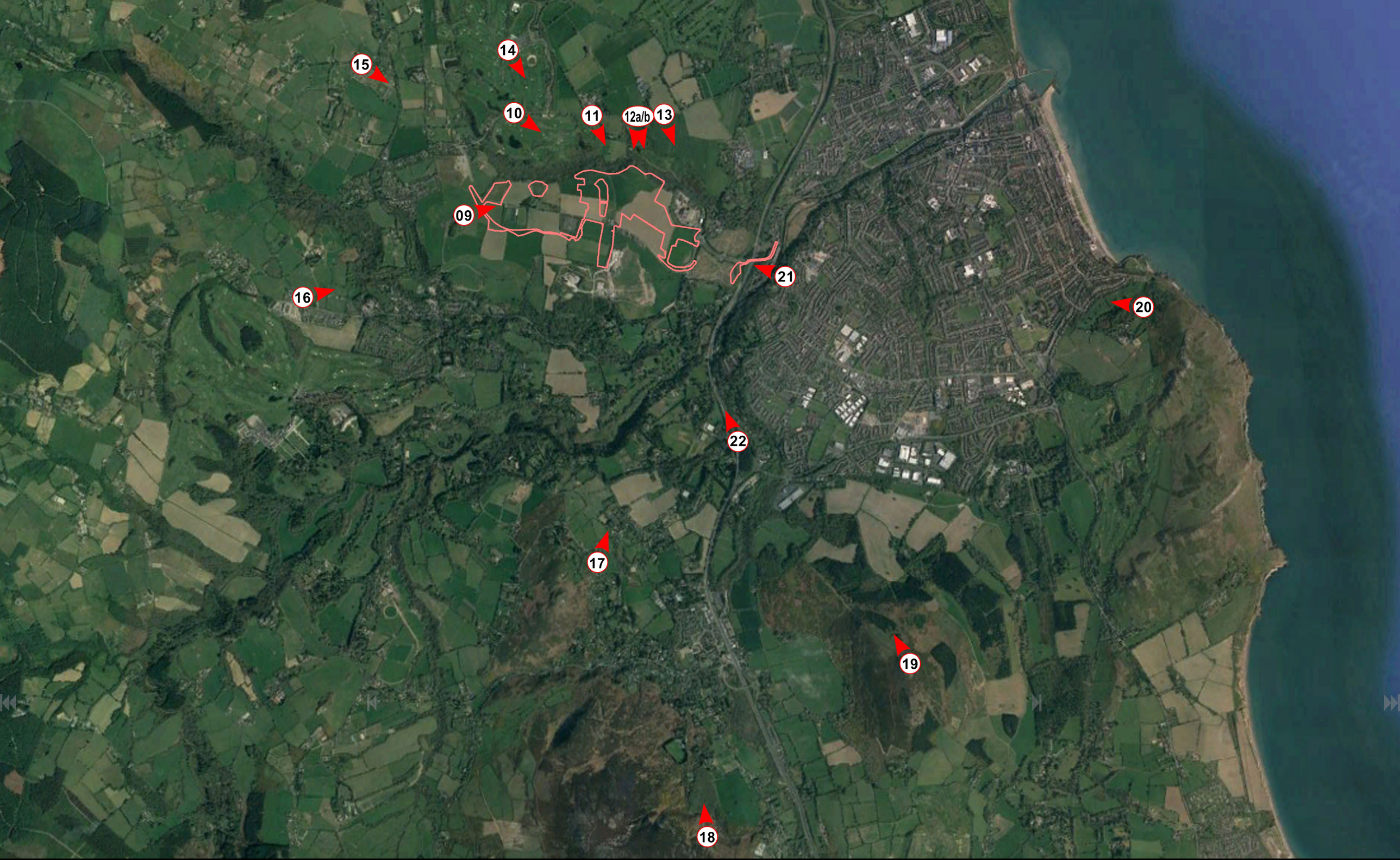
Photomontages of Proposed Development for LVIA

MODEL WORKS

project: Fassaroe, County Wicklow

viewpoint: **View Location Map**

issued: 11-01-2022



MODEL WORKS

project: Fassaroe, County Wicklow

viewpoint: **View Location Map**

issued: 13-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 10:48
Canon 5D Mark II
24 mm Lens

location: E 724328.022 N 717947.564

viewpoint: **View 01 Baseline**

issued: 03-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 10:48
Canon 5D Mark II
24 mm Lens

location: E 724328.022 N 717947.564

viewpoint: **View 01 Proposed**

issued: 15-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:07
Canon 5D Mark II
24 mm Lens

location:
E 724345.952 N 718034.179

viewpoint: **View 02 Baseline**

issued: 20-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:07
Canon 5D Mark II
24 mm Lens

location: E 724345.952 N 718034.179

viewpoint: **View 02 Proposed**

issued: 15-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:14
Canon 5D Mark II
24 mm Lens

location:
E 724272.348 N 717901.725

viewpoint: **View 03 Baseline**

issued: 20-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:14
Canon 5D Mark II
24 mm Lens

location:
E 724272.348 N 717901.725

viewpoint: **View 03 Proposed**

issued: 15-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 14:05
Canon 5D Mark II
24 mm Lens

location: E 723833.329 N 717986.323

viewpoint: **View 04 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 14:05
Canon 5D Mark II
24 mm Lens

location:
E 723833.329 N 717986.323

viewpoint: **View 04 Proposed**

issued: 15-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 11:21
Canon 5D Mark II
24 mm Lens

location:
E 723718.824 N 718047.429

viewpoint: **View 05 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 11:21
Canon 5D Mark II
24 mm Lens

location: E 723718.824 N 718047.429

viewpoint: **View 05 Proposed**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:40
Canon 5D Mark II
24 mm Lens

location: E 723695.077 N 718061.260

viewpoint: **View 06a Baseline**

issued: 22-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:40
Canon 5D Mark II
24 mm Lens

location:
E 723695.077 N 718061.260

viewpoint: **View 06a Proposed**

issued: 22-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:41
Canon 5D Mark II
24 mm Lens

location: E 723688.361 N 718054.147

viewpoint: **View 06b Baseline**

issued: 22-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 11:41
Canon 5D Mark II
24 mm Lens

location: E 723688.361 N 718054.147

viewpoint: **View 06b Proposed**

issued: 22-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 11:26
Canon 5D Mark II
24 mm Lens

location: E 723624.704 N 718076.421

viewpoint: **View 07 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

.MODEL WORKS	*project:*	Fassaroe, County Wicklow	*photography:*	23-10-2020 11:26 Canon 5D Mark II 24 mm Lens	*location:*	E 723624.704 N 718076.421	*viewpoint:* **View 07 Proposed** *issued:* 17-01-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 12:01
Canon 5D Mark II
24 mm Lens

location:
E 723423.820 N718126.791

viewpoint: **View 08 Baseline**

issued: 20-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 06-09-2021 12:01
Canon 5D Mark II
24 mm Lens

location: E 723423.820 N718126.791

viewpoint: **View 08 Proposed**

issued: 17-01-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 14:37
Canon 5D Mark II
24 mm Lens

location: E 722472.968 N 718110.270

viewpoint: **View 09 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 14:37
Canon 5D Mark II
24 mm Lens

location: E 722472.968 N 718110.270

viewpoint: **View 09 Proposed**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 16:05
Canon 5D Mark II
24 mm Lens

location: E 722831.368 N 3718916.367

viewpoint: **View 10 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 16:05
Canon 5D Mark II
24 mm Lens

location: E 722831.368 N 3718916.367

viewpoint: **View 10 Proposed**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 16:21
Canon 5D Mark II
24 mm Lens

location: E 723456.771 N 718915.920

viewpoint: **View 11 Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 16:21
Canon 5D Mark II
24 mm Lens

location: E 723456.771 N 718915.920

viewpoint: **View 11 Proposed**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:46
Canon 5D Mark II
24 mm Lens

location: E 723781.983 N 718912.589

viewpoint: **View 12a Baseline**

issued: 09-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:46
Canon 5D Mark II
24 mm Lens

location:
E 723781.983 N 718912.589

viewpoint: **View 12a Proposed**

issued: 03-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:48
Canon 5D Mark II
24 mm Lens

location:
E 723781.983 N 718912.589

viewpoint: **View 12b Baseline**

issued: 10-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:48
Canon 5D Mark II
24 mm Lens

location:
E 723781.983 N 718912.589

viewpoint: **View 12b Proposed**

issued: 03-11-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:56
Canon 5D Mark II
24 mm Lens

location:
E 723975.098 N 718946.206

viewpoint: **View 13 Baseline**

issued: 10-09-2021

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:56
Canon 5D Mark II
24 mm Lens

location: E 723975.098 N 718946.206

viewpoint: **View 13 Proposed**

issued: 03-11-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:21
Canon 5D Mark II
24 mm Lens

location:
E 722784.496 N 719416.884

viewpoint: **View 14 Baseline**

issued: 10-09-2021

Angle of View 39° Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 28-10-2020 13:21
Canon 5D Mark II
24 mm Lens

location:
E 722784.496 N 719416.884

viewpoint: **View 14 Proposed**

issued: 03-11-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 15:50
Canon 5D Mark II
24 mm Lens

location:
E 721610.387 N 719277.729

viewpoint: **View 15 Baseline**

issued: 11-09-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 15:50
Canon 5D Mark II
24 mm Lens

location:
E 721610.387 N 719277.729

viewpoint: **View 15 Proposed**

issued: 11-09-2021

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS	*project:*	Fassaroe, County Wicklow	*photography:*	23-10-2020 15:27 Canon 5D Mark II 24 mm Lens	*location:*	E 721208.027 N 717514.508	*viewpoint:* **View 16 Baseline** *issued:* 10-09-2021

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 15:27
Canon 5D Mark II
24 mm Lens

location: E 721208.027 N 717514.508

viewpoint: **View 16 Proposed**

issued: 10-09-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 12:18
Canon 5D Mark II
24 mm Lens

location:
E 723517.857 N 715552.742

viewpoint: **View 17 Baseline**

issued: 11-09-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 12:18
Canon 5D Mark II
24 mm Lens

location:
E 723517.857 N 715552.742

viewpoint: **View 17 Proposed**

issued: 03-11-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 12:39
Canon 5D Mark II
24 mm Lens

location:
E 724468.310 N 713390.878

viewpoint: **View 18 Baseline**

issued: 11-09-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 12:39
Canon 5D Mark II
24 mm Lens

location:
E 724468.310 N 713390.878

viewpoint: **View 18 Proposed**

issued: 15-11-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 11:47
Canon 5D Mark II
24 mm Lens

location: E 725930.526 N 714751.948

viewpoint: **View 19 Baseline**

issued: 11-09-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 11:47
Canon 5D Mark II
24 mm Lens

location: E 725930.526 N 714751.948

viewpoint: **View 19 Proposed**

issued: 11-01-2022

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 10:39
Canon 5D Mark II
24 mm Lens

location:
E 727663.755 N 717496.034

viewpoint: **View 20 Baseline**

issued: 12-09-2021

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 10:39
Canon 5D Mark II
24 mm Lens

location: E 727663.755 N 717496.034

viewpoint: **View 20 Proposed**

issued: 15-11-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 10:24
Canon 5D Mark II
24 mm Lens

location: E 724988.685 N 717737.905

viewpoint: **View 21** **Baseline**

issued: 12-09-2021

Angle of View 39^{O} Horizontal (50 mm Lens)

.MODEL WORKS

project: Fassaroe, County Wicklow

photography: 23-10-2020 10:24
Canon 5D Mark II
24 mm Lens

location:
E 724988.685 N 717737.905

viewpoint: **View 21 Proposed**

issued: 15-11-2021

Angle of View 39^{o} Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 11:10
Canon 5D Mark II
24 mm Lens

location: E 724619.931 N 716477.008

viewpoint: **View 22 Baseline**

issued: 12-09-2021

Angle of View 39° Horizontal (50 mm Lens)

MODEL WORKS

project: Fassaroe, County Wicklow

photography: 22-10-2020 11:10
Canon 5D Mark II
24 mm Lens

location: E 724619.931 N 716477.008

viewpoint: **View 22 Proposed**

issued: 04-11-2021

APPENDIX 11A

Archaeological Heritage Legislative / Guideline Considerations

APPENDIX 11A
ARCHAEOLOGICAL HERITAGE
LEGISLATIVE/GUIDELINE CONSIDERATIONS

Archaeological Heritage

The statutory and administrative framework of development control in zone of archaeological potential or in proximity to recorded monuments has two main elements:

(a) Archaeological preservation and licensing under the National Monuments Acts – see the DAHGI *Policy & Guidelines* below; and
(b) Development plans and planning applications under the Planning Acts.

National Monuments Acts

RECORD OF MONUMENTS AND PLACES (RMP)

Section 12 (1) of the National Monuments (Amendment) Act, 1994 provides that the Minister for the Environment, Heritage and Local Government shall establish and maintain a record of monuments and places where the Minister believes there are monuments, such record to be comprised of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect to each county of the State. This is referred to as the 'Record of Monuments and Places' (RMP), and monuments entered into it are referred to as 'Recorded Monuments'.
Section 12(3) of the National Monuments (Amendment) Act 1994 provides for the protection of monuments and places in the record, stating that

"*When the owner or occupier (not being the Minister) of a monument or place which has been recorded under subsection (1) of this section or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Minister and shall not, except in the case of urgent necessity and with the consent of the Minister, commence work for a period of two months after having given the notice.*

SITES CH-1 to CH-9 and CH-11, identified in Chapter 11, are all entered into the respective RMPs for Cos. Wicklow and Dublin

NATIONAL MONUMENTS & MINISTERIAL CONSENT

Section 14(1) of the National Monuments (Amendment) Act, 2004 states that *in respect of a national monument of which the Minister or a Local Authority are the owners or the guardians or in respect of which a preservation order is in force, it shall not be lawful for any person to do any of the following things in relation to such national monument:…(b) to excavate, dig, plough or otherwise disturb the ground around, or in proximity to it...without the consent referred to in subsection (2) of this section or otherwise tan in accordance with such consent.*

Section 14(2) refers to the granting, or otherwise, of consent and includes for a period of not more that 14days consultation with the Director of the National Museum of Ireland following submission of a written consultation document. In addition, it should be noted that this subsection is not restricted to archaeological considerations.

In general, consent to undertake work in the environs of a National Monument is required for any works within *c.* 50m of the boundary to the monument. The application for consent is applied for by

the landowner/local authority and should be submitted as early as possible in advance of any works proceeding.

SITE CH-1, identified in Chapter 11, is a National Monument and, consequently, works in the immediate environs of such will require Ministerial Consent.

Framework and Principles for the Protection of the Archaeological Heritage

This report, published by the Department of Arts, Heritage, Gaeltacht and the Islands in 1999, sets out broad principles for the protection of the Archaeological Heritage. In terms of the subject lands, the following sections of the document apply:

Archaeological Assessment
3.6.1. In the present context archaeological assessment means investigation aimed at…considering the potential that proposed development works or longer term effects of a development may have on elements of the archaeological heritage not identified prior to the commencement of development works.

3.6.2. Where it is considered that a development may (due to its location, size or nature) have archaeological implications, then an archaeological assessment should be carried out. Archaeological assessment, as defined above may be appropriate in relation to development of such a scale or nature as to make it reasonable to consider the impact on as yet identified elements of the archaeological heritage. Examples of such development include…development which is extensive in terms of area or length…development in respect of which an environmental impact statement is required to be prepared.

3.6.7. If archaeological assessment is appropriate, a report on the assessment should accompany any application for authorisation to undertake development.

Wicklow County Development Plan 2016 – 2022

The policies of this plan, with respect to Archaeological Heritage, are contained in Section 10.22 and contain the following relevant objectives:

BH1 No development in the vicinity of a feature included in the Record of Monuments & Places (RMP) will be permitted where it seriously detracts from the setting of the feature or which is seriously injurious to its cultural or educational value.

AR2 Any development that may due to its size, location or nature have implications for archaeological heritage (including both sites and areas of archaeological potential / significance as identified in Schedule 10.01 & 10.02 and Map 10.01 & 10.02 of this plan) shall be subject to an archaeological assessment. When dealing with proposals for development that would impact upon archaeological sites and/or features, there will be presumption in favour of the 'preservation in situ' of archaeological remains and settings, in accordance with Government policy. Where permission for such proposals is granted, the Council will require the developer to have the site works supervised by a competent archaeologist.

BH3 To protect previously unknown archaeological sites and features, including underwater sites, where they are discovered during development works.

APPENDIX 11B

Classification of Archaeological Monuments

APPENDIX 11B - CLASSIFICATION OF ARCHAEOLOGICAL MONUMENTS

A number of monument types and structures have been identified within the study area (Chapter 11; Section 11.2.1). These are described below in Appendix 5 and 6. What follows is a brief introduction, describing the main characteristics and the broad cultural and chronological context of such monument types.

CLASSIFICATION	SCOPE NOTE
Burial	An internment or deposition of human or animal remains in an isolated context not associated with a burial ground or graveyard. These can date to any period from prehistory onwards
Castle – Tower House	A fortified residence in the form of a tower, usually four or five storeys high, and for the most part more rectangular than square in plan. They were constructed by a lord or landowner and often partially or completely enclosed by a bawn. The majority date to the 15th and 16th centuries AD.
Church	A building used for public Christian worship. These may be on any date from *c.* 500 AD onwards
Cross	A free-standing structure, in the form of a cross (+), symbolising the structure on which Jesus Christ was crucified.
Ecclesiastical Remains	A location where a religious foundation existed but there is insufficient evidence to allow for a more precise classification. These date from the medieval (5th – 16th centuries AD) up to the 18th century.
Ecclesiastical Enclosure	A large oval or roughly circular area, usually over 50m in diameter, defined by a bank/banks and external fosse/fosses or drystone wall/walls, enclosing an early medieval church or monastery and is associated areas of domestic and industrial activity. These date to the early medieval period (5th – 12th centuries AD).
Font	A vessel usually made of stone, over which baptisms were held. These date from the medieval period (5th – 16th centuries AD).
Graveslab	A stone designed to be recumbent and marking a grave – AD 1200-1700 in date
Graveyard	The burial area around a church. These date from the medieval period (5th – 16th centuries AD) onwards.
House – 18th/19th century	A building for human habitation which dates to the 18th/19th century and which is not classified as either a country house or a vernacular house.
House – country house	The rural residence of the landed gentry. These houses date from the late 17th century to the first half of the 19th century AD.
Kiln – corn drying	A structure used for drying corn before it is ground. These are also known as cereal-drying kilns. These date from the medieval period (5th – 16th centuries) onwards
Metalworking Site	A place where metal is produced, They may date from the Bronze Age (**c.** 2400-500BC) onwards.
Mound	An artificial elevation of earth or earth and stone of unknown date and function which cannot be classified as any other known archaeological monument on present evidence.

CLASSIFICATION	SCOPE NOTE
Pier / Jetty	A structure, extending out into the water, built of iron, wood or stone, for docking or accessing ships or boats. They may also serve to protect a harbour, influence the current or tide and are sometimes used as promenades. These may date to any period from prehistory onwards.
Pit Burial	A pit-burial can vary from an oval or sub-rectangular pit large enough to accommodate a crouched inhumation to a small circular pit with only space for a deposit of cremated bone or cinerary urn. The date to the Bronze Age (**c.** 2400-500BC) and Iron Age (**c.** 500BC – AD 400).
Redundant Record	Records classed as 'Redundant Record' are those that fulfil one or more of the following criteria: (1) a record identifying a location where, according to documentary sources (e.g. published reference, cartographic sources) or personal communication, a monument might have existed, but which, on inspection, was found not to be an archaeological monument (e.g. a natural feature); (2) a record classified using a term which is now obsolete; (3) a record created in error, a duplicate record or one which has no supporting evidence recorded on file or in the ASI database; (4) an archaeological object (i.e. an artefact); (5) a record entered as 'Shipwreck' (Shipwrecks are entered in a separate database).
Ring Ditch	A circular or near circular fosse, usually less than 10m in diameter and visible as cropmarks/soilmarks on aerial photographs. The function of these monuments is unknown as ring-ditches may be the remains of ploughed-out barrows, round houses or other modern features and, in consequence, may date to any period from prehistory onwards.
Ritual Site – holy tree/bush	Named bush or tree, sometimes associated with a particular saint, often considered to have miraculous properties. They are generally found in close proximity to holy wells and formed part of the associated patterns or rounds performed on certain days. They are known in Irish as 'bile', which translated as 'sacred tree'. Sometimes corrupted into the English words 'bell' or 'bellow'. These may have their origins in prehistory but are associated with devotions from the medieval period (5^{th} – 16^{th} centuries AD) onwards.
Ritual Site – holy well	A well or spring, though in some unusual cases a natural rock basin, which usually bears a saint's name and is often reputed to possess miraculous healing properties. These may have their origins in prehistory but are associated with devotions from the medieval period (5^{th} – 16^{th} centuries AD) onwards.
Standing Stone	A stone which has been deliberately set upright in the ground, usually orientated on a northeast – southwest axis, although other orientations do occur, and varying in height from 0.5m up to 6m. They functioned as prehistoric burial markers, commemorative monuments, indicators of routeways or boundaries and date from the bronze Age and Iron Ages **(c.** 2400 – AD 500), with some associated with early medieval ecclesiastical and burial contexts (*c.* 5^{th} – 12^{th} centuries).

APPENDIX 11C

Archaeological Inventory

APPENDIX 11C - ARCHAEOLOGICAL INVENTORY

SITE CH-1

SMR No:
WI007-026
TOWNLAND:
Fassaroe
CLASSIFICATION:
Ecclesiastical Remains – Possible Site
ITM:
724245 717785
PROTECTION:
National Monument (Ref: 337); RMP;

This archaeological site comprises three elements, as follows:

A. WI007-026001 – Font

An octagonal limestone font described in the *Ordnance Survey Letters was* previously located immediately to the east of a cross (Wi007-026002). It is no longer at this location.

B. WI007-026002 – Cross

A granite cross (H: 1.42m; T: 0.16m) known as St. Vallery's Cross, with a circular head and chamfered edges. The west face has a depiction of Christ, represented as naked, with head inclined to the right. In the centre of the E face are two apparently bearded human heads in relief, one possible wearing a mitre. There are two other much worn heads, one on the lower S edge of the cross-head and one on the NE side of the base. This is now located fronting onto a footpath adjacent the eastern distributor road to the subject development lands – see Plate 11.1 below

C. WI007-026003 – Cross

The Ordnance Survey Letters describe a second cross, alongside the above, as follows: 'there is a piece of stone, 2ft 6in long, 9in wide and 5in thick lying at the foot of the cross, having one end shaped for the purpose of filling a round hole or mortice…This was another cross, but the arms or circle was broken off and probably for the purpose of what is called a cap stone under a rick or stack of corn.

Archaeological Testing was carried out on the site of a proposed warehouse and ancillary offices in the townland of Fassaroe by Redmond Tobin in 2002 (Licence No: 02E0084; www.excavations.ie Ref: 2002:1967) The area was adjacent to the monument of St Valery's Cross (SMR 7:26 (02)), and testing was required to ensure that the development did not encroach on or affect any buried archaeological features associated with the cross. A buffer zone around the cross was required, and testing would define the minimum diameter of such a buffer. Six trenches were excavated, three to the east and three to the west of Fassaroe Lane. All trenches started at 12–15m from the base of the cross and extended radially from it. This testing revealed no evidence of any archaeological features associated with St Valery's Cross. The excavator noted that 'therefore, it seems that two interpretations are possible in respect of the cross. Firstly, the cross has been moved from its original location, as suggested by Anne Plumtree in the early 19th century. This view is not contradicted by the test results. The other possibility is that it is a tearmann cross. If this is the case, it marks the boundary of consecrated lands and may be peripheral to any physical ecclesiastical remains'.

Plate 11.1 Site CH-1B

SITE CH-2

SMR No:
WI007-024
TOWNLAND:
Fassaroe
CLASSIFICATION:
Burial
ITM:
723524 717550
PROTECTION:
RMP;

Situated on a former gentle E-facing slope. Extended inhumation of an adult female (aged approx. 35 years) in an unlined grave found during quarrying in 1943. The skeleton was aligned E-W with the head to the W. Part of a flint scraper and a flint blade came from a high level in the grave fill (NMI 1943-00316/7). The site has been destroyed by quarrying.

SITE CH-3

SMR No:
WI007-027
TOWNLAND:
Fassaroe
CLASSIFICATION:
Castle – Tower House
ITM:
724218 717516
PROTECTION:
RMP; Preservation Order (Ref: 120/1940);

Situated on a SE-facing slope overlooking the Dargle Valley and built by William Brabazon, Treasurer of Ireland, in 1535. Only two walls of this granite-built tower house survive, although traces of the foundations of the other two can be identified. A substantial part of the barrel vault extends from the S wall over the first floor. Embrasures and aumbries survive at ground- and first-floor levels on both walls. The barrel vault and soffits of the embrasures retain traces of wicker centring. The doorway and stairwell were on either of the E or N side and no trace of them survives.

SITE CH-4

SMR No:
WI003-032
TOWNLAND:
Monastery
CLASSIFICATION:
Ecclesiastical Remains – Possible
ITM:
722415 718407
PROTECTION:
RMP;

This archaeological site comprises two elements, as follows:

A. WI003-032001 – Ecclesiastical Enclosure

Situated on a low-level rise in undulating terrain and very overgrown. An enclosure is indicated in the 1838 OS 6-inch map for which there now no visible traces. A Geophysical Survey was undertaken in June 2016 by J.M. Leigh Surveys (Licence Ref: 16R0086) within the field containing Site CH-4. The geophysical survey has successfully located the extent of the outer enclosure (RMP WI003:032001) of a partially extant church (RMP WI003:032002). Although the responses appear fragmented in places, a sub-circular enclosure, measuring c.77m in diameter was clearly represented in the data (See **Appendix 11.4**). This correlates with a ditch feature identified in aerial photographs. In addition, several pit-type responses and rectilinear ditch type features have been identified. It is most likely that multiphase activity is represented here, and it is possible that several enclosure features, including a possible rectilinear enclosure, were represented by the recorded responses. Elsewhere in the data, broad amorphous responses may represent plough damaged remains of large enclosing features. However, it is equally possible that the responses result from natural features within the sub-soil and interpretation is cautious. Adjacent to a large electricity pylon there is a circular response, measuring c.7m in diameter. This occurs in the magnetic 'shadow' of the pylon. Although there are no further responses in the vicinity this may represent a small circular enclosure. This is speculative but must be considered.

B. WI003-032002 – Church

All that remains of the church is a possible wall foundation (Wth: 1m; H: 0.2m) running N-S towards the E end of an irregular area of stones (27m E-W; 15.5m N-S) defined at N by a stone bank. It is presently very overgrown, as illustrated below in Plate 11.2

A programme of Archaeological Testing associated with the Enniskerry Water Supply Scheme, was undertaken by David Bayley with Faith Bailey in 2007 (Licence No.: 07E169; www.excavations.ie Ref: 2007:2008). Part of the testing was undertaken adjacent the subject monument and nothing of interest was uncovered.

Archaeological Testing was undertaken by Martin Byrne in August 2016 (Licence No: 16E0356) within the field containing Site CH-4. A total of 14 test trenches were excavated across the field but excluding the area of the enclosure detected by the geophysical survey. In general, the trenches were positioned to gain information with respect to the geophysical anomalies detected outside the 'monastic enclosure', and

within potential development areas. In particular, T5 was excavated across F13, T2 across F11 and T12 in the area of F9. T8 and T9 were positioned to determine if any potential burials existed outside the 'monastic enclosure', with the latter (T9) to be excavated from north to south and to terminate at the inside edge of the detected outer enclosing element of the 'monastic enclosure'. Such testing uncovered the remains of a ditch feature at a location along the external enclosure (RMP: WI003-032001), as detected by the geophysical survey, thereby proving its archaeological origins. The remaining geophysical anomalies across the field and outside the enclosure were determined to be either of geological origin, or related to magnetic variations associated with the electricity pylon/mast and its associated overhead lines. Three sherds of late-12th/early-13th century pottery were recovered – see **Appendix 11.5** for further details

Plate 11.2 Site CH-4B

SITE CH-5

SMR No:
WI007-023
TOWNLAND:
Monastery
CLASSIFICATION:
Mound
ITM:
722790 717628
PROTECTION:
RMP;

Situated on the E end of a flat-topped ridge and overlooking the steep-sided Cookstown River valley to the S. It comprises an Oval mound (17.5m WNW-ESE; 12.5m NNE-SSW); max H: 5m). The mound is surrounded by a berm (Wth: 5m) except on the N side where the edge borders the side of a narrow valley.

SITE CH-6

SMR No:
DU028-001
TOWNLAND:
Ballyman
CLASSIFICATION:
Standing Stone
- Possible
ITM:
723492 718629
PROTECTION:
RMP;

This feature is not marked on any OS or other maps. It is noted by Turner (1983, 28) as an undecorated stone. The exact location has not been determined by the Archaeological Survey of Ireland and it is now classified as a 'Redundant Record' (www.archaeology.ie).

SITE CH-7

SMR No:
DU028-002
TOWNLAND:
Ballyman
CLASSIFICATION:
Ecclesiastical Remains
ITM:
723479 718629
PROTECTION:
RMP;

This archaeological site is located in a valley bottom on the north bank of the County Brook. This is the church of Glen Mhuire, formerly an Early Christian Foundation dedicated to St. Sillian and attached to Glendalough. The church in the early 14th century is listed among the possessions of the Knights Templars at their dissolution. It was the subject of archaeological excavations by Dr. Elizabeth O'Brien in the 1980s, and incorporates a number of elements, as follows:

A. DU028-002001 – Ecclesiastical Enclosure

A possible enclosure is indicated on the 1838 O.S.6-inch map for which there are now no surface traces. This enclosure was extant until 1850.

B. DU028-002002 – Church

The E gable and a portion of the S wall are extant, while the N wall survives to foundation level. The walls are of roughly coursed granite masonry and incorporate a round-headed E window under a segmental arch and a splayed ope at the W end of

the S wall. The aumbry in the E gable has a graveslab as a lintel (DU028-002006 below).

C. DU028-002003 – Ritual Site: Holy Well

Indicated as 'St. Kevin's Well' on the 1909 O.S. 6" map; there are now no surface traces.

D. DU028-002005 – Graveslab

This slab formed a lintel to the church window and was moved to the National Museum of Ireland on 1960 (Reg. No: 1940:106). The slab is carved with two groups of concentric circles with centre cup marks, a centre band and herringbone pattern (Ó hÉailidhe, 1973, 57).

E. DU028-002006 - Graveslab

An aumbry in the S end of the E able of the church is partly formed by a graveslab fragment (L: 0.38m; Wth: 0.28m). The slab bears a central band and herringbone pattern (Ó hÉailidhe, 1957, 78, 83).

F. DU028-002007 – Kiln: Corn Drying

Hour-glass shaped kiln excavated by O'Brien and dated to early 5th century AD.

G. DU028-002008 – Fulacht Fiadh?

Investigation of a river meander (originally suspected of being the site of a possible Fulacht Fiadh) was undertaken in August 1979 by Dr. Elizabeth O'Brien (www.excavation.ie. No. 317). Excavation revealed the stony layer of a probable post-glacial river meander, sealed underneath a shallow layer of peat-like material, which has been identified as an old Al horizon; this was partly sealed by a layer of hill-wash. The site appears to be a squatting area; finds include a small number of artefacts of flint and stone, waste flint and small cores, also some fragments of burnt and split bone and animal teeth. Recovered mainly from upper levels were several pieces of slag, and a small number of pottery sherds, probably associated with the known Early Christian/medieval church site nearby.

H. DU028-002009 – Ritual Site: Holy tree/bush

There is a tradition in the area that visitors to the site would tie a piece of cloth on the branches of a nearby tree. This feature has not been precisely located.

I. DU028-002010 – Metalworking Site

Excavations by O'Brien recovered a number of fragments of slag but the actual smelting area was not discovered

J. DU028-002011 – Graveyard

There is a graveyard associated with the site for which there are no extant gravestones/gravemarkers

SITE CH-8

SMR No:
DU026-113
TOWNLAND:
Ballyman
CLASSIFICATION:
Pit Burial
ITM:
723533 718829
PROTECTION:
RMP;

Two burials were truncated by road widening operations in 1979. Grave 1 was a burial contained in a cordoned urn and contained the remains of a young adult. Grave 2 was a cordoned urn that contained the remains of two individuals, an adult and a juvenile. The burials were dated to 1936 – 1531 BC and 1684 – 1523 BC (both at 95% probability (Cahill & Sikora, 2011, 161-67).

SITE CH-9

SMR No:
DU026-065
TOWNLAND:
Ballyman
CLASSIFICATION:
Ring Ditch
ITM:
724134 718853
PROTECTION:
RMP;

A possible ring-ditch is visible on an Aerial Photograph – CICAP BDP23. There are no visible surface traces of this feature.

SITE CH-10

SMR No:
N/A
TOWNLAND:
Ballyman
CLASSIFICATION:
Pit Burials
ITM:
723203 718717
PROTECTION:

Three pit burials were uncovered during topsoil stripping associated with the development of the Dun Laoghaire Golf Club by Martin Byrne in 2003. The pits, containing fragments of human bone in a charcoal and soil matrix, were located on the N side of the glen overlooking the County Brook. The pits were set on a line orientated NW-SE.

SITE CH-11

SMR No:
WI007-060
TOWNLAND:
Kilcroney
CLASSIFICATION:
Mound
ITM:
724357 717166
PROTECTION:
RMP;

The Ordnance Survey Letters (1838/40) noted 'the North East part of Kilcroney townland terminates in a point between two streams; on this point is a hillock of considerable size, which the people call a moate; but they tell you that it was anciently called Poll and choradh, i.e. the hole of the weir, or the hole or grave of the champion.' (O' Flanagan 1928, 21).

An oval enclosed area (dims. c. 90m E-W; c. 70m N-S) covered in trees and bounded by a stream on the E, is indicated in the NE part of Kilcroney townland on the 1st ed. OS 6-inch map (1838). In its present form it appears as an oval mound (dims. c. 50m N-S x c. 30m E-W; H c. 5m) with possible traces of a fosse along its N side and cut by the N11 on its E side. Referred to as the 'Rath field' and the 'Fairy fort' (Conboy 2007, 2-3). No archaeological features were encountered when constructing the foot bridge immediately to the S (ibid).

SITE CH-12

SMR No:
WI004-006
TOWNLAND:
Killarney
CLASSIFICATION:
Pier/Jetty
ITM:
724980 718200
PROTECTION:

Seventeen oak timbers (L 0.5m - 3.4m; Wth 0.12m-0.6m; T 0.08m-0.22m) located on a gravel surface were uncovered here in 1995 as part of works associated with widening the river (Excavation Licence 95E0004). The timbers were in two groups, 2.2m apart. Most of the timbers in the larger group (14) lay parallel to one another, and two of those in the smaller group appeared to be parallel. A radiocarbon date of 4661-4360 BC was returned for one of the timbers. The identification of these timbers as an archaeological structure is not certain and the excavator (McDermott 1995, 5) suggested that 'the most likely purpose for a structure at Killarney was as a landing place for log boats'. (McDermott 1995, 1-5).

APPENDIX 11D

Geophysical Survey Report, Monastery, Co. Wicklow, J.M. Leigh 2016

GEOPHYSICAL SURVEY

REPORT

Monastery,

County Wicklow

Date: 16/06/2016

Licence: 16R0086

1. J. M. Leigh
Surveys 124
Oaklawn West
Leixlip
County Kildare
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GEOPHYSICAL SURVEY SUMMARY SHEET

MONASTERY, COUNTY WICKLOW

Site Name	Monastery, County Wicklow	**Ref No.**	16019
Townland	Monastery	**Licence No.**	16-R-0086
County	Wicklow	**Licence Holder**	Joanna Leigh
ITM (centre)	E722381/N718465	**Purpose**	Pre-planning investigation
Client	Byrne Mullins & Associates	**Planning No.**	DAU reference: G Pre00103/2016
Closest RMP	WI003:032002	**Classification**	Church
ITM	E722415 / N718406	**Location**	Within survey area
Townland	Monastery		
Current land use	Agricultural – young arable crop at the time of survey		
Survey Type	Detailed gradiometer survey in available area. Application area totals c. 5 hectares.		

Summary of Results

The geophysical survey has successfully located the extent of the outer enclosure (RMP WI003:032001) of Annabasky Church (RMP WI003:032002). Although the responses appear fragmented in places, a sub-circular enclosure, measuring c.77m in diameter is clearly represented in the data. This correlates with the ditch feature identified in aerial photographs.

In addition, several pit-type responses and rectilinear ditch type features have been identified. It is most likely that multiphase activity is represented here, and it is possible that several enclosure features, including a possible rectilinear enclosure, are represented by the recorded responses.

Elsewhere in the data, broad amorphous responses may represent plough damaged remains of large enclosing features. However, it is equally possible that the responses result from natural features within the sub-soil and interpretation is cautious.

Adjacent to a large electricity pylon there is a circular response, measuring c.7m in diameter. This occurs in the magnetic 'shadow' of the pylon. Although there are no further responses in the vicinity this may represent a small circular enclosure. This is speculative but must be considered.

Report Date	16/06/2016	**Report Author**	Joanna Leigh

2. Geophysical Survey
Report Monastery,
County Wicklow

1 Introduction

1.1 A geophysical survey has been conducted by J. M. Leigh Surveys in a large open field within the townland of Monastery, County Wicklow. The survey was conducted as part of a pre-planning investigation by Byrne Mullins & Associates for a proposed development site.

1.2 The application area is located within a large open arable field to the north of Berryfield Land, to the west of Old Fassaroe. The survey has been requested (reference GPre00103/2016) to provide further information regarding a recorded church site (RMP WI003:032002). The church, recorded as Annabasky Church on the historic mapping, lies in ruins with substantial overgrown vegetation surrounding it. Recent aerial photographs have highlighted a sub-circular enclosure (RMP WI003:032002) encompassing the church remains. Figure 1 (at a scale of 1:5,000) presents the site and survey location with the location of the church site (WI003:032002)

1.3 It is the main aim of the survey to identify the recorded enclosure of the church and define its extent. The survey was extended throughout the field under investigation to identify any further responses of potential archaeological interest.

1.4 The survey was conducted under licence 16-R-0086 issued by the Department of Arts, Heritage and the Gaeltacht.

2 Survey ground conditions and further information

2.1 Ground conditions were excellent at the time of survey. The church was surrounded by dense vegetation and as much survey was conducted as possible in the area surrounding the church site.

2.2 A large electricity pylon in the north-west of the application area resulted in a large magnetic disturbance. This is clearly evident in the data. No archaeological interpretation within the magnetic disturbance can be provided. Although the disturbance is clearly visible in the data, the overall interpretation of the results is not affected.

3 Survey Methodology

Detailed Gradiometer

Survey

3.1 A detailed gradiometer survey detects subtle variations in the local magnetic field and measurements are recorded in nano-Tesla (nT). Some archaeological features such as ditches, large pits and fired features have an enhanced magnetic signal and can be detected through recorded survey.

3.2 Data was collected with a Bartington Grad 601-2 instrument. This is a specifically designed gradiometer for use in archaeological prospection. The gradiometer operates with a dual sensor capacity making survey fast and effective.

3.3 The instrument is calibrated in the field to ensure a constant high quality of data. Extremely sensitive, these instruments can detect variations in soil magnetism to 0.01nT, affording diverse application throughout a variety of archaeological, soil morphological and geological conditions.

3.4 All data was collected in 'zigzag' traverses. Grid orientation remained constant throughout each field to facilitate the data display and interpretation. The subsequent resistance survey was conducted on the same survey grid to allow a comparison of the results.

3.5 Data was collected with a sample interval of 0.25m and a traverse interval of 1m, providing 6400 readings per 40m x 40m grid. The survey grid was set-out using a GPS VRS unit. Survey tie-in information is available upon request.

4 Data display

4.1 A summary greyscale image and accompanying interpretation diagram of the results are presented in Figures 2 and 3, both at a scale of 1:1,250.

4.2 Numbers in parentheses in the text of the report refer to specific responses highlighted in the detailed gradiometer survey interpretation diagram, Figure 3.

4.3 The raw gradiometer data is presented in archive format and available upon request. The data is displayed as a raw data greyscale image and xy-trace plot both at a scale of 1:500. These plots are used to aid interpretation of the data and are for reference only.

5 Survey Results

5.1 The geophysical survey has identified several responses of clear interest. Many of the responses form incoherent patterns and it is speculated that multi-phase activity is likely.

5.2 In the vicinity of the church remains, a series of responses (1) is indicative of a sub-circular enclosure. This measures c.77m in diameter and correlates with the features identified in recent aerial photographs.

5.3 Within the sub-circular enclosure are several further responses of clear interest. However, their association with the outer enclosure is questionable and they most likely represent multi-phase activity.

5.4 Notably, there is a rectilinear response (2) which may represent a separate enclosure. The response is fragmented and interpretation is tentative, but it is possible that responses (2) form the eastern extent of a rectangular or square enclosure, possibly extending to fragmented responses (3), measuring 46m x 46m. This is speculative as the responses are magnetically weak and incoherent in places. Nevertheless, it is considered to represent a rectilinear enclosure and an archaeological interpretation must be considered.

5.5 A possible third enclosure may also be discerned from the data. A curvilinear response (4) may represent the eastern extent of another spherical enclosure. The western extent of the possible enclosure may be represented by the fragmented responses (5).

5.6 In the north west of the main outer enclosure (1) there is a circular response (6), measuring c.14m in diameter. This may represent a small enclosure and appears to have two possible isolated pits in the centre.

5.7 A series of isolated responses (7) are evident within the north of (1). Although an archaeological pattern is difficult to discern, these responses are typical of pit features and are considered to be of interest.

5.8 A series of linear trends (8) in the south of the data appear to extend from the enclosure (1). Although these are barely discernible in the data, they may suggest a continuation of features to the south-east.

5.9 Further isolated responses (9) outside the enclosure may represent isolated pit-type features. These are considered to be of archaeological potential.

5.10 In the north-western half of the data set there are broad responses (10) forming a vague large rectilinear pattern. The possible origin of these responses is unclear. It is possible that they represent large archaeological enclosing features. However, the broad appearance of the responses may equally suggest natural variations. An archaeological interpretation is cautious. Further curvilinear trends extend through the northern half of the data set. There are no clear archaeological patterns evident and these magnetically weak trends most likely represent natural variations.

5.11 A negative response (11) is curious. There is no clear pattern and interpretation is tentative. No clear archaeological interpretation can be provided.

5.12 A broad area of magnetic disturbance (12) results from a large electricity pylon. The magnetic ‘shadow’ extends out from the pylon and no interpretation within this can be provided.

5.13 At the edge of the magnetic disturbance (12) there is a response of possible interest. Interpretation is cautious due to the proximity to the pylon but it is possible that a circular ditch (13) with a diameter of c.7m is represented here.

5.14 Isolated ferrous responses in the data are most likely modern in origin and result from modern litter and debris in the top soil. These are not considered to be of archaeological interest

6 Discussion & Conclusion

6.1 The geophysical survey has successfully located the extent of the outer enclosure (RMP WI003:032001) of Annabasky Church (RMP WI003:032002). Although the responses appear fragmented in places a sub-circular enclosure, measuring c.77m in diameter is clearly represented in the data. This correlates with the ditch feature identified in aerial photographs.

6.2 In addition, several pit-type responses and rectilinear ditch type features have been identified. It is most likely that multiphase activity is represented here, and it is possible that several enclosure features, including a possible rectilinear enclosure, are represented by the recorded responses.

6.3 Elsewhere in the data, broad amorphous responses appear to traverse the data set. The archaeological potential of these is unclear. Although it is possible that the plough damaged remains of large enclosing features are represented here, it is equally possible that the responses result from natural features within the sub-soil.

6.4 Adjacent to a large electricity pylon there is a circular response, measuring c.7m in diameter. This occurs in the magnetic ‘shadow’ of the pylon. Although there are no further responses in the vicinity this may represent a small circular enclosure. This is speculative but must be considered.

6.5 Consultation with a licensed archaeologist and with the Department of Arts, Heritage and the Gaeltacht is recommended to establish if any additional archaeological works are required.

Technical Information

Section Instrumentation & Methodology

Fluxgate Gradiometer Survey

Gradiometer survey is the most frequently applied survey instrument as it can be used in 'Scanning' or detailed survey mode.

Scanning

This is a fast and effective reconnaissance technique. The instrument is set in scanning mode and regular traverses of the investigation area are made, usually at 10m intervals. This allows a fast and effective scan of the application area, looking for any responses which may be of archaeological potential. As the traverses are made, the operator observes the instrument readout, and any responses of interest are marked for further investigation.

Detailed Gradiometer Survey

This is conducted to clearly define any responses detected during scanning, or can be applied as a stand-alone methodology. Detailed survey is often applied with a sample interval of 0.25m and a traverse interval of 1m. This allows detection of potential archaeological responses. Data is collected in grids 40m x 40m, and data is displayed accordingly. A more detailed survey methodology may be applied where archaeological remains are thought likely. A survey with a grid size of 10m x 10m and a traverse interval of 0.5m will provide a data set with high resolution.

Bartington GRAD 601-2

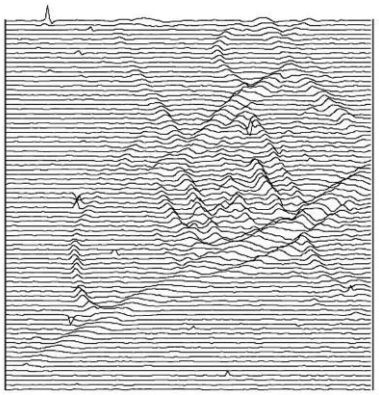
The Bartington *Grad* 601-2 instrument is a specifically designed gradiometer for use in archaeological prospection. The gradiometer operates with a dual sensor capacity making survey very fast and effective. The sensors have a separation of 1m allowing greater sensitivity.

Frequent realignment of the instruments and zero drift correction; ensure a constant high quality of data. Extremely sensitive, these instruments can detect variations in soil magnetism to 0.1nT, affording diverse application throughout a variety of archaeological, soil morphological and geological conditions.

Gradiometer Data Display &

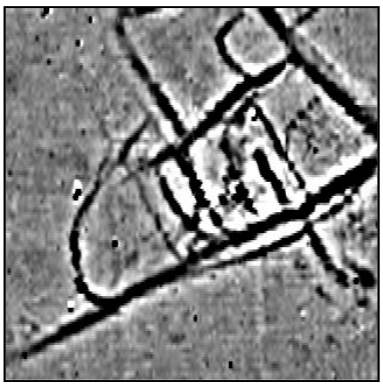
Presentation *XY Trace*

The data are presented as a series of linear traces, enabling a semi-profile display of the respective anomalies along the X and Y-axes. This display option is essential for distinguishing between modern ferrous materials (buried metal debris) and potential archaeological responses. The XY trace plot provides a linear display of the magnitude of the response within a given data set.



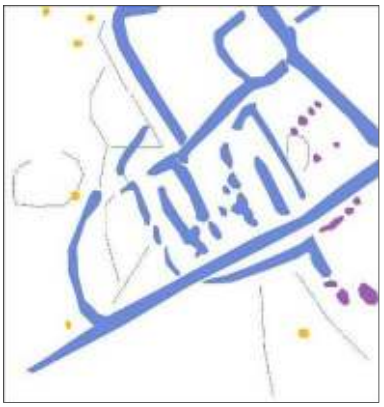
Greyscale*

As with dot density plots, the greyscale format assigns a cell to each datum according to its location on the grid. The display of each data point is conducted at very fine increments, allowing the full range of values to be displayed within the given data set. This display method also enables the identification of discrete responses that may be at the limits of instrument detection. In the summary diagrams processed, interpolated data is presented. Raw un-interpolated data is presented in the archive drawings along with the xy-trace plots.



Interpretation

An interpretation of the data is made using many of the plots presented in the final report, in addition to examination of the raw and processed data. The project managers' knowledge and experience allows a detailed interpretation of the survey results with respect to archaeological potential.



**XY Trace and raw greyscale plots are presented in archive form for display of the raw survey data. Summary greyscale images of the interpolated data are included for presentation purposes and to assist interpretation.*

Glossary of Interpretation Terms

Archaeology

This category refers to responses which are interpreted as of clear archaeological potential, and are supported by further archaeological evidence such as aerial photography or excavation. The term is generally associated with significant concentrations of former settlement, such as ditched enclosures, storage pits and associated features.

? Archaeology

This term corresponds to anomalies that display typical archaeological patterns where no record of comparative archaeological evidence is available. In some cases, it may prove difficult to distinguish between these and evidence of more recent activity also visible in the data.

? Industrial

Such anomalies generally possess a strong magnetic response and may equate with archaeological features such as kilns, furnaces, concentrations of fired debris and associated industrial material.

Area of Increased Magnetic Response

These responses often lack any distinctive archaeological form, and it is therefore difficult to assign any specific interpretation. The resulting responses are site specific, possibly associated with concentrations of archaeological debris or more recent disturbance to underlying archaeological features.

Trend

This category refers to low-level magnetic responses barely visible above the magnetic background of the soil. Interpretation is tentative, as these anomalies are often at the limits of instrument detection.

Ploughing/Ridge & Furrow

Visible as a series of linear responses, these anomalies equate with recent or archaeological cultivation activity.

? Natural

A broad response resulting from localised natural variations in the magnetic background of the subsoil; presenting as broad amorphous responses most likely resulting from geological features.

Ferrous Response

These anomalies exhibit a typically strong magnetic response, often referred to as ‘iron spikes,’ and are the result of modern metal debris located within the topsoil.

Area of Magnetic Disturbance

This term refers to large-scale magnetic interference from existing services or structures. The extent of this interference may in some cases obscure anomalies of potential archaeological interest.

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Figure 3	Summary Interpretation Diagram	A3	1:1,250

Archive plots available as PDF drawings available on request

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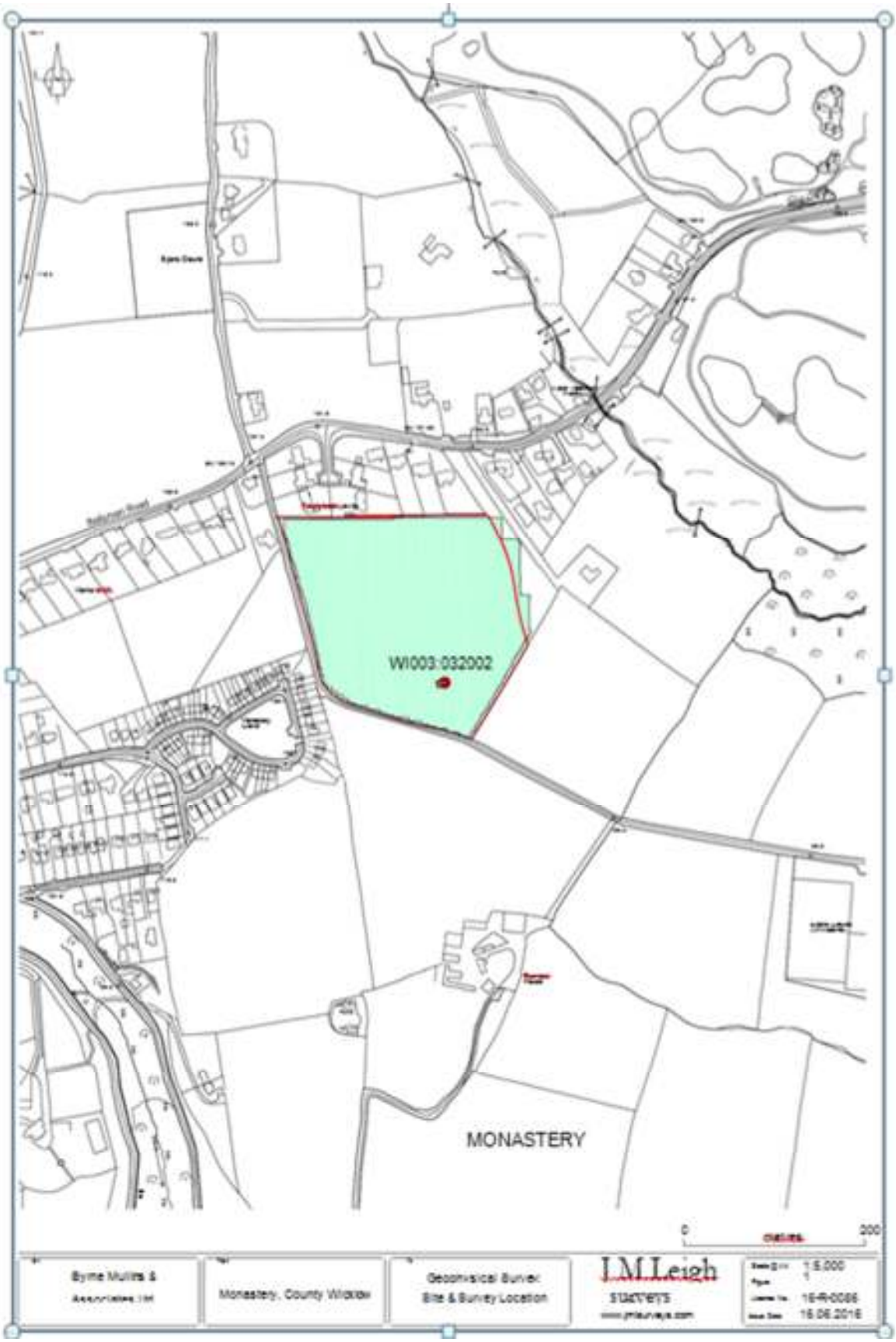
A1.02	Raw data xy trace plot	A0	1:500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Monastery, County Wicklow
Geophysical Survey:
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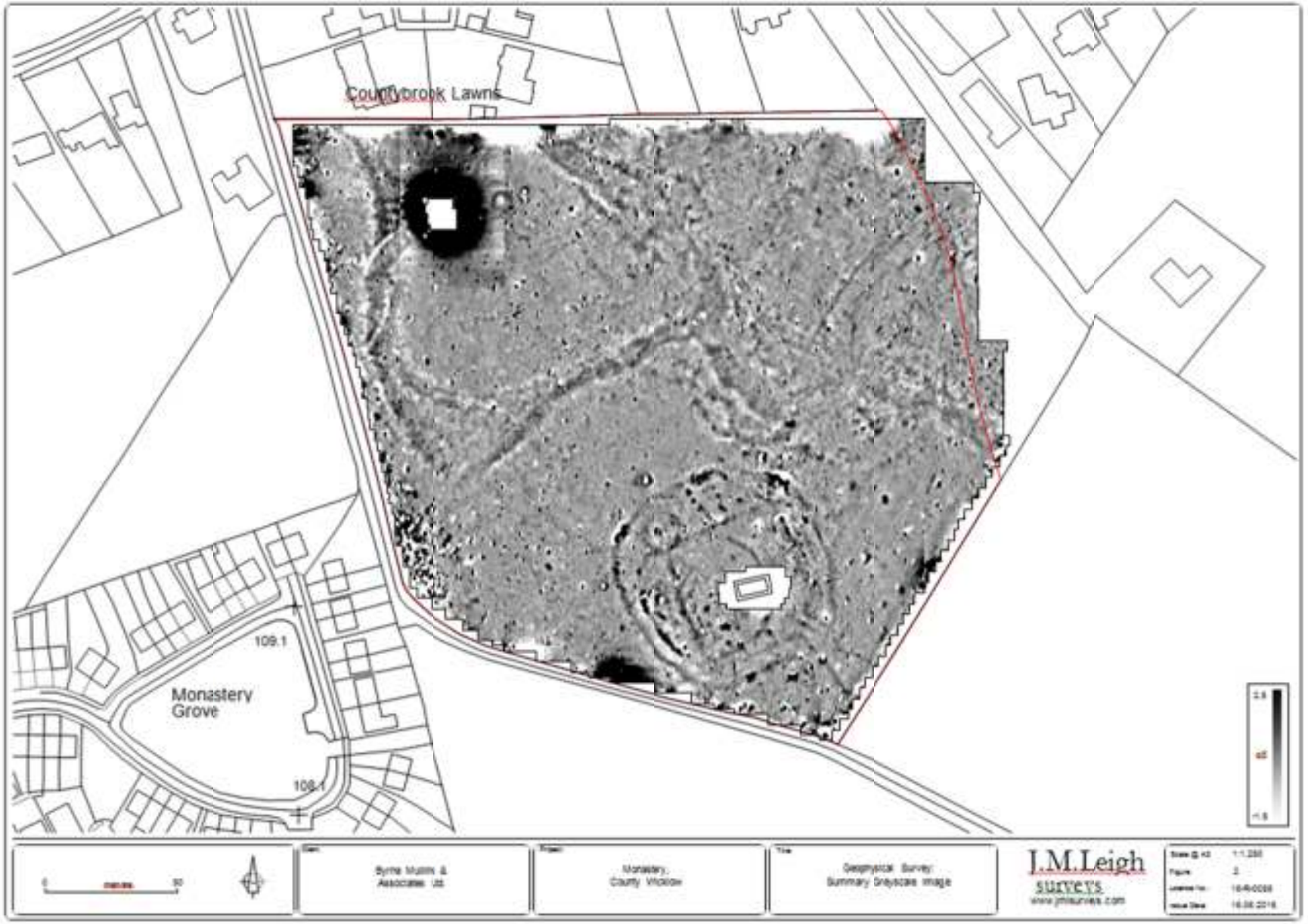
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Monastery, County Wicklow
Geophysical Survey: Summary Greyscale Image
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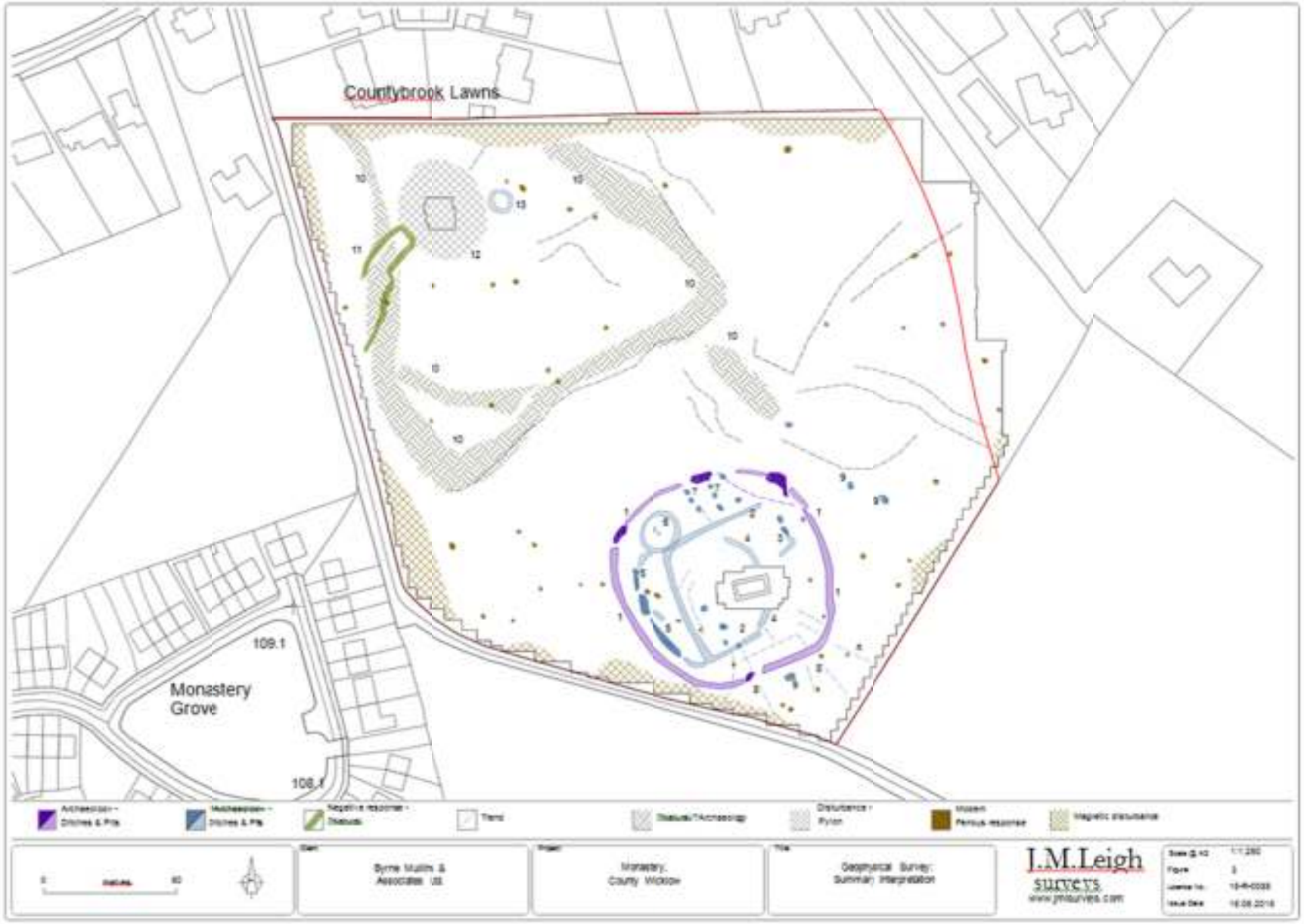
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APPENDIX 11E

Site CH-4 – Results of Archaeological Testing

MONASTERY
ENNISKERRY, Co. WICKLOW

ARCHAEOLOGICAL TESTING REPORT
Excavation Licence No.: 16E0356

Martin E. Byrne, MA, Dip. EIA Mgmt, MIAI.
BYRNE MULLINS & ASSOCIATES – ARCHAEOLOGICAL CONSULTANTS

Following a review of the results of a Geophysical Survey, a programme of Archaeological Testing was proposed and agreed with the National Monuments Service, DAHRRGA and undertaken under Licence No. 16E0356 from the DAHRRGA.

A total of 14 test trenches were excavated across the site but excluding the area of the enclosure detected by the geophysical survey. The locations of the trenches are illustrated below in Figure 1. In general, the trenches were positioned to gain information with respect to the geophysical anomalies detected outside the ’monastic enclosure’, and within potential development areas. In particular, T5 was excavated across F13, T2 across F11 and T12 in the area of F9. T8 and T9 were positioned to determine if any potential burials existed outside the ‘monastic enclosure’, with the latter (T9) to be excavated from north to south and to terminate at the inside edge of the detected outer enclosing element of the ‘monastic enclosure’.

All trenches were excavated by machine fitted with a toothless ditching bucket and all resultant spoil was ‘raked through‘ in an effort to increase the chances of artefact recovery. The trenches were excavated in spits of approx. 10cm depth, with the surface of each spit examined before excavation of the next spit. In addition, the trenches terminated at the surface of the underlying subsoil.

Figure 1 Locations of Archaeological Test Trenches

The results from the archaeological testing process indicate that the topsoil/ploughsoil generally comprised moderately compact mid-brown sandy silty clay with moderate pebbles and cobbles dispersed randomly throughout. This layer was almost consistently 310mm in depth across the site.

Removal of the topsoil revealed the surface of a generally compact layer of orange-brown silty clay subsoil, with occasional bands of stony gravel and sands protruding through the surface and associated with deeper geological layers. The locations of these geological variations largely coincided with the anomalies detected by the geophysical survey (i.e. F10) and are not considered to be of archaeological potential. No evidence for F11 was uncovered and this geophysical anomaly may be associated with deeper geological variations and not protruding through the surface of the clay subsoil. Likewise, no evidence for F12 was uncovered and it is likely that this geophysical anomaly is associated with magnetic disturbance associated with the nearby electricity pylon/mast. Furthermore, as illustrated in Plate 10, no evidence for the circular geophysical anomaly/feature (F13) was uncovered and it may be that this anomaly was associated with magnetic disturbances caused by the adjacent electrical pylon/mast.

The trenches are illustrated below in Plates 1 – 14.

Plate 1 T1 from E

Plate 2 T2 from E

Plate 3 T3 from S

Plate 4 T4 – E section from W

Plate 5 T5 – W section from E

Plate 6 T6 from W

Plate 7 T7 from E

Plate 8 T8 from NW

Plate 9 T9 from N

Plate 10 T10 from N

Plate 11 T11 from N

Plate 12 T12 from E

Plate 13 T13 from W

Plate 14 T14 from W

As noted above, T9 was positioned to investigate the existence of a possible ditch associated with the monastic enclosure (Geophysical Anomaly F1). Removal of the topsoil at the southern extent of the trench revealed a noticeable change in soil colour and compactness. This was investigated, by hand, to a depth of 250mm below the basal level of the topsoil and revealed the remains of a backfilled ditch feature. The southern limit comprises a gently sloping edge-cut, while the northern limit comprises an almost vertical edge-cut to the east with a most gently sloping edge-cut to the west – Figure 2; Plate 15. The northern edge was largely relatively straight in plan with a possible curvature from W to E, while the southern edge was curving from west to east. The trench measured 2.58 – 2.75m in width, within T9. The fill (dark orange-brown sandy silty clay) was excavated to a depth of 250mm and was terminated when the archaeological nature of the feature was proved beyond reasonable doubt.

Given the location of this feature, coupled with the results of the Geophysical Survey, it is considered that it is evidence of the backfilled outer ditch feature associated with the former Monastic Enclosure.

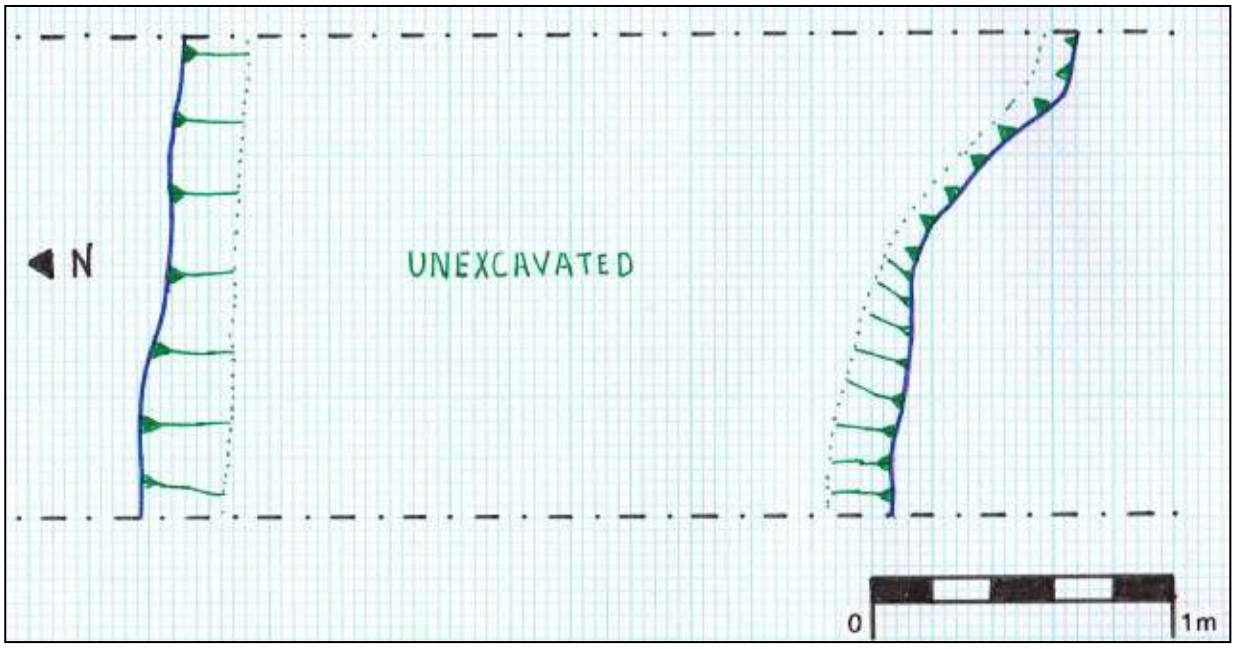

Figure 2 Plan of Ditch Feature – T9

Plate 15 T9 – Ditch Feature

No further subsurface features of archaeological interest and/or potential were noted during the course of the programme of archaeological testing.

A total of three sherds of **pottery artefacts** were recovered during the course of the testing. These were subsequently processed and submitted to Ms. Clare McCutcheon, Ceramic Researcher for examination and reporting. Two small worn unglazed sherds of *Dublin-type cooking ware*, representing a probable cooking jar, were recovered from the area immediately north of the ditch feature uncovered in T9, and a sherd of *Dublin-type coarseware,* comprising a strap handle, heavily incised with a central line bordered by deep slashes, short on one side, longer on the other, was recovered from T13. All of these pottery sherds are of late-12th – early-13th century in date.

APPENDIX 11F

Architectural Heritage Inventory

APPENDIX 11F - ARCHITECTURAL HERITAGE INVENTORY

SITE CH-13

Location: Fassaroe
Classification: Country House
RPS No: 03-32
ITM: 723725 717329

Description
Fassaroe House: Three-bay, two-storey villa with painted rendering, raised quoins, hipped roof with eaves and pedimented ionic porch; built *c.* 1820 and attributed to Sir Richard Morrison

SITE CH-14

Location: Fassaroe
Classification: Country House
RPS No: 03-34
ITM: 724164 717426

Description
St. Valery's: Early Gothic-revival house with crenelated tower at south end and a large, pointed, mullion window; built *c.* 1810 and attributed to Sir. Richard Morrison

SITE CH-15

Location: Thornhill Road, Old Connaught
Classification: House (18th /19th century)
RPS No: 1886
NIAH Ref: 60280004
ITM: 724651 718204

Description
Valombrosa: Detached four-bay two-storey over basement house, extant 1881, on a T-shaped plan centred on two-bay two-storey double gable-fronted split-level breakfront. Set in landscaped grounds with rendered piers to perimeter having cut-granite capping supporting wrought iron double gates.

SITE CH-16

Location: Thornhill Road, Old Connaught
Classification: House
NIAH Ref:: 60280006
ITM: 724511 718330

Description:
The Ochra: Detached four- or five-bay (three-bay deep) single-storey house with half-dormer attic, built 1905; occupied 1911, on a U-shaped plan with single-bay full-height gabled (west) or single-bay full-height (east) advanced end bays centred on single-bay single-storey gabled projecting porch to ground floor. Pitched terracotta tiled roof on a U-shaped plan centred on paired gablets to window openings to half-dormer attic, crested terracotta ridge tiles, red brick Flemish bond chimney stacks having thumbnail beaded stringcourses below capping supporting terracotta or yellow terracotta tapered pots, timber bargeboards to gables on timber purlins with terracotta finials to apexes, and cast-iron rainwater goods on exposed timber rafters retaining cast-iron downpipes. Part creeper- or ivy-covered red brick Flemish bond walls (ground floor) on red brick header bond chamfered cushion course on red brick Flemish bond plinth; roughcast surface finish (half-dormer attic) with "timber frame" surface finish to gables. Square-headed central window opening (ground floor) with moulded rendered sill course, and "timber frame" surround framing timber casement window having leaded stained glass panels. Square-headed opposing door openings ("cheeks") with cut-granite thresholds, and red brick voussoirs framing glazed timber panelled doors having overlights. Paired camber-headed window openings (ground floor) with cut-granite sills, and red brick voussoirs framing timber casement windows having overlights. Paired square-headed window openings (half-dormer attic) with cut-granite sills, and concealed dressings framing timber casement windows. Set in landscaped grounds with wrought iron-detailed "bird cage" piers to perimeter having wrought iron finial-topped capping supporting wrought iron double gates.

SITE CH-17

Location: Thornhill Road, Old Connaught
Classification: Gate Lodge
NIAH Ref: 60280007
ITM: 724592 718334

Description:
The Ochra: Detached three-bay single-storey gate lodge, built 1905; occupied 1911, on a T-shaped plan centred on single-bay single-storey gabled breakfront. Pitched slate roof on a T-shaped plan centred on pitched (gabled) slate roof (breakfront) with terracotta ridge tiles, paired red brick English Garden Wall bond central chimney stacks having corbelled stepped capping supporting terracotta pots, timber bargeboards to gables on timber purlins with timber finials to apexes, and remains of cast-iron rainwater goods on timber eaves boards on exposed timber rafters retaining cast-iron downpipes. Roughcast walls with "timber frame" surface finish to gables. Square-headed central door opening with concrete step threshold, and concealed dressings framing glazed timber panelled door. Square-headed window openings with cut-granite sills, and concealed dressings framing eight-over-two timber sash windows. Set perpendicular to road opposite entrance to grounds of The Ochra.

SITE CH-17

Location: Kilcroney
Classification: Gate Lodge
NIAH Ref: 16400705
ITM: 724359 717065

Description:
Kilcroney House: Detached two-bay gable-fronted single-storey former gate lodge, now in use as a house, built c.1835. The house is constructed in granite rubble. The panelled front door is set within a gabled glazed timber porch. Window openings are generally flat-headed and some have chamfered corners. Glazing to the main house has diamond panes while the porch has plain fixed frames, and the rear addition has modern top-hung frames. The pitched roof is finished with natural slate and cast-iron rainwater goods. The chimneystack is ashlar granite with boldly corbelled cap and clay pots. The building is set immediately behind a large curved gate screen. This has paired granite gate pillars which are square and have pyramidal caps. The railings are cast-iron and are set on low granite walls and there are matching cast-iron gates.

APPENDIX 12A

N11 Junction 6 Traffic management Microsimulation Modelling Results Report

ATKINS

Member of the SNC-Lavalin Group

N11 Junction 6 Traffic Management

Microsimulation Modelling Results Report

Wicklow County Council

March 2020

Notice

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This document has 90 pages including the cover.

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Rev 1	Draft	MA	SW	SW	KB	24/03/2020

Client signoff

Client	Wicklow County Council
Project	N11 Junction 6 Traffic Management
Job number	5186693
Client signature / date	

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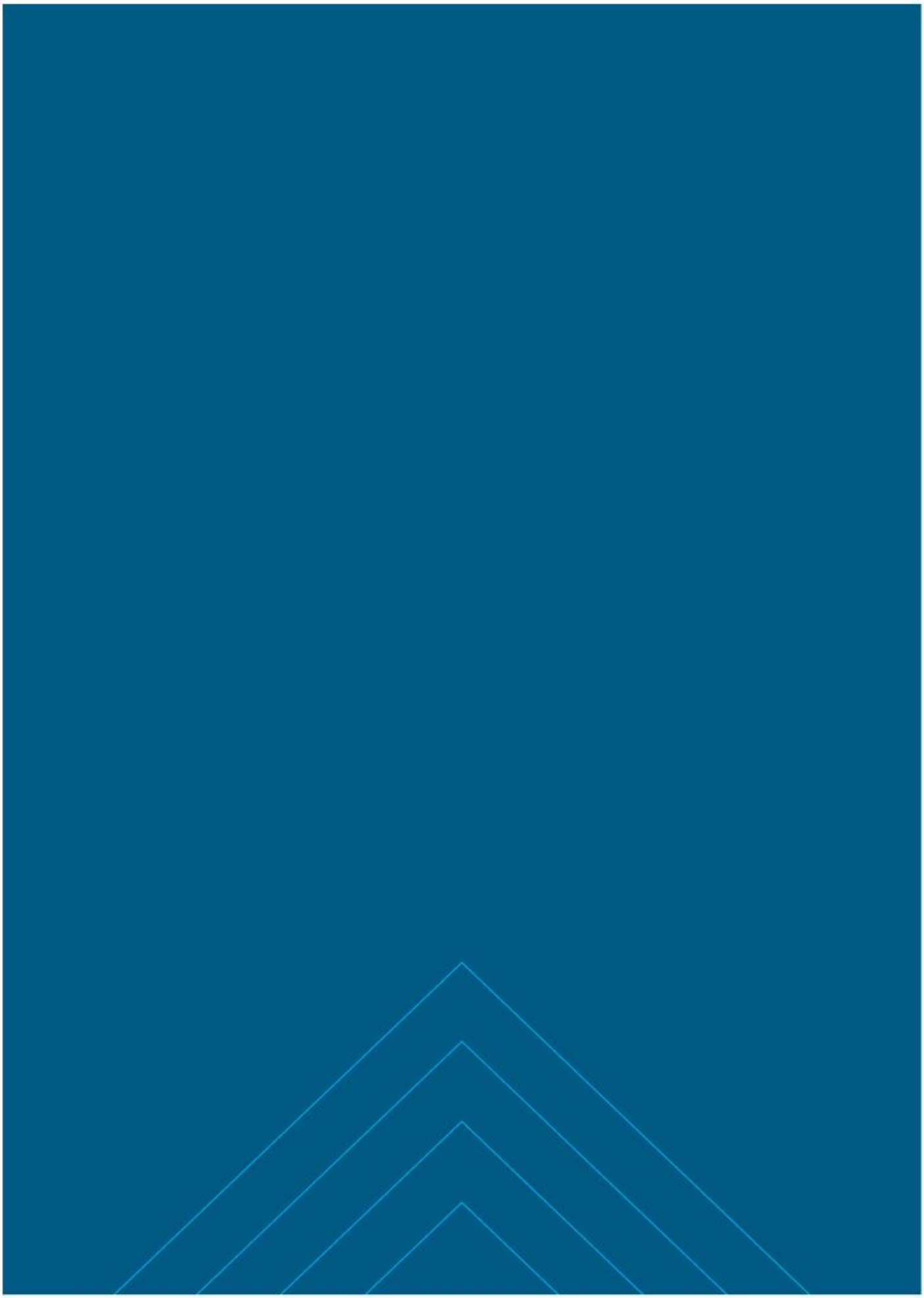


1. Introduction

The lands at Fassaroe, Co. Wicklow, are set out as Area Action Plan 1 of the Bray Municipal District Local Area Plan (2018). This Plan sets out an overall development potential of approximately 4,000 residential units and 3,000 jobs at this location to the west of the N11 adjacent to Junction 6.

The Bray & Environs Transport Study (BETS) identifies Phase 1a of Fassaroe incorporating the development of 650 residential units and appropriate support facilities. The BETS sets out specific transport requirements to be delivered in order to facilitate the delivery of Phase 1a development. These are as follows:

1. Fassaroe Development Roads including link road to Ballyman Road
2. N11 Cycle and Pedestrian Bridge
3. Traffic Management Measures at Fassaroe Interchange, Junction 6, arising from the development
4. New bus services in line with demand
5. Bus Priority on Upper Dargle Road including approach to Sunnybank Junction
6. Bus Priority on Dublin Road and Castle Street

Items 1 and 2 would be delivered in tandem with the development of the lands at Fassaroe. The BETS sets out the proposals for the delivery of Item 4, incorporating new bus services from Fassaroe at up to 5-minute frequency to be delivered in line with demand as the ongoing build-out and population growth develops. Wicklow County Council is currently in the process of delivering Items 5 and 6 to facilitate the efficient running of the new Fassaroe bus services to Dublin Road, Main Street and the DART station in Bray.

Item number 3 refers to the potential Traffic Management Measures (TMMs) to be carried out at N11-Junction 6 to facilitate development at Fassaroe. In this context, a micro-simulation model has been developed by Atkins for the area extending from M50 Junction 17 (M50/M11 interchange) at the northern extent to N11 Junction 8 (N11/R755 interchange, Kilmacanogue, Co. Wicklow) at the southern extent. The focus of the model was to assess the impact of possible traffic management measures at Junction 6 in the context of both impacts on traffic movements on the N11 mainline and the other infrastructure requirements as set out above, in particular, the facilitation of Fassaroe bus services.

Four options of traffic management at Junction 6 were considered at the existing eastern and western roundabout junction as follows;

- Roundabout priority control
- Traffic signal control of the roundabout
- Improvements to the Junction 6 N11 merges and diverges
- Roundabout priority control and ramp metering at the Junction 6 merges

A ‘Proposed Agenda for Draft Traffic Management Framework Agreement’ was incorporated in the BETS and is included in Appendix J of this report. The Agenda, inter alia, sets out a number of infrastructural requirements to be investigated as part of the process of agreeing the required TMMs. It also states the requirement to identify the appropriate traffic modelling to be undertaken and the requirement for the scope of the modelling to be agreed between TII and Wicklow County Council.

This report sets out the findings of a comprehensive traffic microsimulation model of the M11 / N11 corridor in accordance with the agreed scope of modelling work. The model incorporates development traffic associated with Fassaroe and other key development sites in the Bray Environs, together with assumed background growth in traffic. The primary objective of this study was to model the impact of development traffic on this section of national road network in the vicinity of Bray and to identify appropriate conclusions in terms of traffic management

measures at junction 6 of the N11 that would facilitate the first phase of development at Fassaroe in the context of the transport infrastructure requirements set out in the BETS.

2. Scoping

A scoping document was prepared and issued by Atkins in May 2019 for the development of a Vissim microsimulation model for the area extending from M50 Junction 17 (M50/M11 interchange) at the northern extent to N11 Junction 8 (N11/R755 interchange, Kilmacanogue, Co. Wicklow) at the southern extent. The scoping document outlined the key junctions and links to be included in the microsimulation model which are shown in Figure 2-1 below.

The scenarios to be modelled as stated in the scoping document have subsequently been developed and extended during the modelling process and are shown in the table below. The scenarios include scenarios for Do Minimum, Fassaroe development only, all BETS development and options for upgrades at N11 Junction 6. The assumed design years are +4 and +9 and the model incorporates both the AM and PM peak periods.

Phase 1a of development in Fassaroe is identified in BETS as incorporating approximately 650 residential units. In order to assess the impact of a potential further build out at Fassaroe in the +9 year a sensitivity analysis was included to account for Phase 1b development up to a total of 1,200 units on this site.

Table 2-1 - Model Scenarios

Scenario	Name	Future Development	Traffic Management Measures at N11-Junction 6
1	Base Year		
Base + 4 Design Year Scenarios			
2	Do Minimum +4	None	Roundabout priority
3	Fassaroe Phase1a and roundabout priority at Junction 6	Fassaroe Phase 1a	Roundabout priority
4	Fassaroe Phase 1a and traffic signals at Junction 6	Fassaroe Phase 1a	Traffic Signal Controlled Roundabouts
5	Fassaroe Phase1a and improved merges and diverges at Junction 6	Fassaroe Phase 1a	Improvements of merges and diverges at Junction 6
6	All Development sites and roundabout priority at Junction 6	Fassaroe Phase 1a and first phases of Woodbrook, Shanganagh Castle and Bray Golf Club	Roundabout priority
7	All Development sites and traffic signals at Junction 6	Fassaroe Phase 1a and first phases of Woodbrook, Shanganagh Castle, Bray Golf Club	Traffic Signal Controlled Roundabouts
Base + 9 Design Year Scenarios			
8	Do minimum +9	None	Roundabout priority
9	All Development sites and roundabout priority at Junction 6	Fassaroe Phase 1a and full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority
10	All Development sites and traffic signals at Junction 6	Fassaroe Phase 1a and full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Traffic Signal Controlled Roundabouts
11	Sensitivity Analysis: All Development sites and roundabout priority at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority

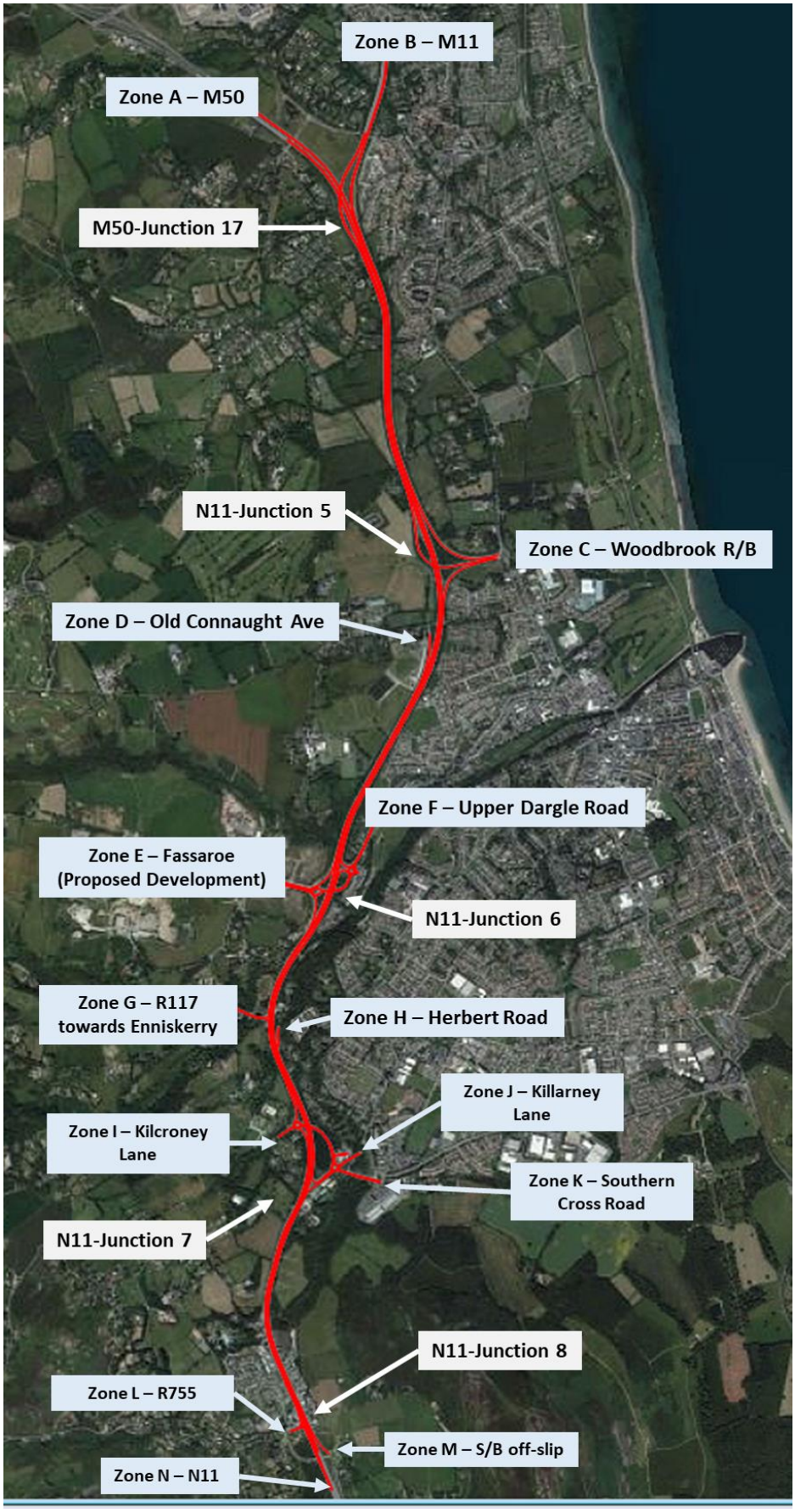
Scenario	Name	Future Development	Traffic Management Measures at N11-Junction 6
12	Sensitivity Analysis: All Development sites and traffic signals at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Traffic Signal Controlled Roundabouts
13	Sensitivity Analysis: All Development sites and roundabout priority and ramp metering at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority with Ramp Metering on N11 Merges

The number of housing units corresponding to key developments located in the vicinity of the model cordon for each scenario are summarised in the table below. The details of the assumptions regarding the scale of development at each key site are set out in Section 5.

Table 2-2 - Summary of housing units for different scenarios

Scenario	Scenario Name	Number of housing units corresponding to different developments			
		Fassaroe	Woodbrook	Shanganagh Castle	Bray Golf Club
Base + 4 Design Year Scenarios					
2	Do Minimum +4	0	0	0	0
3	Fassaroe Phase1a and roundabout priority at Junction 6	650	0	0	0
4	Fassaroe Phase 1a and traffic signals at Junction 6	650	0	0	0
5	Fassaroe Phase1a and improved merges and diverges at Junction 6	650	0	0	0
6	All Development sites and roundabout priority at Junction 6	650	685	400	500
7	All Development sites and traffic signals at Junction 6	650	685	400	500
Base + 9 Design Year Scenarios					
8	Do minimum +9	0	0	0	0
9	All Development sites and roundabout priority at Junction 6	650	1488	800	1000
10	All Development sites and traffic signals at Junction 6	650	1488	800	1000
11	Sensitivity Analysis: All Development sites and roundabout priority at Junction 6	1200	1488	800	1000
12	Sensitivity Analysis: All Development sites and traffic signals at Junction 6	1200	1488	800	1000
13	Sensitivity Analysis: All Development sites and roundabout priority and ramp metering at Junction 6	1200	1488	800	1000

Figure 2-1 - Study Area



3. Traffic Data

3.1. Traffic Surveys

Traffic surveys were commissioned and undertaken by Tracsis on May 28, 2019 for the key junctions and links outlined in Figure 2-1 by means of Junction Turning Counts (JTCs) and Automatic Traffic Counters (ATCs). In addition, an Origin and Destination (O-D) study was undertaken between the zones as illustrated in the above figure.

The surveys were undertaken for the following peak hours:

- AM Peak hours – 07:00 to 10:00 hours
- PM Peak hours – 16:00 to 19:00 hours

3.2. Adjustment to O-D Matrix

The Origin – Destination survey was carried out using video cameras at entry and exit points of the network cordon and matching number plates of vehicles to determine the origin and destination patterns and quantities. As is typical of video O-D surveys, capturing and matching all number plates is not possible, particularly at high speeds or in congested situations where visibility of plates can be limited.

The data obtained from Tracsis shows captured and matched percentages in the order of around 60% for the motorways and around 80% for the other links. While this is generally a good sample rate, it implies that the original O-D matrix supplied by Tracsis underestimates the volume of the vehicles in the network. Therefore, significant work was required to develop this matrix into a more accurate representation of the real world traffic volumes. This was done by growing traffic in line and with reference to all of the data collected from the surrounding JTCs, ATCs and data from TII's automatic traffic counters (TMUs) at a number of locations along the M50, N11 and M11.

The resulting O-D matrices were used in Vissim for the calibration of the model in order to replicate the real world-scenario as closely as possible.

4. Model Calibration and Validation

The microsimulation model was calibrated in accordance with the guidelines provided in the TII document (PE-PAG-02015) for the base year scenario for the morning and evening peak hours. For the purposes of the modelling, the peak hours have been considered to be 7am – 10am and 4pm – 7pm as this is when most congestion is experienced on the network.

The model was validated using the GEH statistic for junction turning movements and link volumes and by travel times for journey times as outlined below. For calibration, the model was run 5 times using varying random seeds for both AM and PM peak. This allows for modelling of typical day to day variations in traffic flows and traffic patterns and more accurately models the real-world situation on site.

4.1. Junction Turning Movements and Link Volumes

The GEH static criteria is a form of chi-square statistic test which compares the modelled and observed traffic volume counts and is defined as:

$$\mathrm{GEH} = \sqrt{\frac{(\mathrm{M}-\mathrm{C})^2}{0.5 \times (\mathrm{M}+\mathrm{C})}}$$

Where M is the modelled traffic volume counts and C is the observed traffic volumes.

The TII guidelines state that the GEH value should be less than 5 for more than 85% of the cases.

The GEH calibration statistical analyses were carried out for the key junctions and links as summarised below:

Junctions

For calibration of Junctions, the turning volume for each movement of the following key junctions in the model was compared with the JTC results.

- Roundabouts on both sides of N11-Junction 6; and
- Roundabouts on both sides of N11-Junction 7;

Links

For the calibration of the Links, the volumes recorded by the following TMU counters were compared with the volumes obtained at the same locations in the model:

- TMU M50 040.0 N – Located between M50 Junction 16 Cherrywood and Junction 17 M50/M11, Shankill;
- TMU M11 010.0 N – Located between M50/M11 and Bray North Junction 5 N11;
- TMU M11 015.0 S – Located between Junction 5 Bray North N11 and Junction 6 Bray Central N11;
- TMU N11 0202.0 N – Located between Junction 8 Kilmacanogue N11 and Junction 9 Glen of the Downs, Kilmacanogue N11

4.2. Journey Time Calibration

The journey-time calibration compares the travel time between two sections of the model and the travel time between the same sections as measured on site. The TII guidelines state that for more than 85% of cases, modelled journey times should be within 15% or 1 minute when compared with the observed journey times at the site.

For the journey-time calibration criteria, the travel time along the following mainline routes was considered. These were chosen as they represent journeys from one end of the cordon to the other and give the best indication of

the actual travel time through the network. There are two entry points to the cordon to the north, i.e. one on the M50 at Junction 17and one on the M11 near the Loughlinstown Roundabout. As a result, the travel times to and from both points were considered as outlined below.

Southbound Route

- M50 at Junction 17, Shankill to N11 at Junction 8, Kilmacanogue; and
- M11 at Junction 17, Shankill to N11 at Junction 8, Kilmacanogue.

Northbound Route

- N11 at Junction 8, Kilmacanogue to M50 at Junction 17, Shankill; and
- N11 at Junction 8, Kilmacanogue to M11 at Junction 17, Shankill

The journey times obtained in the model were compared with real-world journey time obtained from the O-D survey data provided by Tracsis. The use of the time stamped O-D data allows for a large sample of journey times and, therefore, gives a good average journey time for each time period.

Additionally, Atkins carried out a drive through the network on 12th September 2019 including video recording along both routes from the M50 and M11 to N11 Junction 8. These drive throughs gave travel times of 626s for the M11 to N11 Junction 8 route at 4:55pm and 920s for the M50 to N11 Junction 8 route at 5:30pm. These values are very close to those obtained from the O-D survey data.

The results collected for the average of all five runs for both GEH and journey time calibration are detailed in Appendix A and are summarised in the following section.

4.3. Calibration and Validation Summary

The following table summarises the results of GEH and Journey Time calibration criteria.

Table 4-1 - Summary of Calibration and Validation Criteria

Time period	Observed	Modelled	Percentage Calibrated
GEH Calibration Criteria (Modelled GEH < 5) – Junctions			
AM Peak (07:00 – 10:00)	108	107	99.1%
PM Peak (16:00 – 19:00)	108	108	100%
GEH Calibration Criteria (Modelled GEH < 5) – Links			
AM Peak (07:00 – 10:00)	24	24	100%
PM Peak (16:00 – 19:00)	24	22	92%
Journey Time Calibration (Modelled Within 15% or 1 Minute if Higher)			
AM Peak (07:00 – 10:00)	12	12	100%
PM Peak (16:00 – 19:00)	12	12	100%

The results from the above tables indicate that the GEH values for turning movements and link counts and percentage travel time difference values are well within the acceptable limits for all cases and hence, the model represents as close as possible to the existing road network conditions. Therefore, the model was considered fit for purpose and was brought forward for the analysis of further scenarios.

Further details of model calibration data are contained in Appendix A.

5. Trip Generation and Trip Distribution

5.1. Fassaroe Development

5.1.1. Development Schedule

The BETS outlines a Phase 1a of c.650 residential units at Fassaroe. For the purpose of the modelling exercise, all of these units have been assumed to be constructed in both the +4 and +9 design years.

In the +9 design year, for sensitivity analysis, the microsimulation model was also run with an additional 550 units at Fassaroe included, giving a total of 1200 residential units. This accounts for 30% of the total overall development potential of approximately 4,000 residential units as outlined in Area Action Plan 1 of the Bray Municipal District Local Area Plan (2018).

It should be noted that all the development scenarios account only for a portion of the planned residential development and that no employment use is anticipated in the +4 or +9 design year scenarios. The following table summarises the development schedule for both the design years of the development at Fassaroe.

Table 5-1 - Development Schedule - Fassaroe

Design Year	Houses	Apartments	Total
+ 4 design year scenarios	218	432	650
+ 9 design year scenarios	218	432	650
Sensitivity Analysis: + 9 design year scenarios	402	798	1200

5.1.2. Trip Generation

The TRICS database was utilised to determine the trip generation for the proposed apartment and house units at Fassaroe for both the AM and PM peak. The tables show the trip rate per unit for the proposed development for both phases.

Table 5-2 - Trip Rate - AM Peak

Type	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00	
	Arrival	Departure	Arrival	Departure	Arrival	Departure
House	0.091	0.357	0.212	0.712	0.216	0.363
Apartment	0.053	0.317	0.075	0.516	0.075	0.192

Table 5-3 - Trip Rate - PM Peak

Type	16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arrival	Departure	Arrival	Departure	Arrival	Departure
House	0.488	0.285	0.609	0.370	0.446	0.353
Apartment	0.204	0.117	0.387	0.133	0.409	0.179

Based on the above trip rates for both AM and PM peak, total person trips for both phases were calculated and are summarised in Appendix B.

5.1.3. Modal Split

5.1.3.1. Base + 4 Design Year Scenarios

For the Base +4 design year scenarios, it has been assumed that all the traffic measures set out in the BETS for Phase 1a will be completed. Therefore, the likely modal split was determined from the 2016 census data for similar areas in the vicinity, namely CSO Area codes SA 257051032, SA 257051030, SA 257051024, SA 257051025, SA 257051029, and is shown in the table below:

Table 5-4 – Fassaroe Modal Split for Base + 4 design year scenarios)

Mode	Percentage
Active Travel	15%
Public Transport	18%
Car driver	46%
Car passenger and others	22%
Total	**100%**

Based on this modal share, the total number of trips for different modes was calculated and are summarised in Appendix C.

5.1.3.2. Base + 9 Design Year Scenarios

It has been assumed that in +9 design year scenarios no new units will be built. Therefore, the modal share will remain the same as that for the +4 year design year scenarios.

However, for the Sensitivity Analysis scenarios it has been assumed that 1200 units will be developed at Fassaroe. Therefore, it can be assumed that the proposed development will be better connected by the proposed scheduled bus services to Bray and DART and LUAS stations prior to the occupation of all the residential units in Base +9 design year. Therefore, the modal split for the trips generated by 1200 units scenarios in the +9 design year was determined from the 2017 census data for CSO small area codes Sa2017_267097005, Sa2017_267121009, Sa2017_267122001 and Sa2017_257080004.

These sites are located adjacent to the R119 Dublin Road and are well served by bus services. Therefore, these areas are similar to the proposed development at Fassaroe once the proposed frequent bus services are in place. The following table summarises the modal split undertaken for the analysis of scenarios consisting of 1200 units at Fassaroe.

Table 5-5 – Fassaroe Modal Split for Base + 9 design year scenarios

Mode	Percentage
Active Travel	18%
Public Transport	28%
Car driver	40%
Car passenger and others	14%
Total	**100%**

Based on the respective modal share, the total number of trips for the 1200 units was calculated and are summarised in the Appendix C.

5.1.4. Trip Distribution

The distribution of the trips generated by the proposed development at Fassaroe was determined in accordance with the Wicklow County Council: Socio-Economic Profile 2015, prepared for the development of the Local and

Economic Community Plan (LECP) for the county. Based on the document, vehicle trips to and from the proposed development within the model cordon were distributed as illustrated in Appendix D. The remaining trips are distributed outside of the model cordon (e.g. west of Fassaroe) and are, therefore, not included in figures shown in Appendix D.

5.2. Other BETS Development

The scenarios to be modelled, as outlined in the scoping document, include construction of the other developments outlined in the BETS document in addition to the development at Fassaroe. The assumed trip generation and distributions into the modelled network for these developments are summarised in the following section.

5.2.1. Woodbrook Strategic Housing Development

The development at Woodbrook will consist of two phases:

- Phase 1: 685 no. residential units and a crèche facility. Phase 1 also includes a temporary park and ride car park to serve the proposed DART Station immediately adjacent the lands. In this phase the DART Station is subject to a planning application that is currently being prepared by Irish Rail.
- Phase 2: 803 no. residential units, a neighbourhood retail centre and a primary school. The full build out of Phase 2 will include the removal of the DART Park and Ride car park which will be replaced by a strategic park and ride site to be delivered on another site by the NTA. The DART Station will be operational prior to the completion of Phase 2.

For the analysis, it has been assumed that all the dwellings of the Phase 1 of the development will be occupied by 2023, i.e., base + 4 year scenario. The second phase of the development is assumed to be completed by 2028 and therefore, trips generated from Phase 2 development are also considered in the modelling in + 9 year scenarios.

The development schedule, modal share, trip generation and trip distribution of the development have been taken from the TTA report prepared by Atkins (Ref no. – 5154251DG0056 Rev 4) for the strategic housing development at Woodbrook. That TTA report was incorporated in the Phase 1 planning application for Woodbrook. This SHD application was granted permission by An Bord Pleanala in February 2020. The modal share and the development schedule are summarised in the tables below. The distribution of these trips through the network is shown along with other BETS developments in Appendix D.

Table 5-6 – Woodbrook Modal Split

Mode	Base +4 design year scenarios (Phase 1 – Pre DART)	Base +9 design year scenarios (Phase 2 – Post DART)
Active Travel	18%	20%
Public Transport	28%	38%
Car driver	36%	25%
Car passenger and others	18%	17%
Total	**100%**	**100%**

Table 5-7 - Woodbrook Development Schedule

Design Year	Houses	Apartments	Total
Base +4 design year scenarios	255	430	685
Base + 9 design year scenarios	361	1127	1488

5.2.2. Shanganagh Castle

The Dún-Laoghaire-Rathdown County Council's Development Plan 2016-22 has outlined the proposal of building around 2,300 residential units in zoned lands at Woodbrook/Shanganagh. The Woodbrook planning application submitted by Atkins has a provision of development of approximately 1500 residential units at Woodbrook. Therefore, it is assumed that the remaining 800 units will be developed at the Shanganagh Castle development site.

For the analysis, it has been assumed that by 2023, 50% of these units will be occupied will be completed while the remaining 50% will be occupied by 2028. The development at Shanganagh Castle is assumed to consist of one-third housing units and two-thirds apartment units.

Table 5-8 - Shanganagh Castle Development Schedule

Design Year	Houses	Apartments	Total
Base +4 design year scenarios	134	266	400
Base + 9 design year scenarios	268	532	800

As the site is located close to the development at Woodbrook, the modal share, trip generation and trip distribution is assumed to be as for the Woodbrook development site. The distribution of these trips through the network is shown along with other BETS developments in Appendix D.

5.2.3. Bray Golf Club Lands

The Bray Municipal District Local Area Plan 2018 has outlined the potential of 1000 residential units at the site located at the former Bray Golf Club. For the analysis it has been assumed that by 2023 the first phase of the development will be completed which will consist of 50% of the residential units, while the remaining 50% will be developed by 2028. The development schedule is assumed to be similar to Shanganagh Castle and is outlined below.

Table 5-9 - Bray Golf Club Lands Development Schedule

Design Year	Houses	Apartments	Total
Base +4 design year scenarios	168	332	500
Base + 9 design year scenarios	336	664	1000

Given its location, the Bray Golf Club site will be well connected to DART stations and bus services in the area. Therefore, for the development at this site, modal share, and trip generation is taken to be the same as that of Woodbrook.

In terms of vehicular trip distribution, all vehicles arriving and departing north of the development and accessing the N11 are assumed to use N11-Junction 5 while vehicles travelling to/from south of the development to and from the N11 are assumed to use N11-Junction 6. The distribution of these trips through the network is shown in Appendix D.

5.2.4. Old Conna

Dún-Laoghaire-Rathdown County Council's Development Plan 2016-22 outlines a proposal for building around 2,000 residential units at the zoned residential lands of 66 ha at Old Conna. As per the BETS report the following infrastructure development is required to facilitate the scheme:

- Upgrade of Ferndale Road;
- Development of new road link from Ferndale Road to Dublin Road at Shanganagh;
- Cherrywood to Rathmichael link road including upgrade of Junction 16 M50;
- Potential Upgrade of Junction 5 N11

However, the county development plan has outlined that a new local area plan for the development at Old Conna is to be prepared when infrastructural constraints are overcome. Moreover, it is stated that at present it is difficult to have certainty on when the development at the site at Old Conna will take place. Therefore, it is reasonable to assume that this development will be occur later than the other BETS development sites. Dun Laoghaire Rathdown County Council is currently carrying out a transport model assessment of Old Conna to assess the phased implementation of the required transport infrastructure as set out in the BETS.

In this context the development of Old Conna has not been included in this microsimulation model because the substantive development of Old Conna will likely be dependent on an, as yet, undetermined new road infrastructure requirements.

5.2.5. Rathmichael

Dún-Laoghaire-Rathdown County Council's Development Plan 2016-22 has outlined the proposal of building around 3,600 residential units at the zoned residential lands of 85 ha at Rathmichael. The development at Rathmichael requires the development of a similar level of infrastructure to that required for Old Conna. Therefore, the development at this site has been excluded from the analysis.

5.3. Baseline Traffic Growth

For determination of the background traffic growth, traffic data recorded by the three TMU counters located along M11/N11 were taken into the consideration:

- TMU M50 040.0 N – Located between M50 Junction16 Cherrywood and Junctionn17 M50/M11, Shankill;
- TMU M11 010.0 N – Located between M50/M11 and Bray North Junction 5 N11; and
- TMU M11 015.0 S – Located between Junction 5 Bray North N11 and Junction 6 Bray Central N11.

The data considered for the analysis was taken for the average working day across the whole year from 2014 to 2018 for the peak hours (AM Peak: 07:00 to 10:00 and PM Peak: 16:00 to 19:00). The data for the year 2019 was not considered for the analysis since the traffic volumes for the whole of July are not yet available.

Traffic growth along different counters have been summarised in the table in Appendix E. Analysis of traffic growth shows that during the AM peak hours the maximum growth in the northbound traffic is 0.91% while southbound traffic has grown by a maximum by 1.13%. For the PM peak, over the same time period, northbound traffic has decreased along all the three counters while the maximum increase in the southbound traffic has been observed as 0.78%.

However, in accordance with the TII guidelines, background traffic has been forecasted to grow in accordance with TII's "Low Sensitivity Growth Rates" for the Dublin Metropolitan Region included in the Project Appraisal Guidelines, published in May 2019. The growth rates used for the analysis are highlighted in the below figure and equate to around 1.5% growth per year. These growth rates are applied in the model to vehicles travelling along motorways (M50/M11), national road (N11) also for the vehicles traveling from Bray to N11-Junction 5 and 7. Using these growth rates, the base traffic will increase by 6% and 14% over the four and nine years respectively.

These growth factors have been applied to all traffic volumes across the entire network and not only to motorway traffic. Given that an increase in traffic from other areas, particularly from the Bray direction, would be dependent on development in these areas, background traffic is unlikely to grow by this amount in these areas. Regarding M50/N11 traffic, an examination of average traffic volumes at various TMU counters in the area suggests that traffic is tending to grow in the inter-peak hours while traffic in the peak hours is relatively static or declining, likely due to changes in travel patterns to avoid congestion.

Moreover, the model for the future year analyses take account of all the trips generated by planned future BETS development in the area surrounding the M50-N11 road network. Therefore, an assumed background growth rate, significantly higher than the recent trends in traffic growth, together with additional traffic due to the proposed key development sites has been applied as additional traffic on the modelled road network. In this context, it is reasonable to conclude that the application of the "Low Sensitivity Growth Rates" to all traffic in the modelled cordon represents a conservative assessment of likely traffic volumes and therefore an overestimation of future year traffic impacts.

Figure 5-1 - Link-Based Growth Rates

Table 6.1: Link-Based Growth Rates: Metropolitan Area Annual Growth Rates

Metropolitan Area	Low Sensitivity Growth Rates						Central Growth Rates						High Sensitivity Growth Rates					
	2016-2030		2030-2040		2040-2050		2016-2030		2030-2040		2040-2050		2016-2030		2030-2040		2040-2050	
	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
Dublin	1.0146	1.0280	1.0034	1.0116	1.0028	1.0144	1.0162	1.0295	1.0051	1.0136	1.0044	1.0162	1.0191	1.0328	1.0087	1.0172	1.0093	1.0256
Cork	1.0153	1.0279	1.0072	1.0128	1.0065	1.0164	1.0169	1.0294	1.0090	1.0149	1.0083	1.0182	1.0202	1.0328	1.0125	1.0185	1.0166	1.0276
Galway	1.0154	1.0201	1.0077	1.0164	1.0079	1.0203	1.0169	1.0217	1.0097	1.0182	1.0095	1.0220	1.0203	1.0250	1.0131	1.0217	1.0178	1.0313
Limerick	1.0158	1.0313	1.0052	1.0113	1.0050	1.0158	1.0174	1.0329	1.0070	1.0134	1.0069	1.0177	1.0218	1.0364	1.0106	1.0171	1.0146	1.0273
Waterford	1.0123	1.0301	1.0031	1.0131	1.0029	1.0175	1.0140	1.0317	1.0052	1.0153	1.0050	1.0194	1.0173	1.0352	1.0091	1.0194	1.0122	1.0300

6. Future Year Assessment Scenarios

6.1. Infrastructure Upgrades

Following the validation of the model and calculation of the car trip generation and distribution from the proposed Fassaroe development and other BETS development the model was run for the different scenarios. In all of the future year scenarios, the proposed improvements of the N11 between Junctions 7 and 8, due to begin construction shortly, were coded into the model. In summary, this includes an additional third auxiliary lane for traffic between the junctions and a removal of the lower speed limit on the mainline of the N11. No other changes to the network were coded along the mainline for all scenarios, ensuring a valid like for like comparison of the impact of the proposed development traffic volumes and Junction 6 management measures.

6.2. Initial Assessment scenarios

The model was initially run for the following scenarios in order to determine the feasible interim Traffic Management Measures required at N11-Junction 6.

Table 6-1 - Modelling Scenarios for Initial Assessment

Scenario Number	Name	Development	Traffic Management Measures at N11-Junction 6
2	Do Minimum +4	None	Roundabout priority
3	Fassaroe Phase1a and roundabout priority at Junction 6	Fassaroe Phase 1a	Roundabout priority
4	Fassaroe Phase 1a and traffic signals at Junction 6	Fassaroe Phase 1a	Traffic Signal Controlled Roundabouts
5	Fassaroe Phase1a and improved merges and diverges at Junction 6	Fassaroe Phase 1a	Improvements of merges and diverges at Junction 6

For scenarios 3 to 5, only the development traffic of Phase 1a of Fassaroe was modelled with the following Traffic Measurement Measures at N11-Junction 6:

- Scenario 3: The current roundabout traffic management controls were maintained at both junctions
- Scenario 4: Traffic signals were coded at both roundabouts at N11 Junction 6 in the model. For the AM peak these were run as fixed time signals with a cycle time of 120s. However, in the PM peak, due the volume of traffic and sensitivity of the southbound mainline, the signals were coded to operate as vehicle actuated allowing for more efficient operation.
- Scenario 5: Upgrading of the merges and diverges in accordance with the Geometric Design Parameters of Merging Lanes and Diverging Lanes contained in the TII document: DN-GEO-0030 (Geometric Designs of Junctions) published in June 2017.

In order to compare the impact of all three traffic management options the journey times along the mainline routes for Scenarios 2 to 5 were compared.

For both peaks the model was initially run for a 30 minutes warm-up period and the full 3 hour peak period and a 30 minute cool down period. However, increases in flow indicated that the congestion period during the evening peak would extend beyond 7pm, and therefore the model for the PM peak scenarios were run for an additional hour in the +4 year scenarios and an additional 2 hours in the +9 year scenarios

All the scenarios were run 5 times with varying random seeds to capture the effects of day to day variations in traffic giving a more accurate result.

6.2.1. Journey Time – Initial Assessment Scenarios

6.2.1.1. Northbound

The results for the journey times along the N11-Jn 8 to M50-Jn17 route for the northbound traffic are summarised for Scenario 2 to Scenario 5 in the following table. For northbound traffic, only the travel times in the AM peak are compared as this is the period when congestion is occurring northbound on the N11 mainline.

Table 6-2 - Journey Time for Initial Assessment - AM Peak

Scenario	Name	07:00 – 08:00	08:00 – 09:00	09:00 – 10:00	Average
2	Do Minimum	642	619	561	**607**
3	Fassaroe Phase 1a and roundabouts	681	646	562	**630**
4	Fassaroe Phase 1a and Traffic signals at Junction 6	651	645	564	**620**
5	Fassaroe Phase 1a and improvement of merges and diverges at Junction 6	669	655	564	**629**

The above table shows that in Scenario 3 additional traffic due to Fassaroe leads to a marginal increase in the average journey time of 23 seconds compared to the Do Minimum scenario. In Scenario 4, installing signals at both the roundabouts leads to a marginal improvement of 10 seconds in the average journey time as compared to Scenario 3. The average journey time over the three-hour duration for Scenario 5 is very similar to Scenario 3.

6.2.1.2. Southbound

The results for the journey times along the M50-N11 mainline for the southbound traffic are summarised for Scenario 2 to Scenario 5 in the following table. For southbound traffic, the travel times through the network in the PM peak are compared as this is the current congested period.

Table 6-3 - Journey Time for Initial Assessment - PM Peak

Scenario	Name	16:00 – 17:00	17:00 – 18:00	18:00 – 19:00	19:00 – 20:00	Average
2	Do Minimum	819	1157	875	479	**833**
3	Do minimum with Fassaroe	815	1151	889	508	**841**
4	Do minimum with Fassaroe and Traffic signals at Junction 6	814	1121	875	500	**828**
5	Do minimum with Fassaroe and improvement of merges and diverges at Junction 6	839	1301	936	564	**910**

The above table shows that in Scenario 3 additional traffic due to development at Fassaroe leads to a marginal increase in the average journey time of 8 seconds, compared to Scenario 2. In Scenario 4, installing signals at both the roundabouts at Junction 6 gives a marginal improvement of 13 seconds in the average journey time when compared to Scenario 3, with the average travel time over the 4 hour period actually less than for the Do Minimum scenario. This reduction is attributed to the fact that the traffic is being held at the Eastern Roundabout of N11-Junction 6. In Scenario 5, the improvement of the merges and diverges at N11-Junction 6 increases the average journey time by around 70 seconds when compared to Scenario 3. This is likely due to the fact that the improved merge at Junction 6 allows southbound vehicles to gain more speed before merging and causing a greater impact on southbound flow on the mainline.

6.2.2. Summary of Initial Assessment

Based on the comparison of journey times the installation of signals at N11-Junction 6 leads to a marginal improvement in the average journey time compared to the roundabout operation of the junctions. The improvements of merges and diverges have a notable negative impact on travel times along the N11. Therefore, the improvements of merges and diverges were excluded from further analysis.

6.3. Detailed Assessment Scenarios

Following the determination of suitable Traffic Management Measures at Junction 6, the model was run for the additional scenarios as shown in the table below.

Table 6-4 - Modelling Scenarios for Further Assessment

Scenario Number	Name	Development	TMMs at N11-Junctio 6
Base + 4 design year scenarios			
6	All Development sites and roundabout priority at Junction 6	Fassaroe Phase1a and first phases of Woodbrook, Shanganagh Castle and Bray Golf Club	Roundabout priority
7	All Development sites and traffic signals at Junction 6	Fassaroe Phase1a and first phases of Woodbrook, Shanganagh Castle Bray Golf Club	Traffic Signal Controlled Roundabouts
Base + 9 design year scenarios			
8	Do minimum +9	None	Roundabout priority
9	All Development sites and roundabout priority at Junction 6	Fassaroe Phase 1a full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority
10	All Development sites and traffic signals at Junction 6	Fassaroe Phase 1a full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Traffic Signal Controlled Roundabouts
11	Sensitivity Analysis: All Development sites and roundabout priority at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority
12	Sensitivity Analysis: All Development sites and traffic signals at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Traffic Signal Controlled Roundabouts
13	Sensitivity Analysis: All Development sites and roundabout priority and ramp metering at Junction 6	Fassaroe Phase 1a & 1b, full build out of Woodbrook, Shanganagh Castle, Bray Golf Club	Roundabout priority with Ramp Metering on N11 Merges

6.3.1. Ramp Metering

Ramp Metering is a traffic regulatory method used to control the vehicle flow along the merges at the interchanges. Ramp metering may be based on fixed-timing or utilise detector loops. The latter was modelled in Scenario 13 along the merges of the N11-Junction 6.

Three detector loops were incorporated on the north and southbound merges as follows;

- The first detector loop was modelled at the signal head located adjacent the end of the merge lane. This loop turns the signal head green when it detects the vehicles at the signal head and is referred to as the approach detector.
- The second detector head was modelled just after the signal head. Once the vehicle pass this detector loop the signal head turns red. This loop is referred to as the departure loop

  The signal remains red until all of the following three conditions have been satisfied simultaneously:

  - A vehicle is detected by the approach detector;
  - There is no vehicle detected on the departure loop; and
  - The signal head has been red for at least three seconds.
- The third detector loop was located upstream of the signal head which detects whether queues along the merge are backing up to the roundabout. Once the queue backs up to this loop the signal head turns green for a minimum 10 seconds, allowing the queue to dissipate.

7. Traffic Impact Analysis

7.1. PM Peak

7.1.1. Volume

For the PM Peak, only the southbound vehicle volumes are considered as this is the critical volume in the congested southbound direction. The traffic volume between Junction 5 and 6 for different scenarios are shown in the table below, with the base year data taken from the average daily volume for 2019 from TMU data:

Scenario	Design Year	Volume	Volume Increase	Percentage Increase	Comments
1	Base year	9883			
2	+4 design year	10473	590	5.97%	Background growth
6 & 7	+4 design year with all development	10736	263	2.51%	Increase due to development
8	+9 design year	11260	1377	13.93%	Background growth
9 & 10	+9 design year with all development (Fassaroe – 650 units)	11519	259	2.30%	Increase due to development
11,12 & 13	+9 design year with all development (Fassaroe – 1200 units)	11674	414	3.68%	Increase due to development

7.1.1.1. Base +4 Year Scenarios

The average volume over the three-hour period (16:00-19:00 hours) grows approximately by 600 vehicles (6%) due to background growth only. For Scenarios 6 and 7, the developments add approximately 260 vehicles (2.5%) over the background traffic along the M50/N11 southbound mainline.

7.1.1.2. Base +9 Year Scenarios

The average volume over the three-hour period (16:00-19:00 hours) grows approximately by 1380 vehicles (14%) due to background growth only. For Scenarios 9 and 10, the development traffic adds 259 vehicles, a 2.3% growth over the background traffic along M50/N11 southbound mainline. For Scenarios 11, 12 and 13 the development traffic adds 414 vehicles, equating to a 3.7% growth in volume.

7.1.2. Duration of peak hours

Currently the PM peak period congestion operates in the 4pm to 7pm period. In the +4 design year this period is indicated to extend beyond 7pm whilst in the +9 year period this congestion period has the potential to extend past 8pm. Therefore, in the +4 design year scenarios, the model was run for a total of 5 hours (3:30pm – 8:30pm) and for the scenarios of +9 design year, the model was run for 6 hours (3:30pm – 9:30pm).

7.1.3. Journey Times

The results for the journey times along the M50-N11 mainline for all scenarios are included in Appendix G and are summarised below. For the PM Peak, only the travel times through the network southbound are considered

as this is the critical movement. In all cases, the travel time through the network from M50-Junction 17 to N11-Junction 8 at Kilmacanogue was measured.

7.1.3.1. Base +4 Year Scenarios

The journey times for Scenarios 2 – 5 have been summarised in a previous section and are not discussed further.

Scenario 6: The journey time is similar for the first hour when compared to Scenario 2, while it decreases by 28 seconds from 5 to 6pm, due to a reduction in throughput along the N11. However, due to extension of the congested period, the journey time increases by 17s and 40s in the final two hours respectively when compared to Scenario 2. On average over the four-hour period, the journey time increases marginally by 8 seconds when compared to Scenario 2.

Scenario 7: Again the journey time when compared to Scenario 2 remains similar for the first hour. Similar to Scenario 6 the journey time decreases for 5 to 6 pm. An increase of 16 and 31 seconds where observed in the final two hours. When compared to Scenario 6, which has similar traffic but no signals at roundabouts, the average journey time over the four-hour peak period marginally improves by three seconds.

7.1.3.2. Base +9 Year Scenarios

The journey time for the vehicles for different scenarios for the Base +9 design year have been summarised in Appendix G.

Scenario 8: With no development traffic, the travel time through the network was observed to be between a minimum of 8 minutes and a maximum of 22.1 minutes with the average journey time calculated to be 15.30 minutes over the five-hour period.

Scenario 9: The journey time remains almost the same for the first hour when compared to Scenario 8. However, as throughput reduces, the travel time also reduces by 9 seconds for the 5 to 6 time-period. It increases respectively, by 14, 33 and 8 seconds in the final three hours when compared to Scenario 8. On average over the five-hour period a marginal increase of 9 seconds was seen in the journey times when compared to Scenario 8.

Scenario 10: The journey time reduces respectively in the order of 17 and 58 seconds for the first two-hours when compared to Scenario 8. However, as the congested period extends, the journey time increases respectively by 17, 73 and 21 seconds in the final three hours. When compared to Scenario 9, which has similar traffic but no signals at the roundabouts, on average the journey time improves marginally by 5 seconds over the five-hour period.

Scenario 11: The journey time decreases respectively by 4 and 36 seconds when compared to Scenario 8 for the first two hours while the journey time is similar for the 6 to 7 pm period. However, the journey times increase by 46 and 7 seconds in the final two hours respectively when compared to Scenario 8. On average over the five-hour period, the journey time increases marginally by 2 seconds when compared to Scenario 8.

Scenario 12: The journey time when compared to Scenario 8 decreases respectively by 17 and 76 seconds for the first two hours. An increase of 14, 42 and 12 seconds where observed in the final three hours. When compared to Scenario 11 which has similar traffic but no signals at roundabouts, the average journey time over the five-hour peak period marginally improves by seven seconds.

Scenario 13: With ramp meters in place, the journey time reduces respectively by 10 and 59 seconds for the first two hours when compared to Scenario 8. The journey time remains similar to Scenario 8 for 6-7 pm time-period while an increase of 62 and 18 seconds were observed for the final two hours respectively. When compared to Scenario 11, which has the same traffic and no ramp metering at Junction 6, the overall journey time over the five-hour remains similar.

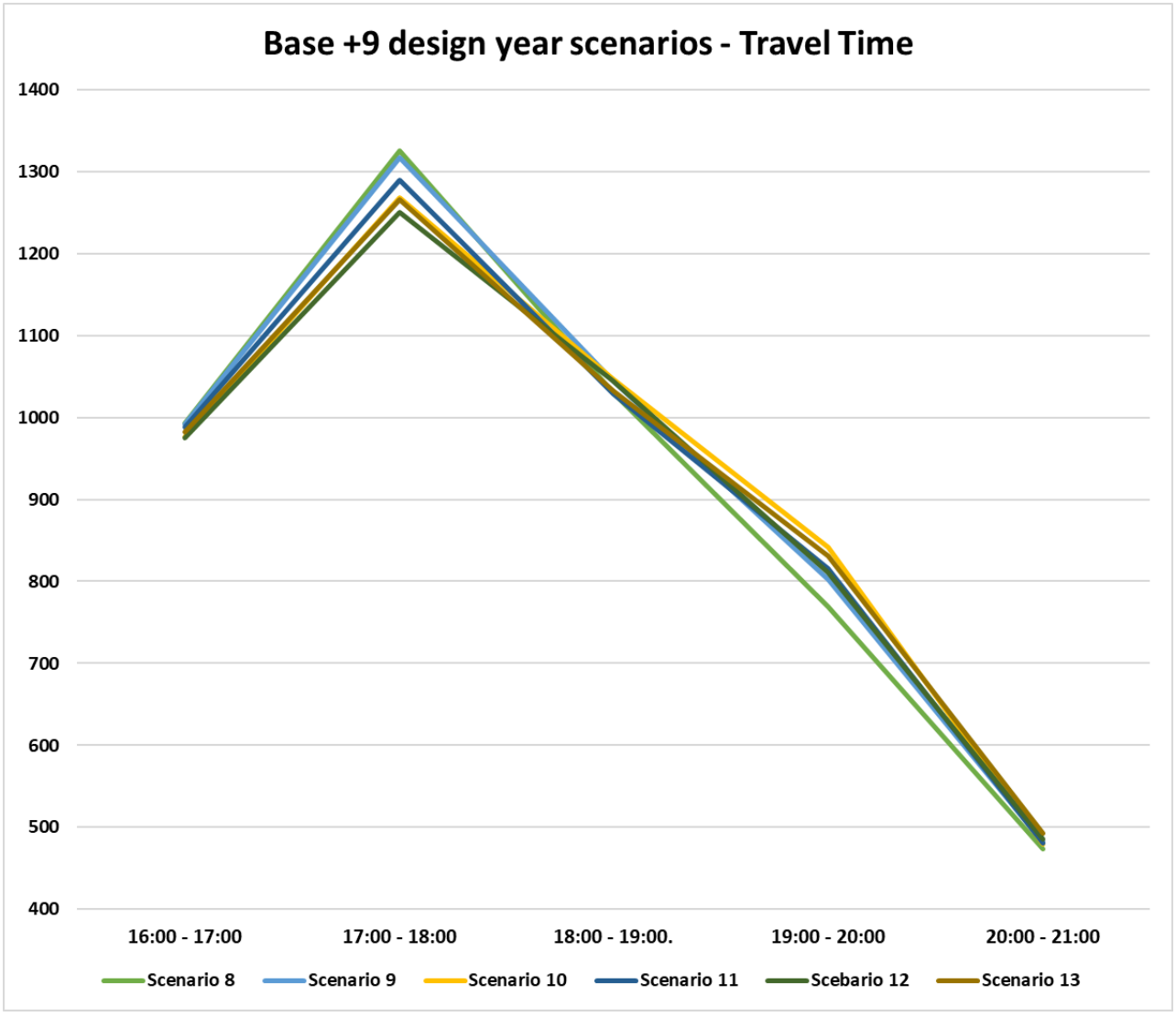
In summary, when compared to the Do Minimum Scenario, the journey time for first two hours decreases for all 'with development' scenarios, as a result of congestion reducing throughput. However, an increase in the journey time was observed in almost all cases for the final three hours as the congestion period extends. Over the entire

five-hour period, there is a marginal increase in the journey time with maximum increase of 9 seconds being observed for Scenario 9. The relatively small increase in traffic due to the key development sites is reflected in an increase in the the level of congestion already experienced on the N11 southbound in the evening peak. Increase in traffic demand reduces the throughput along the mainline effectively lengthening the congestion period slightly. This is evident in Figure 7-1, where it can be observed that the shoulder of the journey time curve for the final three hours for 'with development' scenarios is somewhat more extended in time when compared to no development scenarios.

Similar to +4 design year scenarios, the Traffic Management measures in the form of signals at both roundabouts of Junction 6 has a limited impact with average journey time over the five-hour period decreasing marginally by 7 and 9 seconds when compared to scenarios consisting of similar traffic with priority roundabouts in operation.

The ramp meter has almost no effect on the overall journey time. This is likely due to the fact that ramp meters are more effective in cases where vehicles are allowed to merge when suitable gaps are available on the mainline. But, due to level of congestion on the M50/N11 mainline, the availability of suitable gaps along the mainline for the traffic to merge is minimal. As the majority of the congestion is due to traffic volumes entering a throttle point along the network at the M11 / M50 merge, the measures at Junction 6 generally have a limited impact.

Figure 7-1 - Base +9 design year scenarios (Travel Time)



7.1.4. Overall Network Performance

The overall network performance results are included in Appendix H and include the latent delay, total delay and vehicles arrived at their destination for each hour. Latent delay and total delay for each hour were added together to obtain the net delay across the five-hours for each scenario. This gives an estimate of the total delay experienced by vehicles across the network and those waiting to enter the modelled cordon. Thereafter, average delay per vehicle for each scenario was computed by dividing net delay by the total number of vehicles passing through the network in the entire modelled period. These are also shown in the Appendix H table and the results are summarised below.

7.1.4.1. Base +4 Year Scenarios

Scenario 2: The net delay per vehicle is 5.54 minutes

Scenario 3: The additional trips due to Fassaroe development in Scenario 3 increases the net delay per vehicle by 28 seconds (8.4%).

Scenario 4: Incorporating signals at the roundabouts increases the net-delay/vehicle by 23 seconds (7%) when compared to Scenario 2. When compared to Scenario 3, the net-delay/vehicles improves marginally by 5 seconds.

Scenario 6: The average delay increases by 38 seconds (11.4%) when compared to Scenario 2.

Scenario 7: The net delay/vehicle increases by 41 seconds (12.3%) when compared to the Do-Minimum scenario. When compared to Scenario 6, average delay/vehicle marginally increases by 3 seconds.

The latent demand was observed for all the scenarios as zero at the end of the 7- 8pm period. This suggests that the congestion along the network has extended beyond 7pm but is cleared before 8pm hours.

7.1.4.2. Base +9 Year Scenarios

Scenario 8: The net delay per vehicle is 11.8 minutes, over 6 minutes higher than the Base +4 Scenario 2 due to background growth only.

Scenario 9: The additional vehicles due to all development increases the average per vehicle by around 70 seconds (9.75%) when compared to Scenario 8.

Scenario 10: With all development incorporating signals at the Junction 6 roundabouts, the average delay per vehicle increases by 66 seconds (9.3%) when compared to Scenario 8. When compared to Scenario 9, the inclusion of traffic signals at Junction 6 improves the average delay marginally by 3 seconds/vehicle.

Scenario 11: The additional vehicles due to all development, including an assumed 1,200 units in Fassaroe, increases the average delay per vehicle by 84 seconds (11.8%) when compared to Scenario 8. When compared with Scenario 10, the additional sensitivity development at Fassaroe increases average delay by a relatively small 18s.

Scenario 12: With all development, including 1,200 units at Fassaroe incorporating signals at roundabouts, the average delay per vehicle increases by 79 seconds (11.1%) when compared to Scenario 8. When, compared to Scenario 9, signals improve the average delay marginally by 5 seconds per vehicle.

Scenario 13: Incorporating ramp-meters at the merges of N11-Junction 6 in Scenario 13 results in average delay per vehicle increasing by 77 seconds (10.9%) compared to Scenario 8. This is marginally better than the average delay for Scenarios 11 and 12.

The latent demand was observed for all the scenarios as zero at the end of 8pm to 9pm period. This suggests that the congestion along the network has extended beyond 8pm but is cleared before 9pm.

7.1.4.3. Overall Network Performance Summary

In the +4 year scenarios, it is clear that additional traffic due to background growth results in a lengthening of the PM Peak with congestion occurring up to between 7 and 8pm while in the +9 year scenarios this peak extends

into the following hour. In the +9 year scenario the significant increase in background traffic results in a significant increase in net delay per vehicle compared to the impact of background traffic in the +4year. The introduction of additional traffic due to development results in more modest increases the average delay across the network. The introduction of traffic signals or ramp metering result in minor improvements when compared to the roundabout priority remaining in place.

7.1.5. Junction Impact Assessment Results Summary

The analysis of the junctions includes a comparison of average queue length (in pcus), maximum queues (in pcus), average delay (in seconds) and vehicle throughput between scenarios. Appendix I includes the results of the junction analysis for both the eastern and western roundabouts at Junction 6 which are summarised below.

7.1.5.1. Base +4 Year Scenarios

Eastern Roundabout

In Scenario 2, 3 and 6 with roundabout priority at the Junction 6 roundabouts, there are minimal queues and delays at all arms. Queueing is transitory with negligible average queues, maximum queues in the order of 11 – 15 pcus and average delay of generally less than 3s. This indicates that there is more than sufficient capacity to cater for development in the +4 year scenario. The development traffic has only a minor impact on the roundabout in these scenarios as can be seen by the small increases in results for queue lengths and delays for the with and without development scenarios.

In scenarios 4 and 7 with the signals in place, average queues are generally less than 10 pcus at most arms with a maximum average queue of 11 pcus in Scenario 4 and 11.5 pcus in Scenario 7. As is typical of signal controlled junctions, maximum queues and average delays are higher than for priority roundabout control with a maximum queue of around 30 pcus seen for both scenarios and average delays of around 45 seconds on the approach from the N11 bridge. The Upper Dargle Road is subjected to a maximum queue of around 32 pcus and delays of 75 seconds. The maximum queue of around 16 pcus on the southbound off-slip suggests that queues may backup to the N11 mainline and thus impact the movement of vehicles along the southbound mainline. Also, the longer queues and delays on the Upper Dargle Road and N11 bridge will affect the operation of bus services to and from Fassaroe.

Western Roundabout

In Scenario 2, 3 and 6 similar to the eastern roundabout, there are minimal queues and delays at all arms. Queueing is transitory with negligible average queues, maximum queues of less than 10 pcus and average delays of generally less than 5s indicating that there is more than sufficient capacity to cater for development in the +4 year scenario. The development traffic has only a minimal impact on the roundabout in these scenarios as is evident by the small increases in queue lengths and delays for the with and without development scenarios.

In scenarios 4 and 7 with the signals in place, average queues are generally less than 3 pcus at most arms with a maximum average queue of 3.28 pcus in Scenario 4 and 3.18 in Scenario 7. Again, as is typical of signal controlled junctions, maximum queues and average delays are higher than for priority roundabout control with a maximum queue of around 20 pcus seen for both scenarios. Average delays in both scenarios are around 30s across all arms and any such delays would be cumulative to delays at the eastern roundabout, further impacting bus journey times

7.1.5.2. Base +9 Year Scenarios

Eastern Roundabout

For roundabout priority control, in Scenarios 9 and 11, results are similar to +4 design year scenarios with minimal queues and delays on all arms. Average queues are negligible with maximum queues of around 12 - 20 pcus and average delays of less than 7 seconds, illustrating that the junction operates well within capacity for these scenarios.

In Scenario 10 and 12 with the signals in place, queueing and delays are increased when compared to Scenario 9 and 11. Similar to +4 year scenarios, the maximum queue on the N11 southbound off-slip was observed to be around 16 pcus, which suggests that occasionally queues may backup on the mainline, and thus impact the N11-southbound flow. Average queues on the N11 overbridge are higher at 10 – 15 pcus but maximum queues and delays are significant at around 28 pcus and 50s respectively. Queues and delay on Upper Dargle Road are notably increased with average queues of around 14 – 18 pcus, maximum queues of almost 50 pcus and delays of 2.5+ minutes in the 5 –6 pm period. The maximum queues on the overbridge would extend back to the western roundabout and in overall terms the delays would significantly impact bus journeys through the roundabout.

For scenario 13, with ramp metering on merges at N11-Junction 6, the junction is also operating with negligible average queues and delays.

Western Roundabout

Operating as roundabout priority control in Scenarios 9 and 11, the western roundabout has minimal queues and delays on all arms. Average queues are negligible with maximum queues of around 8.5 pcus and average delays of 6 seconds at most, indicating that the junction operates well within capacity for these scenarios.

In scenarios 10 and 12, with signal controlled roundabouts, the average queues were observed to be around 7 pcus with maximum queues of 31 pcus being observed. Delays are around 70 seconds. Queueing and delays are significantly higher than for the +4 year scenarios with additional delays being caused by queueing from the eastern roundabout backing up across the motorway overbridge.

For Scenario 13, with ramp metering in place, queues and delays were observed to be similar to the roundabout priority control scenarios.

7.1.5.3. Summary of PM Peak Junction Results

Roundabout priority control, in all scenarios operates with marginal queuing and delays. This is further reflected in the Ramp Metering option, wherein both junctions would continue to operate with roundabout priority control.

The traffic signal controls cause significant queues and delays on the arms of eastern roundabout and notable queuing and delay on the western roundabout. The queuing on the N11 overbridge in +9 scenarios also affects the functionality of western roundabout. These will affect the operation of all traffic, in particular bus services to/from Fassaroe. The latter are key transport interventions to facilitate the development of the Fassaroe lands Moreover, the queuing on the southbound off-slip arm at the eastern roundabout may affect the movement along the N11 southbound mainline.

7.2. AM Peak

7.2.1. Volume

For the AM Peak, only the northbound vehicle volumes are considered as this is the critical volume in the congested northbound direction. The traffic volume between Junction 5 and 6 for different scenarios are shown in the table below:

Scenario	Design Year	Volume	Volume Increase	Percentage Increase	Comments
1	Base year	10990			
2	+4 design year	11646	656	5.97%	Background growth
6 & 7	+4 design year with all development	11902	256	2.20%	Increase due to development
8	+9 design year	12521	1531	13.93%	Background growth
9 & 10	+9 design year with all development (Fassaroe – 650 units)	12776	255	2.04%	Increase due to development
11, 12 & 13	+9 design year with all development (Fassaroe – 1200 units) (Scenario 11, 12 and 13)	12916	395	3.15%	Increase due to development

7.2.1.1. Base +4 Year Scenarios

The average daily volume over the three-hour period grows by 655 vehicles (6%) due to background growth alone. For Scenarios 6 and 7, the development adds approximately 255 vehicles (2.2%) over the background traffic along the M50/N11 northbound mainline.

7.2.1.2. Base +9 Year Scenarios

The average daily volume over the three-hour period grows by 1380 vehicles (14%) due to background growth alone. For Scenarios 9 and 10, the development traffic increases traffic by 2.04% over the background traffic along M50/N11 northbound mainline. For Scenario 11, 12 and 13 the development traffic increases traffic by 3.15% between Junctions 5 and 6.

7.2.2. Journey Times

For the morning peak all the scenarios in the +4 and +9 design year were run with the 30-minute cooldown period. The results for the journey times along the M50-N11 mainline for all scenarios are included in Appendix G and are summarised below.

For the AM Peak, the travel times through the network northbound are considered only as this is the critical movement. Travel times southbound are effectively the same in all scenarios and are not discussed further. In all cases, the travel time through the network from N11 Junction 8 at Kilmacanogue to M50 Junction 17 are taken. In addition, the travel times between the R117 to M50 Junction 17 were assessed as this gives the travel times along the N11 north of Junction 7 where the majority of congestion is experienced in the AM Peak. This latter measure gives a clearer indication of the impact of the traffic management measures at Junction 6 on the passing N11 traffic.

7.2.2.1. Base +4 Year Scenarios

Scenario 2: The travel time through the network is generally between 9.4 – 10.7 minutes in all three hours.

Scenario 3: With Fassaroe Phase 1 development and roundabout priority, there is an increase in travel time from N11 Junction 8 to M50 Junction 17 for all hours ranging from 40s in the 7 – 8am hour reducing to 1s in the final hour. On average, there is around 22s of additional travel time through the network across the 3 hour period. The increase in travel time between the R117 and M50 is only 10s in comparison.

Scenario 4: With signal controls, there is a smaller increase in travel times ranging from 3s to 25s, peaking in the 8 – 9 am period. On average, across the three-hour period, there is an increase of 12s in travel times on the N11 and 6s from the R117 to the M50.

Scenario 6: With all development and roundabout priority, the travel times increase by around 4 to 20s for all three hours when compared to Scenario 2. On average, travel time on N11 mainline increases by 10 seconds on the N11 and 6s from the R117 to M50-Jn17.

Scenario 7: With all development and signals in place, the journey time along the N11 mainline increases by 10 and 19 seconds respectively for first two hours, while the journey time improves by 6 seconds in the final hour. Overall, the average journey time across all three hours increases by 8 seconds along N11 while the travel time from the R117 to M50-Jn17 increases by 5 seconds.

The majority of congestion on the N11 northbound is experienced at the merge and diverge of Junction 6 and its western roundabout. In particular, queuing back from the northbound off-slip blocks the N11 mainline in the future year scenarios, causing significant delays and throttling traffic through the network. Only a small proportion of development traffic travels northbound through this congested mainline in the morning peak.

In terms of traffic management, the signals at Junction 6 have a marginal effect, with average journey times being 10 seconds less in Scenario 4 compared to Scenario 3. Similarly, the average journey time was marginally less for Scenario 7 when compared to Scenario 6 with a decrease of 3s.

7.2.2.2. Base +9 Year Scenarios

Scenario 8: With no development and roundabout priority in place, travel times are between 11 – 13 minutes on the N11 mainline and 4 – 5 minutes from the R117 to M50 Junction 17.

Scenario 9: With all development and roundabout priority at Junction 6, the average travel time along the N11 increases by an average of around 7s over the peak hours, while travel time from the R117 increases by around 2s.

Scenario 10: With signals in place, on average over the 3-hour period there is a decrease in travel times on the N11 by around 39s. For the R117 to M50 Junction 17, there is a decrease of -13s on average over the three hours.

Scenario 11: and roundabout priority, there is an increase in average travel times across the peak hours by almost 24s on the N11 mainline while there is a smaller decrease averaging around 2s for the R117 to M50 route when compared with Scenario 8.

Scenario 12: With 1,200 units in Fassaroe and signals included at Junction 6, there is a decrease of 14 seconds on average along the N11 mainline and 8s along the R117 to M50 route.

Scenario 13: The ramp metering at Junction 6 increases the journey time by a marginal 15 seconds along the N11 mainline and 2 seconds from R117 to M50-Junction 17 when compared to Scenario 8.

In all scenarios, the impact of the congestion at Junction 7 has a significant bearing on travel times along the N11. It is important to note that this congestion is not as a result of the development traffic but directly results from the existing traffic volumes and further growth in background traffic in this area and the very limited gaps available to cars trying to enter the western roundabout at Junction 7 from the northbound off-slip.

In order to determine the impact of the traffic management measures at Junction 6, the journey time from R117 to M50-Junction 17 was analysed as this removes the main congestion from consideration. The travel time along this route sees a marginal reduction of 8 to 13 seconds with traffic signals in place but in all cases, the development traffic has very marginal impacts of only around 2s increases.

7.2.3. Overall Network Performance

The overall network performance results are included in Appendix H and include the average delay, total delay, latent demand and average speed for each hour. Congestion at N11 Junction 7 is the critical issue on the network in the AM Peak and results in vehicles being delayed passing through the network northbound on the N11 mainline. This congestion is due to queuing of vehicles back along the Junction 7 off-slip arm back on to the N11 northbound mainline and merging of traffic onto the N11 northbound mainline at Junction 7. Therefore, a large number of vehicles are not able to enter the network which is evident form a high latent demand at 10am.

The key development sites are located north of this location and attract only marginal traffic volumes northbound on the N11 at this location. Therefore, this congestion is unrelated to the proposed developments or indeed traffic management at N11 Junction 6.

7.2.4. Junction Impact Assessment Results Summary

The analysis of the junctions includes a comparison of average queue length (in pcus), maximum queues (in pcus), average delay (in seconds) and vehicle throughput between scenarios. Appendix I includes the results of the junction analysis for the roundabouts located on both sides of N11 Junction 6. These results are summarised below.

7.2.4.1. Base +4 Year Scenarios

Eastern Roundabout

In Scenarios 2, 3 and 6 where no signals are in place at the N11 Junction 6 roundabouts, there are minimal queues and delays at all arms. Queueing is transitory with negligible average queues, maximum queues in the order of 7 – 8 pcus and average delays of less than 1.5s. This indicates that there is more than sufficient capacity to cater for development in the +4 year scenario. The development traffic has little impact on the roundabout in these scenarios as can be seen by the similar results for queue lengths and delays for the with and without development scenarios.

In Scenarios 4 and 7 with the signals in place, average queues are generally of order of 2 to 6 pcus for most of the arms with a maximum average queue of 6.62 pcus in Scenario 4, and 7.66 pcu for Scenario 7. As is typical of signal-controlled junctions, maximum queues and average delays are higher than for priority roundabout control with a maximum queue of around 26-27 pcus seen for all three scenarios and average delays of around 50 seconds to 80 seconds on the critical arms. Despite these delays, the relatively low average queue lengths and reasonable maximum queue lengths indicates that the junction performs adequately with the signals in place.

Western Roundabout

In Scenarios 2, 3 and 6, similar to the eastern roundabout, there are minimal queues and delays at all arms. Queueing is transitory with negligible average queues, maximum queues of less than 9 pcus and average delays of generally less than 5.5s indicating that there is more than sufficient capacity to cater for development in the +4 year scenario. The development traffic has only a minimal impact on the roundabout in these scenarios as can be seen by the small increases in queue lengths and delays when comparing the with and without development scenarios.

In Scenarios 4 and 8 with the signals in place, average queues are generally less than 5 pcus at most arms with a maximum average queue of 4.44 pcus in Scenario 4, and 6.2 pcu for Scenario 7. Maximum queues and average delays are higher than for the priority roundabout control with a maximum queue of around 24.4 pcus seen for Scenario 4 and 32.8 pcus for Scenario 7. The delays for Scenario 4 and 6 were observed to be around 40 seconds and 60 seconds respectively. Despite these delays, the relatively low average queue lengths and reasonable maximum queue lengths indicates that the junction performs adequately with the signals in place.

7.2.4.2. Base +9 Year Scenarios

Eastern Roundabout

Similar to +4 year, in scenarios with no signals or ramp-metering in place at Junction 6, minimal queues and delays were observed on all arms. Maximum queue were observed to be less than 10 pcus with average delays were observed to be less than 5 seconds suggests that the junction operates well within capacity for these scenarios.

In Scenario 9 and 11, similar to PM peak long queues and delays were observed on Upper Dargle Road and the motorway overbridge with average queues observed to be around 17 pcus and delays of more than 2 minutes. Maximum queues of 30 and 40 pcus were observed on the overbridge and Upper Dargle Road arms. This suggests that the junction is operating close to capacity. These delays would notably impact bus journey times through the junction.

For scenario 13, with ramp metering on the Junction 6 merges, the delays and queues were found to similar to scenarios roundabout priority. The maximum queue was observed to be around 7.85 pcus with average delays observed to be around 7.7 seconds. This suggests that the junction is operating within the capacity.

Western Roundabout

Similar to the eastern roundabout, minimal queues and delays are seen on all arms when roundabout priority is maintained. Maximum queues of around 5 pcus and average delays of less than 4 seconds suggest that the junction operates well within capacity for these scenarios.

In Scenario 9 and 11, with the signals in place, the average and maximum queues were observed to be around 5 pcus and 32 pcus respectively. The maximum delays were observed to be just over a minute for both the scenarios. The results suggest that the junction operates within capacity for this scenario.

For scenario 13, with ramp metering in place on the Junction 6 merges, the delays and queues are similar to the scenarios with roundabout priority.

7.2.4.3. Summary of AM peak Junction Results

The junction results suggest that in both design years, the junction will be operating well within capacity for all scenarios where traffic signals are not in place at the roundabouts. As expected, the signals at the roundabouts increase the delays and queues at the junction. However, for most scenarios, the junctions are working just within capacity and would cause delays for bus services travelling through them.

8. Summary and Conclusion

This report sets out the findings of a comprehensive traffic microsimulation model of the M11 / N11 corridor. The primary objective of this study was to model the impact of development traffic on this section of national road network in the vicinity of Bray and to identify appropriate conclusions in terms of traffic management measures at junction 6 of the N11 that would facilitate the first phase of development at Fassaroe of 650 units in the context of the transport infrastructure requirements set out in the Bray Environs Transport Study (BETS) as follows;

1. Fassaroe Development Roads including link road to Ballyman Road
2. N11 Cycle and Pedestrian Bridge
3. Traffic Management Measures at Fassaroe Interchange, Junction 6, arising from the development
4. New bus services in line with demand
5. Bus Priority on Upper Dargle Road including approach to Sunnybank Junction
6. Bus Priority on Dublin Road and Castle Street

Items 1 and 2 would be delivered in tandem with the development of the lands at Fassaroe. The BETS study sets out the proposals for the delivery of Item 4, new bus services from Fassaroe in line with demand. Wicklow County Council is currently in the process of delivering Items 5 and 6 to facilitate the efficient running of the new Fassaroe bus services. In this context the microsimulation model focusses on Item 3, the consideration of traffic management measures at Junction 6, in the context of the other transport infrastructure requirements and, in particular, the facilitation of the Fassaroe bus services

The microsimulation model was developed using Vissim software and was based on a comprehensive suite of traffic surveys carried out in 2019. The model cordon extends from the M50 / M11 merge to junction 8 of the N11 incorporating the junction layouts at junctions 5, 6, 7 and 8.

The model incorporated a fully validated 2019 base year morning and evening peak hour period, of 3 hours duration in each period plus an additional 30 minutes warm up and cool down periods. The model was then developed to measure the impacts of both background traffic growth and traffic associated with the key development sites in the Bray environs including Fassaroe, Bray Golf Club, Woodbrook and Shanganagh Castle. These impacts were assessed in +4 year and +9 year design years.

In each of the design years the impact of just background growth in traffic was modelled. In both design years the impact of development traffic relating to the assumed scale of development at each of the key development sites was superimposed on the background traffic growth in order to assess the combined impact of both background traffic growth and development traffic. Whilst both AM and PM peak periods were modelled the key period that would be impacted by the traffic associated with the key development sites is the PM period.

Four options of traffic management at Junction 6 were modelled as follows;

- The current roundabout traffic management controls were maintained at both junctions
- Traffic signals at both roundabouts at N11 Junction 6.
- Upgrading of the merges and diverges at Junction 6
- Introduction of ramp metering at the Junction 6 merges

In the AM peak the model results indicate that development traffic has a very minor impact on travel times through the network. Significant congestion is experienced on the network at N11 Junction 7 with vehicles queueing onto the N11 from the northbound off-ramp and vehicles merging onto the N11 at the northbound on-ramp resulting in a throttling of capacity at this location. The model results indicate that there is significant latent demand waiting to enter the network at the end of the peak period as a result. However, as all of the BETS development is located

north of this junction, the impact of traffic travelling to and from these sites is very minor and predominantly avoids the congested area. The results of the model also indicate that while traffic signals at the Junction 6 roundabouts are beneficial to the N11 mainline in the AM peak, the improvements in travel time are generally minor.

Within the PM period the key consideration is the southbound flow of traffic on the mainline together with traffic flow at Junction 6. Key findings of the modelling process are summarised below in terms the PM peak southbound flows in the context of increase in traffic demand flow, overall network delay, the duration of the PM peak period, impacts of traffic management options at Junction 6 and the impact of these options on the operation of Junction 6 .

Traffic flow southbound on the N11 in the critical PM peak hour period will increase in the design years due to assumed background growth in traffic and traffic due to the key development sites. In the +9 design year background growth in traffic would account for a 14% growth in current traffic volumes on the N11 mainline whilst development traffic would account for approximately 3.2% increase. Therefore, three quarters of the increase in traffic volumes would be due to background growth and the remainder due to development related traffic. Growth in traffic demand will result in longer congestion periods in the PM peak.

In terms of journey times on the mainline southbound, between Junction 17 M50 and Junction 8 N11, the introduction of background and development traffic growth and the various traffic management measures has marginal impacts when considering the entire peak period. This outcome indicates that within this cordon the level of congestion southbound is such that increases in traffic demand result in longer congestion periods rather than increased journey time on the mainline southbound through the model cordon.

This outcome is reflected in the overall network performance, taking account of the entire road network within the model cordon and latent delay experienced by those outside of the modelled cordon but waiting to enter it. This is reflected in the lengthening of the congested period as more traffic is introduced into the network, with congestion ending between 7 and 8pm in the +4 year design year and after 8pm in the +9 design year.

The most significant increase in delay, in terms of the overall network, is due to background growth in traffic in the design years. Comparing the +4 year and +9 year scenarios with only background growth, there is an increase in average vehicle delay of over 6 minutes per vehicle in the +9 year. The addition of development traffic results in more marginal increases in the average delay per vehicle. The average delay per vehicle increases by between 23 and 41 seconds in the +4 design year and between 70 and 84s in the +9 design year when compared to the respective Do Minimum scenarios.

The introduction of traffic signals at the roundabouts at Junction 6 will marginally improve journey time through the model cordon on the N11 mainline, compared to maintaining the current roundabout control. Improvements to the merges and diverges at Junction 6 result in notable increases in the journey time compared to the other two traffic management options. In all modelled scenarios the roundabout operation has significant spare capacity with nominal delays to traffic and no queuing back on to the main line.

At the eastern and western junctions at Junction 6, the introduction of traffic signals will result in potential significant increases in delays and queuing on all arms. These are most acute on the eastern roundabout with the potential for queues extending back towards the N11 mainline at the southern diverge, long queues on Upper Dargle Road and queueing across the N11 overbridge impacting the western roundabout. These delays would mitigate against the efficient operation of the junctions and, in particular, the operation of bus services to and from Fassaroe.

In terms of the overall requirements to facilitate the phased development of Fassaroe, it is therefore concluded that the current operation of the two roundabouts at Junction 6 would be the optimal traffic management arrangement.

The model indicates that the ramp metering would have marginal impact in terms of improving main line flow. However, in order to provide the option and ability to control traffic merging on to the N11 mainline, ramp metering traffic signal control could be introduced onto both the northbound and southbound merge lanes in conjunction with the continued roundabout priority operation at the two junctions. These signals would need to operated so

as to ensure that queuing on the merge lane does not extend back in to the roundabouts and therefore compromise the overall operation of the two roundabouts and to preclude any potential for queues to develop back on to the N11 mainline at the two diverges.

Appendices

Appendix A. Calibration of Model

A.1. GEH calibration – Junctions

Table A-1 - AM Peak JTC Calibration

Movement	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00		
	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value
N11 – Junction 6 (Eastern Roundabout)									
UDR – Link	17	17	0.00	26	26	0.00	24	24	0.00
UDR – R918	147	142	0.42	157	148	0.73	91	94	0.31
UDR – On slip	65	62	0.38	117	111	0.56	112	119	0.65
Link – UDR	19	19	0.00	31	31	0.00	26	26	0.00
Link – R918	56	52	0.54	50	47	0.43	21	21	0.00
Link – On slip	7	5	0.82	30	27	0.56	29	28	0.19
R918 – UDR	101	107	0.59	242	226	1.05	256	258	0.12
R918 – Link	27	26	0.19	44	42	0.30	37	33	0.68
R918 – On slip	73	79	0.69	226	262	2.30	205	194	0.78
Off slip – UDR	33	32	0.18	86	82	0.44	66	66	0.00
Off slip - Link	10	9	0.32	21	19	0.45	20	20	0.00
Off slip – R918	25	25	0.00	49	47	0.29	32	29	0.54
N11 – Junction 6 (Western Roundabout)									
R918 – On slip	193	184	0.66	198	187	0.79	104	113	0.86
R918 – Link	33	34	0.17	58	55	0.40	46	33	2.07
Off slip – R918	168	179	0.84	387	410	1.15	434	419	0.73
Off slip - Link	28	26	0.38	39	36	0.49	33	39	1.00

Movement	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00		
	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value
Link – On slip	33	28	0.91	87	84	0.32	35	37	0.33
Link – R918	35	34	0.17	127	121	0.54	64	67	0.37
N11 – Junction 7 (Eastern Roundabout)									
R768S – R767N	164	184	1.52	199	207	0.56	161	165	0.31
R768S – R768E	159	129	2.50	175	144	2.45	172	151	1.65
R768S – On slip	81	52	3.56	102	64	4.17	46	51	0.72
R767S – R768N	128	163	2.90	253	288	2.13	216	235	1.27
R767S – R768W	96	145	4.46	145	169	1.92	185	229	3.06
R767S – On slip	12	26	3.21	27	48	3.43	23	24	0.21
R768W– R768N	546	542	0.17	566	552	0.59	438	429	0.43
R768W– R767N	12	12	0.00	10	8	0.67	14	26	2.68
R768W– On slip	66	72	0.72	86	84	0.22	125	129	0.35
Off slip– R768N	520	528	0.35	375	365	0.52	529	523	0.26
Off slip– R767N	10	7	1.03	7	4	1.28	9	20	2.89
Off slip– R768W	41	51	1.47	56	62	0.78	91	105	1.41
N11 – Junction 7 (Western Roundabout)									
R768 – On slip	1216	1231	0.43	1230	1205	0.72	1145	1135	0.30
R768 – Kilcroney Lane	21	16	1.16	34	22	2.27	23	24	0.21
Off slip– R768	205	300	5.98	321	388	3.56	366	423	2.87
Off slip– Kilcroney Lane	3	3	0.00	6	6	0.00	14	8	1.81
Kilcroney Lane – On Slip	34	24	1.86	46	33	2.07	32	25	1.31

Movement	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00		
	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value
Kilcroney Lane – R768	25	32	1.31	82	92	1.07	47	54	0.99
R117 – N11 Northbound Junction									
N11 – R117	124	121	0.27	186	210	1.71	198	198	0.00
R117 – N11	101	119	1.72	159	215	4.10	237	208	1.94
Herbert Road – N11 Southbound Junction									
N11 – Herbert Road	148	145	0.25	237	231	0.39	133	137	0.34
Herbert Road – N11	132	159	2.24	365	407	2.14	273	343	3.99
Total number of movements			**40**	**Number of movements with GEH > 5**			**1**	**%**	**97.5%**

Table A-2 - PM Peak JTC Calibration

Movement	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00		
	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value	Observed flow (C)	Modelled flow (M)	GEH Value
N11 – Junction 6 (Eastern Roundabout)									
UDR – Link	24	25	0.20	43	43	0.00	26	26	0.00
UDR – R918	88	84	0.43	76	75	0.12	52	54	0.27
UDR – On slip	166	219	3.82	196	231	2.40	167	171	0.31
Link – UDR	15	15	0.00	25	25	0.00	18	18	0.00
Link – R918	9	8	0.34	32	32	0.00	10	8	0.67
Link – On slip	21	19	0.45	57	50	0.96	35	31	0.70
R918 – UDR	182	178	0.30	229	224	0.33	161	158	0.24
R918 – Link	22	22	0.00	26	25	0.20	29	27	0.38
R918 – On slip	270	241	1.81	412	379	1.66	313	316	0.17
Off slip – UDR	98	92	0.62	88	86	0.21	125	120	0.45
Off slip - Link	24	22	0.42	25	23	0.41	30	28	0.37
Off slip – R918	28	34	1.08	15	17	0.50	23	20	0.65
N11 – Junction 6 (Western Roundabout)									
R918 – On slip	72	75	0.35	89	87	0.21	57	56	0.13
R918 – Link	46	52	0.86	33	37	0.68	28	27	0.19
Off slip – R918	302	237	3.96	406	337	3.58	318	307	0.62
Off slip - Link	23	24	0.21	16	14	0.52	10	8	0.67
Link – On slip	42	42	0.00	34	33	0.17	16	16	0.00
Link – R918	170	206	2.63	262	293	1.86	181	191	0.73

N11 – Junction 7 (Eastern Roundabout)									
R768S – R767N	164	184	1.52	199	207	0.56	161	165	0.31
R768S – R768E	159	129	2.50	175	144	2.45	172	151	1.65
R768S – On slip	81	52	3.56	102	64	4.17	46	51	0.72
R767S – R768N	235	276	2.57	286	328	2.40	196	225	2.00
R767S – R768W	15	15	0.00	10	10	0.00	12	12	0.00
R767S – On slip	211	213	0.14	204	205	0.07	158	161	0.24
R768W– R768N	415	472	2.71	451	504	2.43	380	438	2.87
R768W– R767N	13	12	0.28	15	19	0.97	17	17	0.00
R768W– On slip	228	228	0.00	197	198	0.07	170	175	0.38
Off slip– R768N	109	132	2.10	110	132	2.00	134	128	0.52
Off slip– R767N	178	178	0.00	149	156	0.57	192	183	0.66
Off slip– R768W	387	394	0.35	492	434	2.70	553	548	0.21
N11 – Junction 7 (Western Roundabout)									
R768 – On slip	695	823	4.65	798	901	3.53	642	730	3.36
R768 – Kilcroney Lane	59	57	0.26	47	56	1.25	49	46	0.44
Off slip– R768	312	279	1.92	340	272	3.89	250	257	0.44
Off slip– Kilcroney Lane	3	3	0.00	8	6	0.76	5	0	3.16
Kilcroney Lane – On Slip	25	29	0.77	18	19	0.23	18	21	0.68
Kilcroney Lane – R768	82	80	0.22	130	129	0.09	102	104	0.20
R117 – N11 Northbound Junction									
N11 – R117	138	143	0.42	144	148	0.33	127	109	1.66
R117 – N11	226	226	0.00	334	347	0.70	274	275	0.06

Herbert Road – N11 Southbound Junction									
N11 – Herbert Road	358	427	3.48	339	370	1.65	408	421	0.64
Herbert Road – N11	95	94	0.10	123	114	0.83	111	116	0.47
Total number of movements			**40**	**Number of movements with GEH > 5**			**0**	**%**	**100.0%**

A.2. GEH calibration – Links

Table A-3 - GEH Validation Criteria for Links (AM Peak)

TMU Counter	07:00 – 08:00			08:00 – 09:00			09:00 – 10:00		
	Actual	Modelled	GEH	Actual	Modelled	GEH	Actual	Modelled	GEH
Northbound									
M50 Between Jn16 Cherrywood and Jn17 M50/M11, Shankill, Co. Dublin	3160	3281	2.13	2923	3067	2.63	2457	2586	2.57
M11 Between M50/M11 and Bray North Jn, Bray, Co. Dublin	4955	4936	0.27	4568	4573	0.07	3598	3807	3.43
M11 Between Jn5 Bray North and Jn6 Bray Central, Fassaroe , Co. Wicklow	4309	4287	0.34	4133	4142	0.14	3271	3388	2.03
N11 Between Jn8 Kilmacanogue and Jn9 Glen of the Downs, Kilmacanogue, Co Wicklow	2944	2973	0.53	2868	2859	0.17	2503	2496	0.14
Southbound									
M50 Between Jn16 Cherrywood and Jn17 M50/M11, Shankill, Co. Dublin	1168	1225	1.65	1358	1373	0.41	1273	1287	0.39
M11 Between M50/M11 and Bray North Jn, Bray, Co. Dublin	1652	1682	0.73	2192	2190	0.04	2115	2068	1.03
M11 Between Jn5 Bray North and Jn6 Bray Central, Fassaroe , Co. Wicklow	1446	1358	2.35	1926	1891	0.80	1843	1819	0.56
N11 Between Jn8 Kilmacanogue and Jn9 Glen of the Downs, Kilmacanogue, Co Wicklow	1018	978	1.27	1406	1417	0.29	1306	1268	1.06
Total number of movements along the Links	**24**		**Number of movements with GEH<5**	**24**		**% of movements with GEH<5**	**100%**		

Table A-4 - GEH Validation Criteria for Links (PM Peak)

TMU Counter	07:00 – 08:00			08:00 – 09:00			09:00 – 10:00		
	Actual	Modelled	GEH	Actual	Modelled	GEH	Actual	Modelled	GEH
Northbound									
M50 Between Jn16 Cherrywood and Jn17 M50/M11, Shankill, Co. Dublin	1623	1650	0.67	1369	1458	2.37	1162	1164	0.06
M11 Between M50/M11 and Bray North Jn, Bray, Co. Dublin	2365	2499	2.72	2274	2593	6.47	1879	2012	3.02
M11 Between Jn5 Bray North and Jn6 Bray Central, Fassaroe, Co. Wicklow	2140	2194	1.16	1973	2309	7.26	1749	1776	0.64
N11 Between Jn8 Kilmacanogue and Jn9 Glen of the Downs, Kilmacanogue, Co Wicklow	1444	1489	1.18	1411	1534	3.21	1235	1220	0.43
Southbound									
M50 Between Jn16 Cherrywood and Jn17 M50/M11, Shankill, Co. Dublin	2425	2478	1.07	1871	1903	0.74	2096	2041	1.21
M11 Between M50/M11 and Bray North Jn, Bray, Co. Dublin	3834	3921	1.40	3596	3516	1.34	3480	3497	0.29
M11 Between Jn5 Bray North and Jn6 Bray Central, Fassaroe, Co. Wicklow	3645	3614	0.51	3641	3369	4.59	3478	3343	2.31
N11 Between Jn8 Kilmacanogue and Jn9 Glen of the Downs, Kilmacanogue, Co Wicklow	3250	3013	4.24	3327	3095	4.09	2928	2788	2.62
Total number of movements along the Links	**24**		**Number of movements with GEH<5**	**22**		**% of movements with GEH<5**	**91.6%**		

A.3. Journey Time calibration

Table A-5 - Journey Time Calibration Criteria (AM Peak)

Route	07:00 – 08:00			08:00 – 09:00			09:00 – 10:00		
	Observed travel time (s)	Modelled travel time (s)	% Diff	Observed travel time (s)	Modelled travel time (s)	% Diff	Observed travel time (s)	Modelled travel time (s)	% Diff
Northbound Route									
N11 to M50	549	601	9.47%	400	394	-1.50%	324	352	8.64%
N11 to M11	550	607	10.36 %	407	396	-2.70%	331	355	7.25%
Southbound Route									
M50 to N11	329	337	2.43%	333	346	3.90%	324	348	7.41%
M11 to N11	319	330	3.45%	318	341	7.23%	331	343	3.63%

Total number of routes	**12**	**Number of routes within 15% or 1 minute if higher**	**12**	**Percentage of routes within 15% or 1 minute**	**100%**

Table A-6 - Journey Time Calibration Criteria (PM Peak)

Route	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00		
	Observed travel time (s)	Modelled travel time (s)	% Diff	Observed travel time (s)	Modelled travel time (s)	% Diff	Observed travel time (s)	Modelled travel time (s)	% Diff
Northbound Route									
N11 to M50	304	331	8.88%	303	330	9.24%	302	321	6.29%
N11 to M11	324	338	4.32%	313	338	7.99%	313	332	6.39%
Southbound Route									
M50 to N11	726	750	3.31%	914	1035	13.24 %	606	566	-6.60%
M11 to N11	611	613	0.33%	706	738	4.53%	516	532	3.10%

Total number of routes	**12**	**Number of routes within 15% or 1 minute if higher**	**12**	**Percentage of routes within 15% or 1 minute**	**100%**

Appendix B. Fassaroe Trip Generation

B.1. AM Peak

Table B-1 - Fassaroe Trip Generation (AM Peak)

Type	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00	
	Arrival	Departure	Arrival	Departure	Arrival	Departure
Trips Generated by 650 units in Fassaroe (for scenarios 3,4,5,6,7,9 and 10)						
House	20	78	46	155	47	79
Apartment	23	137	32	223	32	73
Total trips	**43**	**215**	**78**	**378**	**79**	**162**
Trips Generated by 1200 units in Fassaroe (for scenarios 11,12 and 13)						
House	37	144	85	286	87	146
Apartment	42	253	60	412	60	153
Total trips	**79**	**397**	**145**	**698**	**506**	**285**

B.1. PM Peak

Table B-2 - Fassaroe Trip Generation (PM Peak)

Type	16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arrival	Departure	Arrival	Departure	Arrival	Departure
Trips Generated by 650 units in Fassaroe (for scenarios 3,4,5,6,7,9 and 10)						
House	106	62	133	81	97	77
Apartment	88	51	167	57	177	77
Total trips	**194**	**113**	**300**	**138**	**274**	**154**
Trips Generated by 1200 units in Fassaroe (for scenarios 11,12 and 13)						
House	196	115	245	149	179	142
Apartment	163	93	309	106	327	143
Total trips	**359**	**208**	**554**	**255**	**506**	**285**

Appendix C. Modal Share – Fassaroe

C.1. For scenarios 3, 4, 5, 6, 7, 9 and 10 which has 650 units in Fassaroe

Table C-1 - Fassaroe Modal Trip Generation by 650 units (AM Peak)

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00	
Active Travel	6	32	12	57	12	24
Public Transport	8	39	14	68	14	29
Cars	20	99	36	174	37	75
Total	**34**	**170**	**62**	**299**	**63**	**128**

Table C-2 - Fassaroe Modal Trip Generation by 650 units (PM Peak)

Mode	16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
Active Travel	29	17	45	21	41	23
Public Transport	35	20	54	25	49	28
Cars	89	52	138	64	126	71
Total	**154**	**89**	**237**	**109**	**216**	**122**

C.2. For scenarios 11,12 and 13 which has 1200 units in Fassaroe

Table C-3 - Fassaroe Modal Trip Generation by 1200 units (AM Peak)

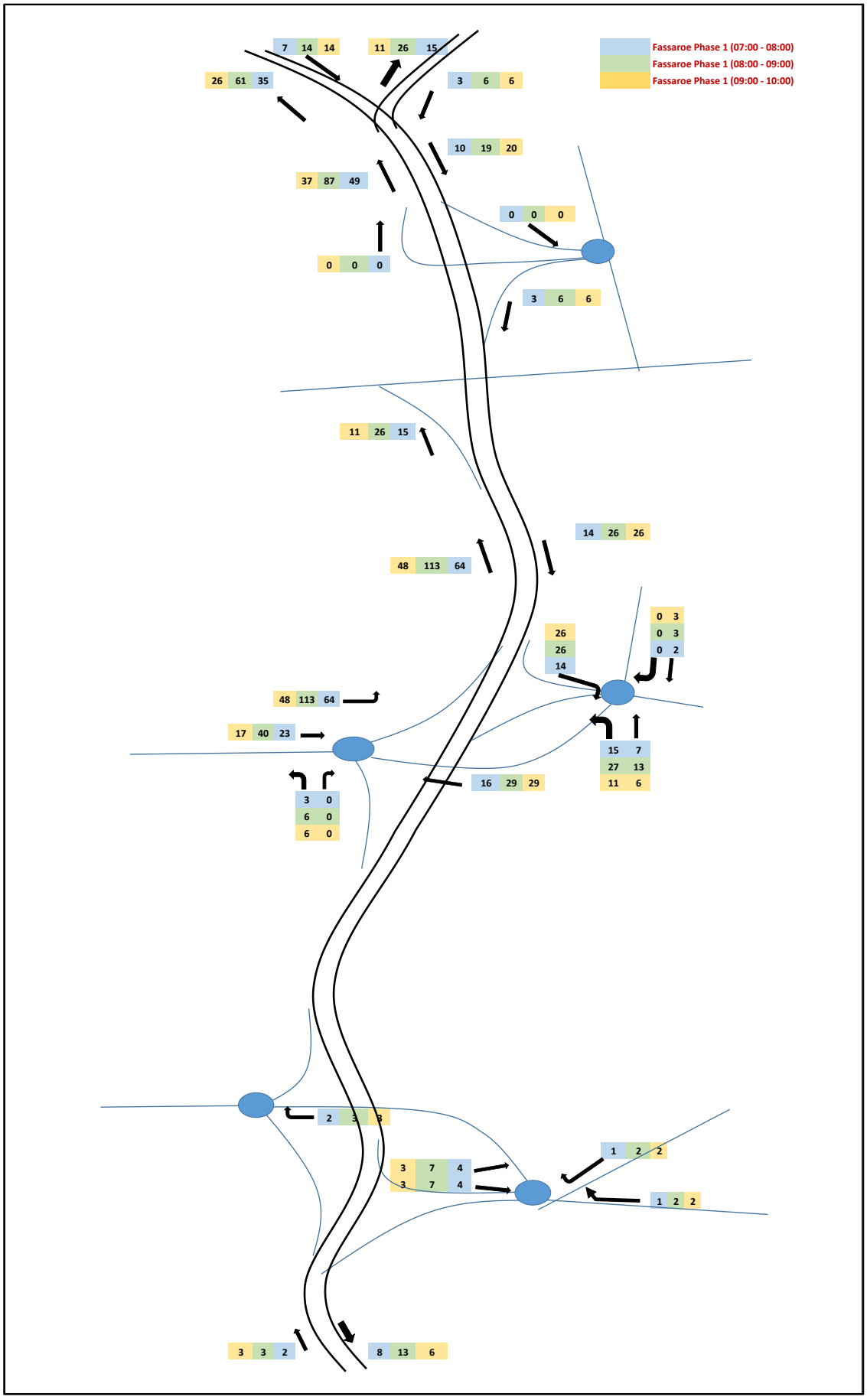
Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00	
Active Travel	14	71	26	126	26	54
Public Transport	22	111	41	195	41	84
Cars	32	159	58	279	59	120
Total	**68**	**341**	**125**	**600**	**126**	**257**

Table C-4 - Fassaroe Modal Trip Generation by 1200 units (PM Peak)

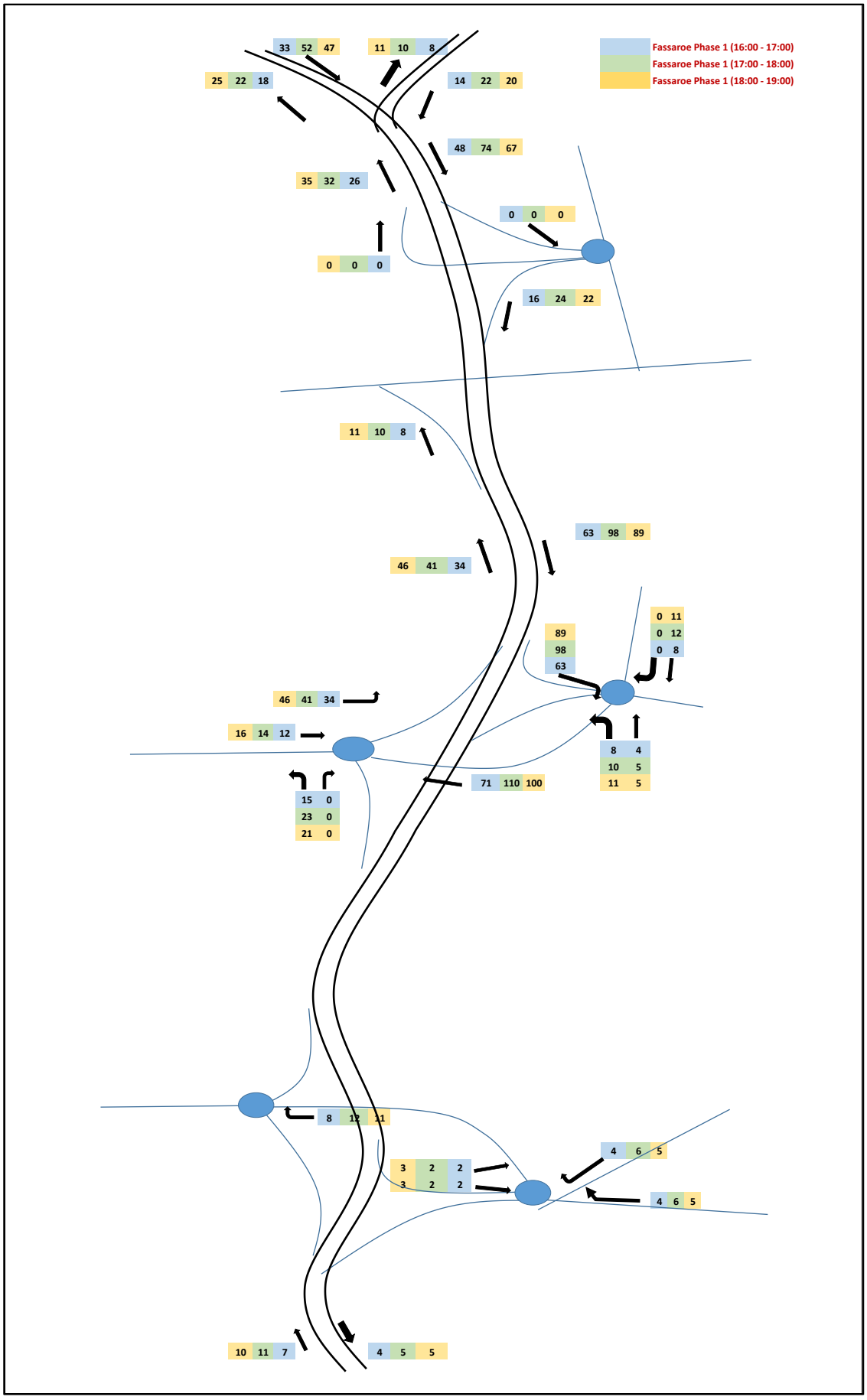
Mode	16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
Active Travel	65	37	100	46	91	51
Public Transport	101	58	155	71	142	80
Cars	144	83	221	102	202	114
Total	**309**	**179**	**476**	**219**	**435**	**245**

Appendix D. Trip Distribution

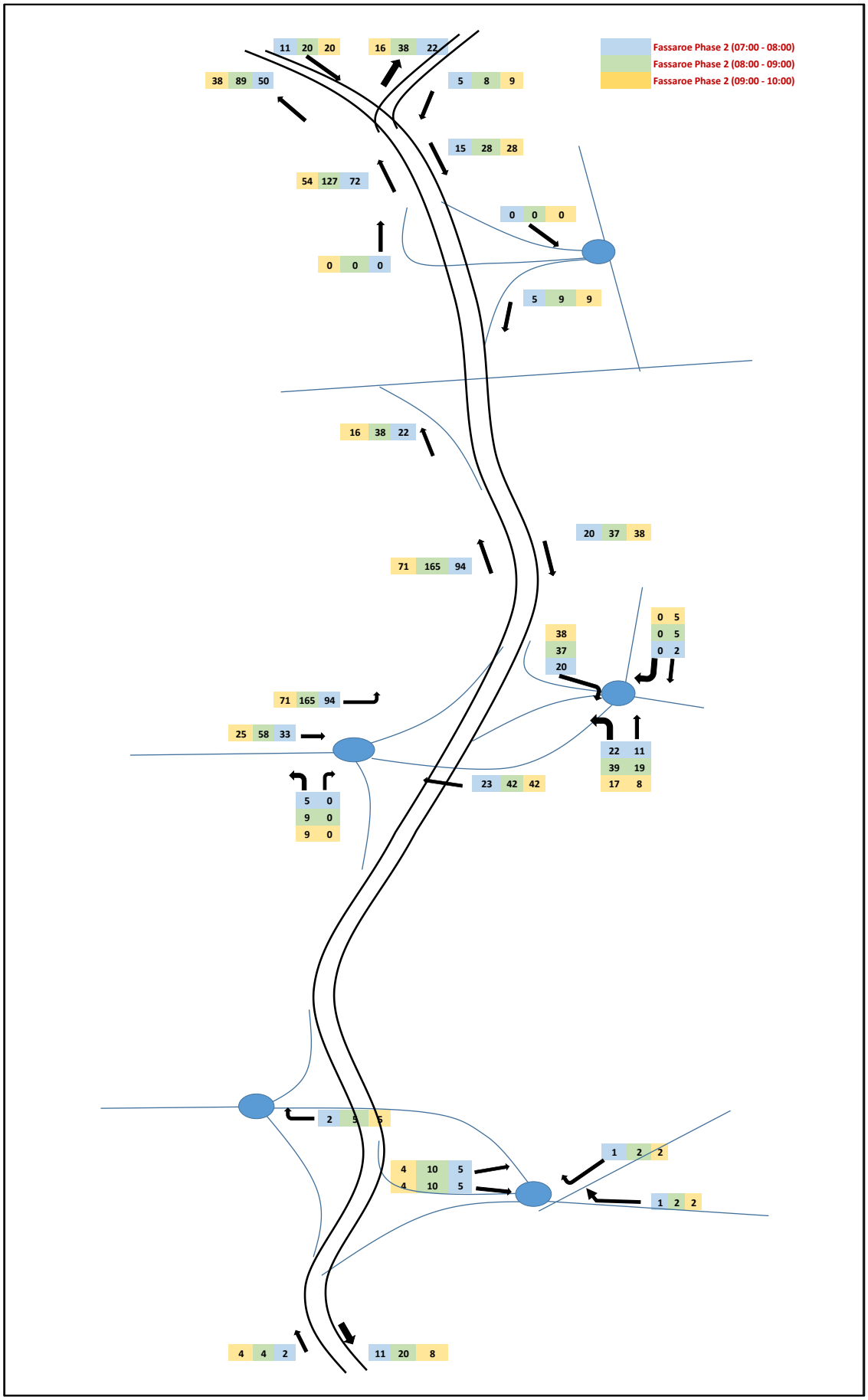
D.1. Fassaroe (650 units) – AM Peak



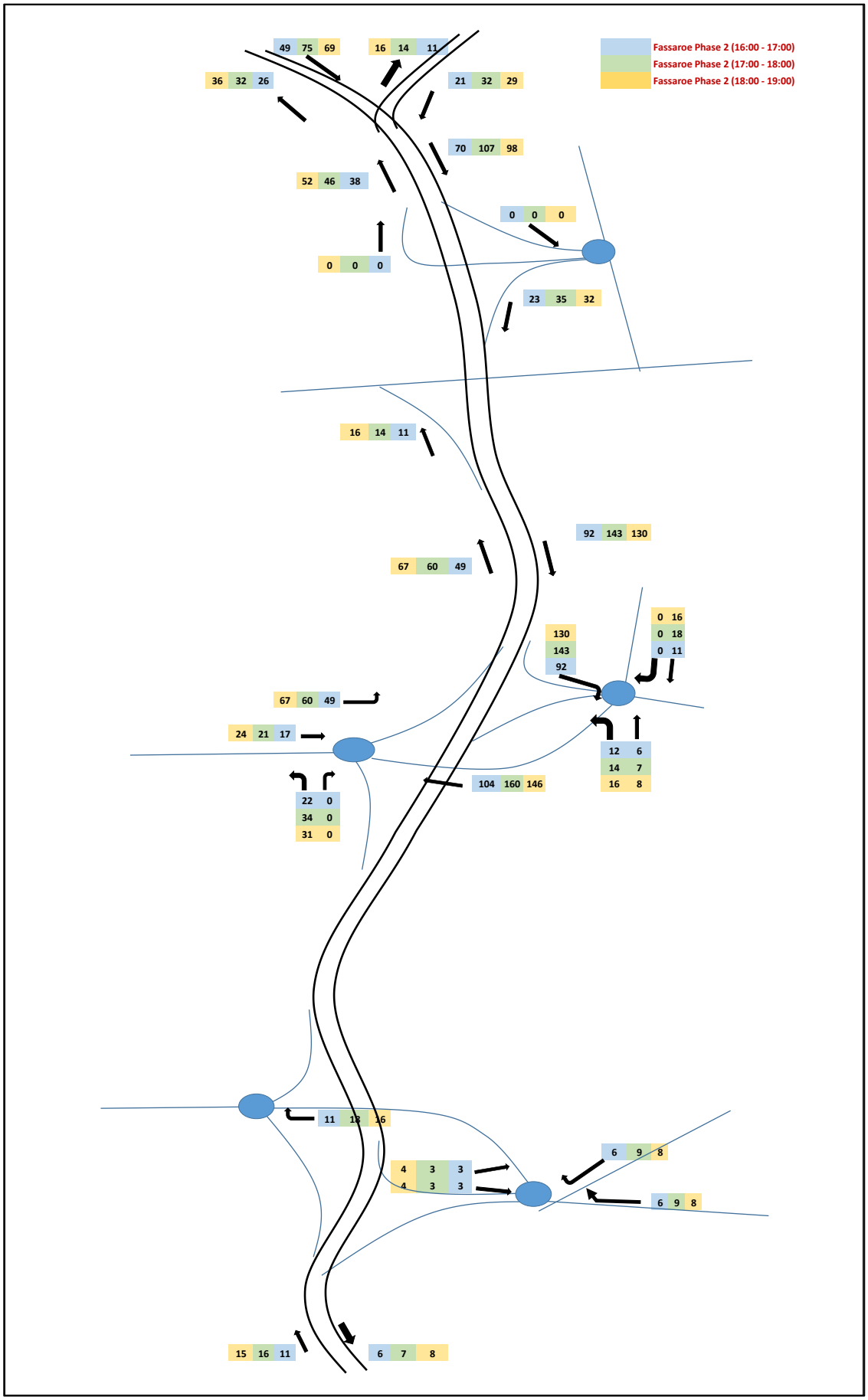
D.2. Fassaroe (650 units) – PM Peak



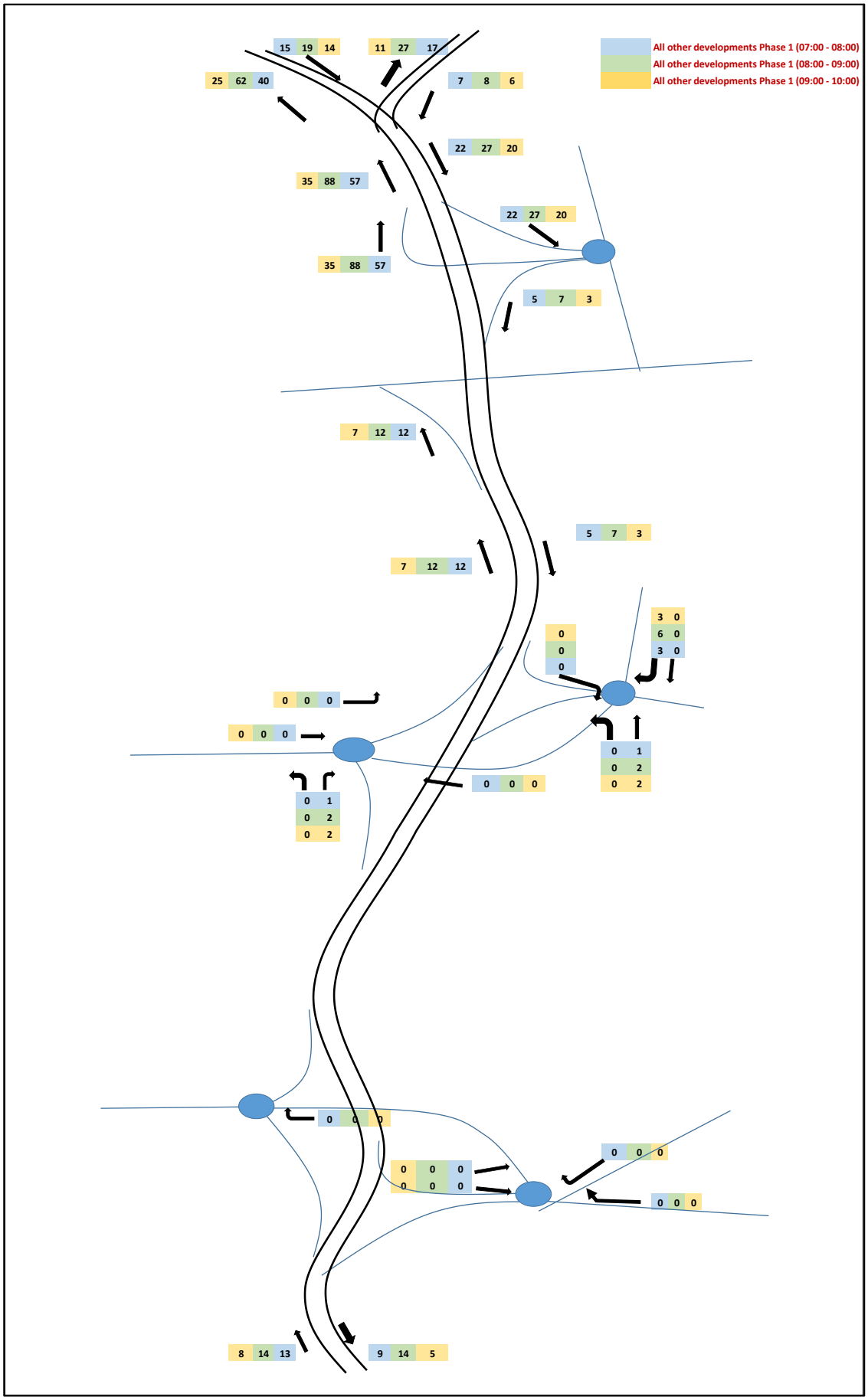
D.3. Fassaroe (1200 units) – AM Peak



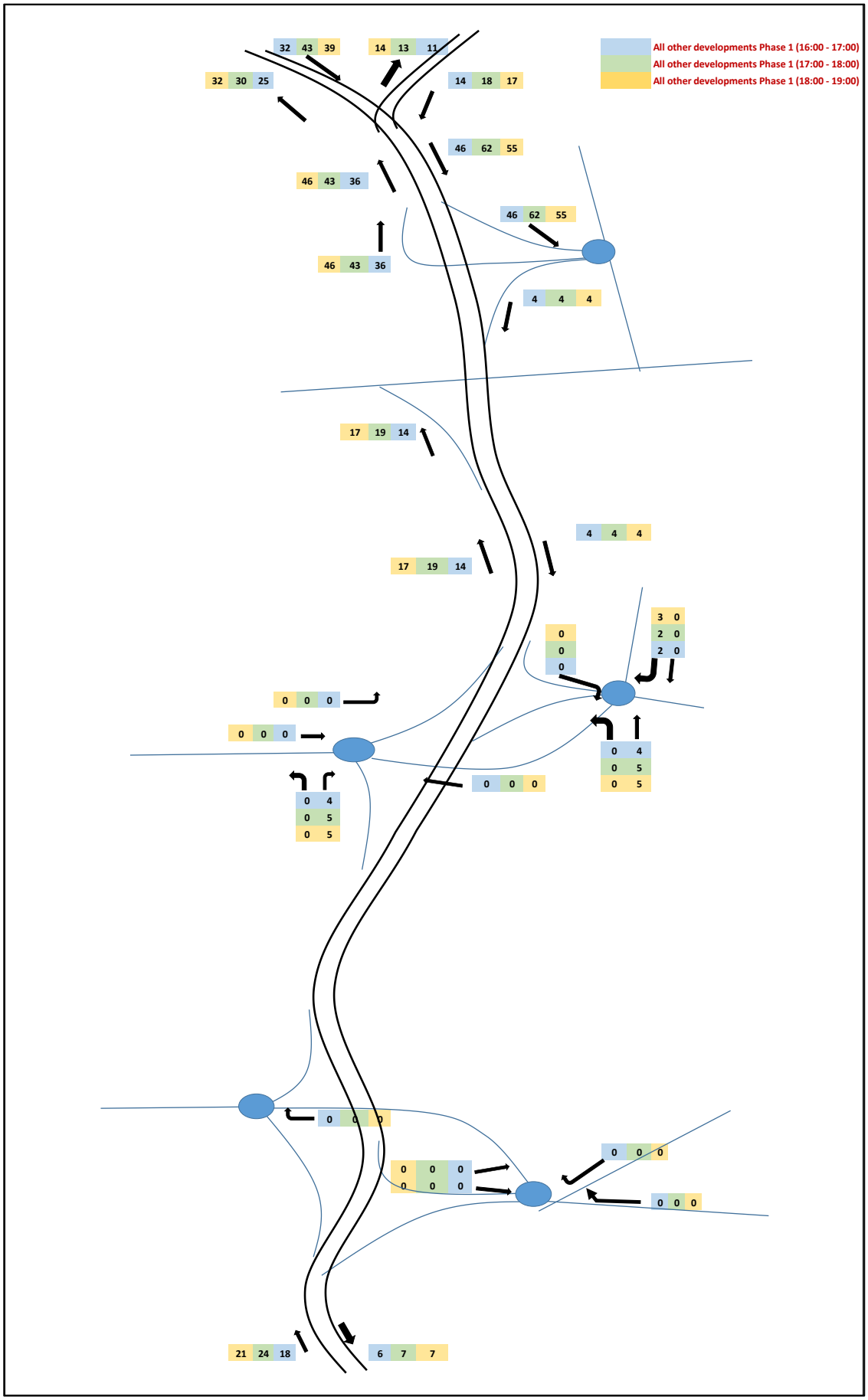
D.4. Fassaroe (1200 units) – PM Peak



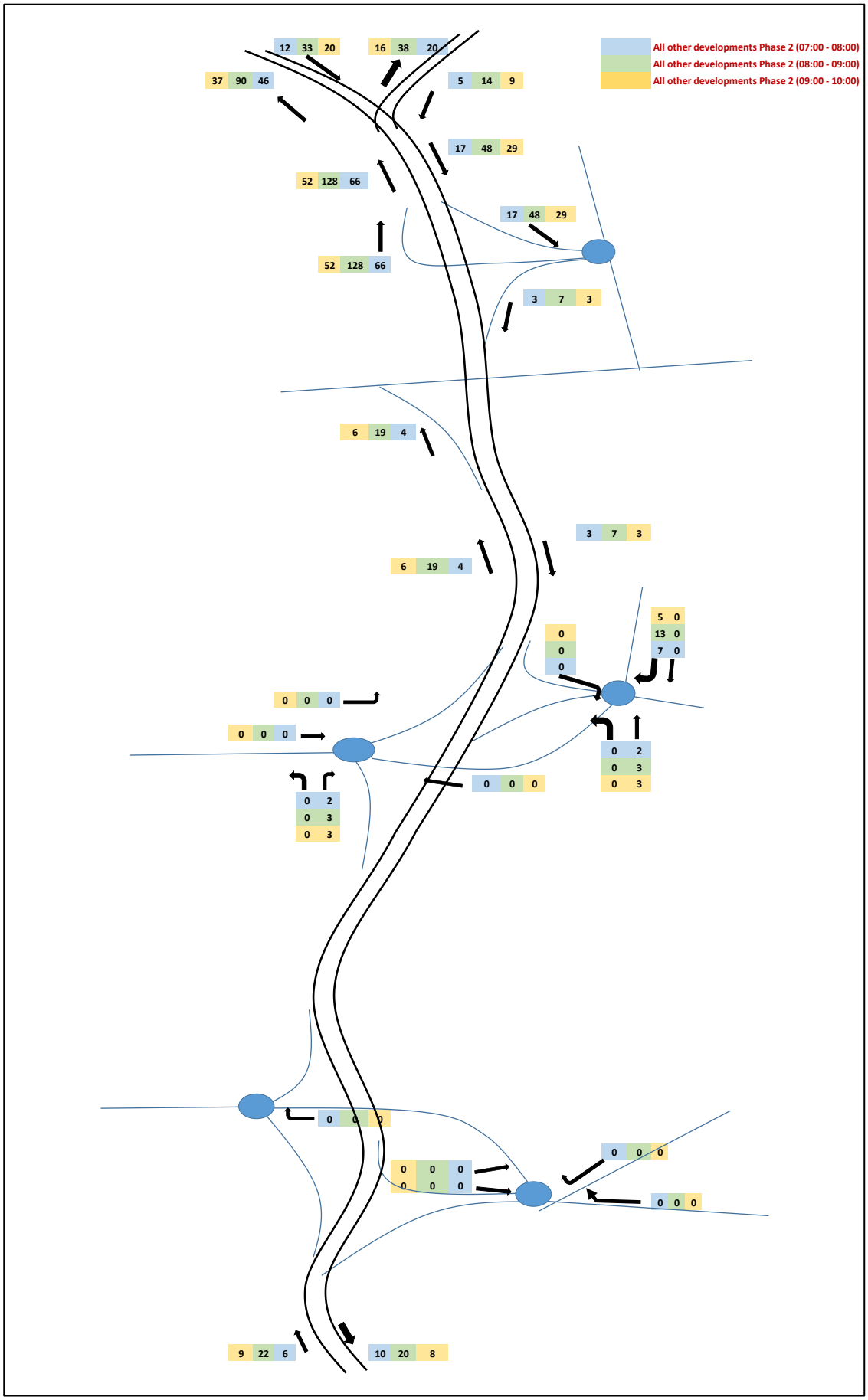
D.5. Other BETS Development (Base+4) – AM Peak



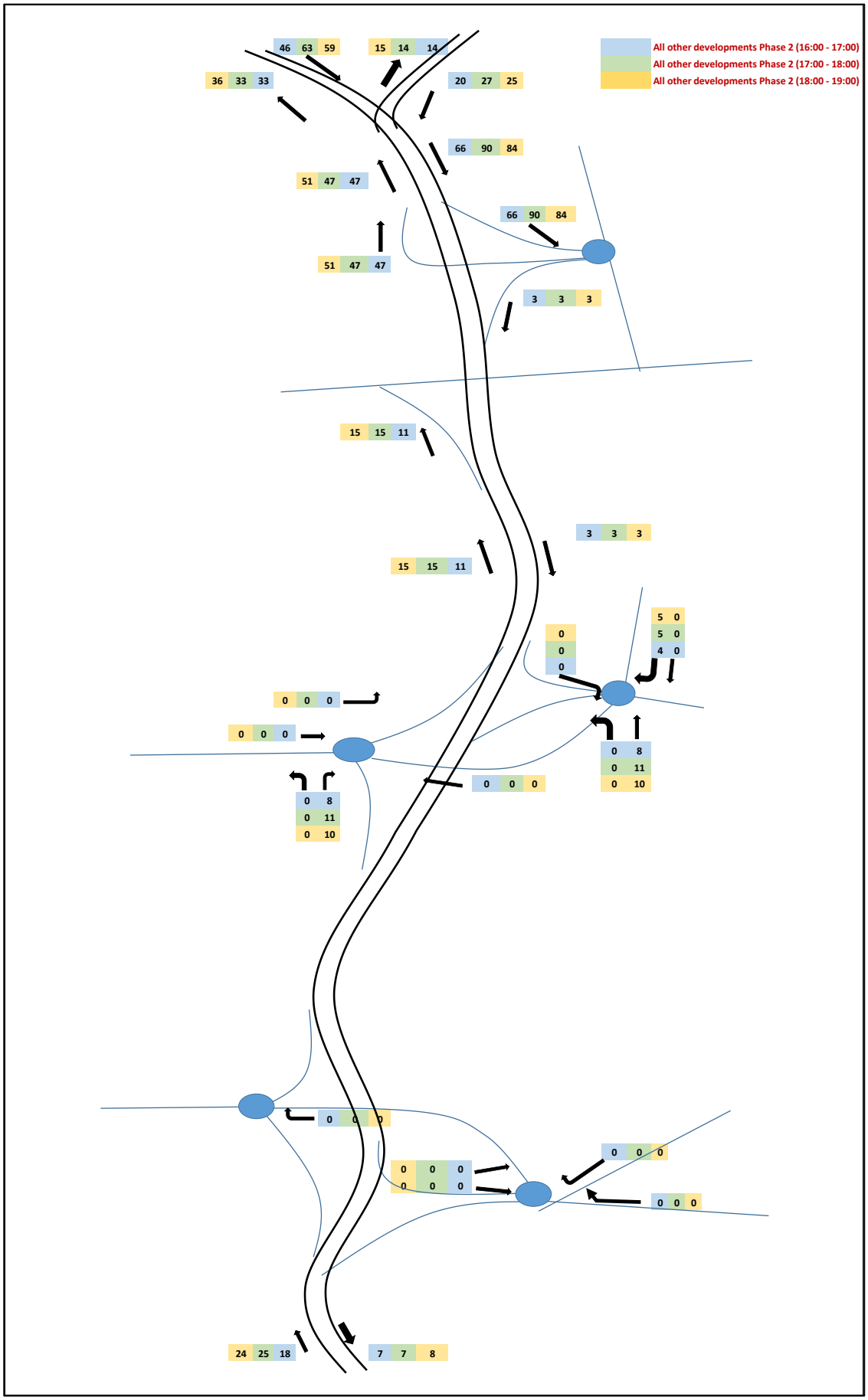
D.6. Other BETS Development (Base+4) – PM Peak



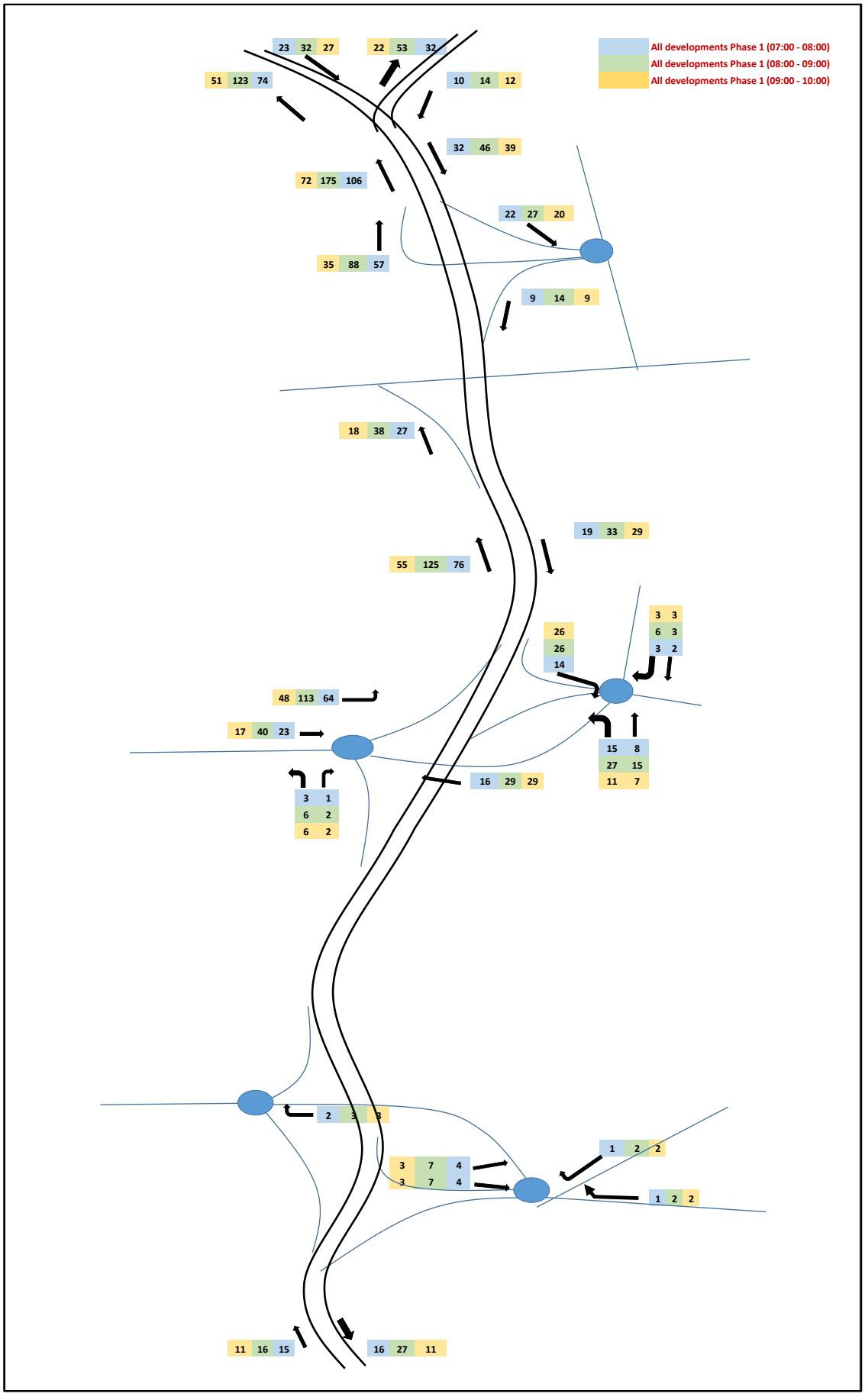
D.7. Other BETS Development (Base+9) – AM Peak



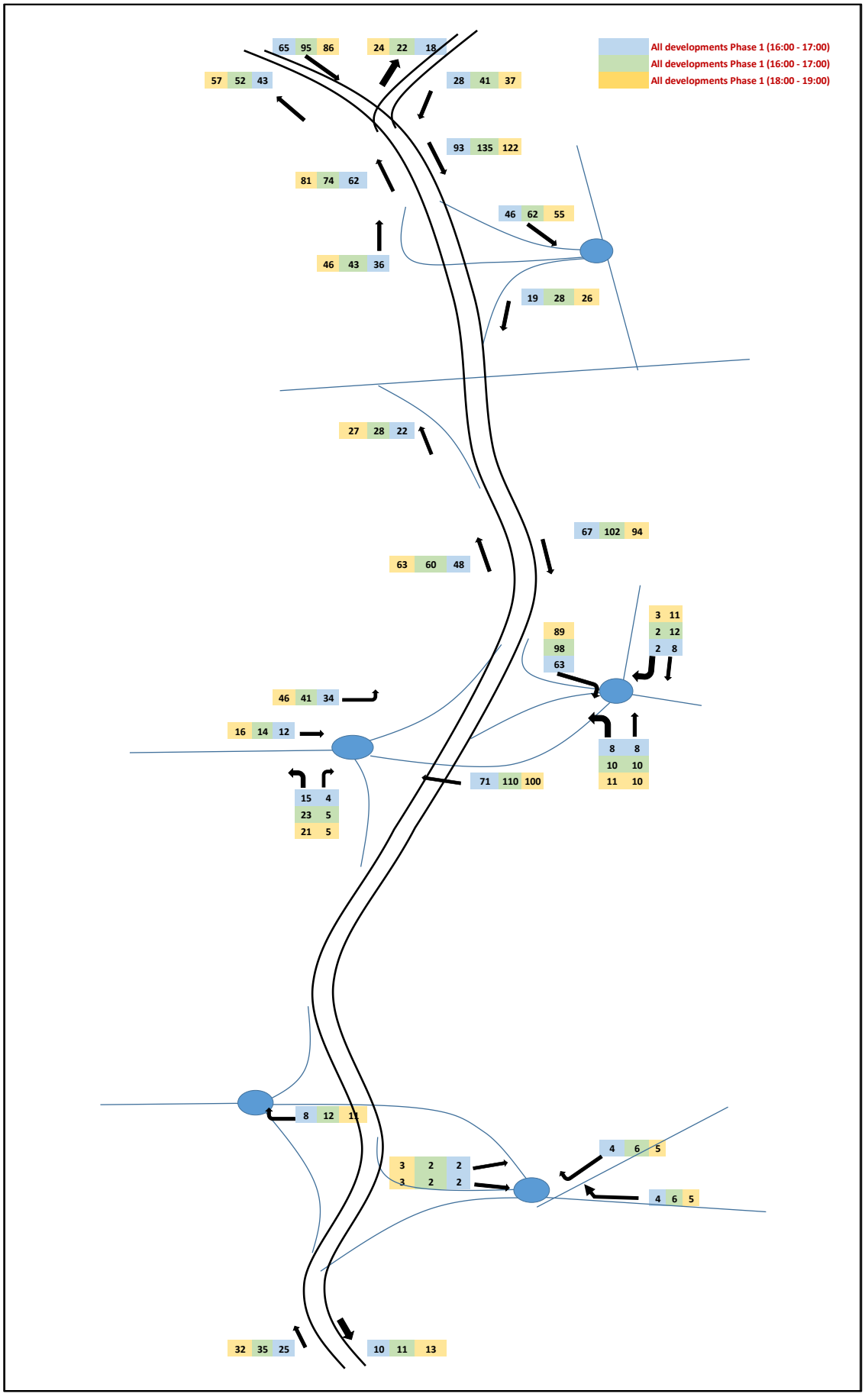
D.8. Other BETS Development (Base+9) – PM Peak



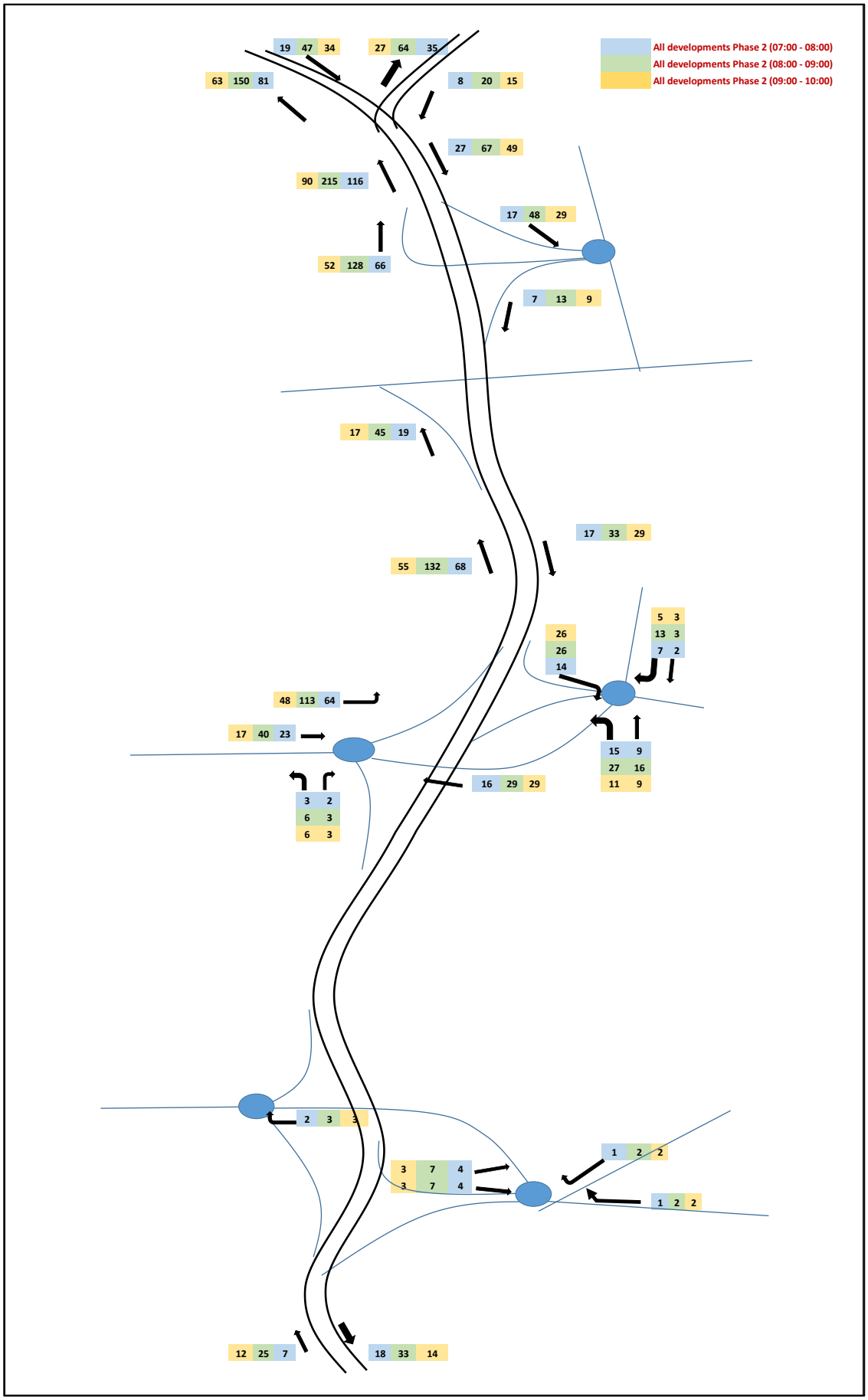
D.9. All Development Traffic (Base + 4) – AM Peak



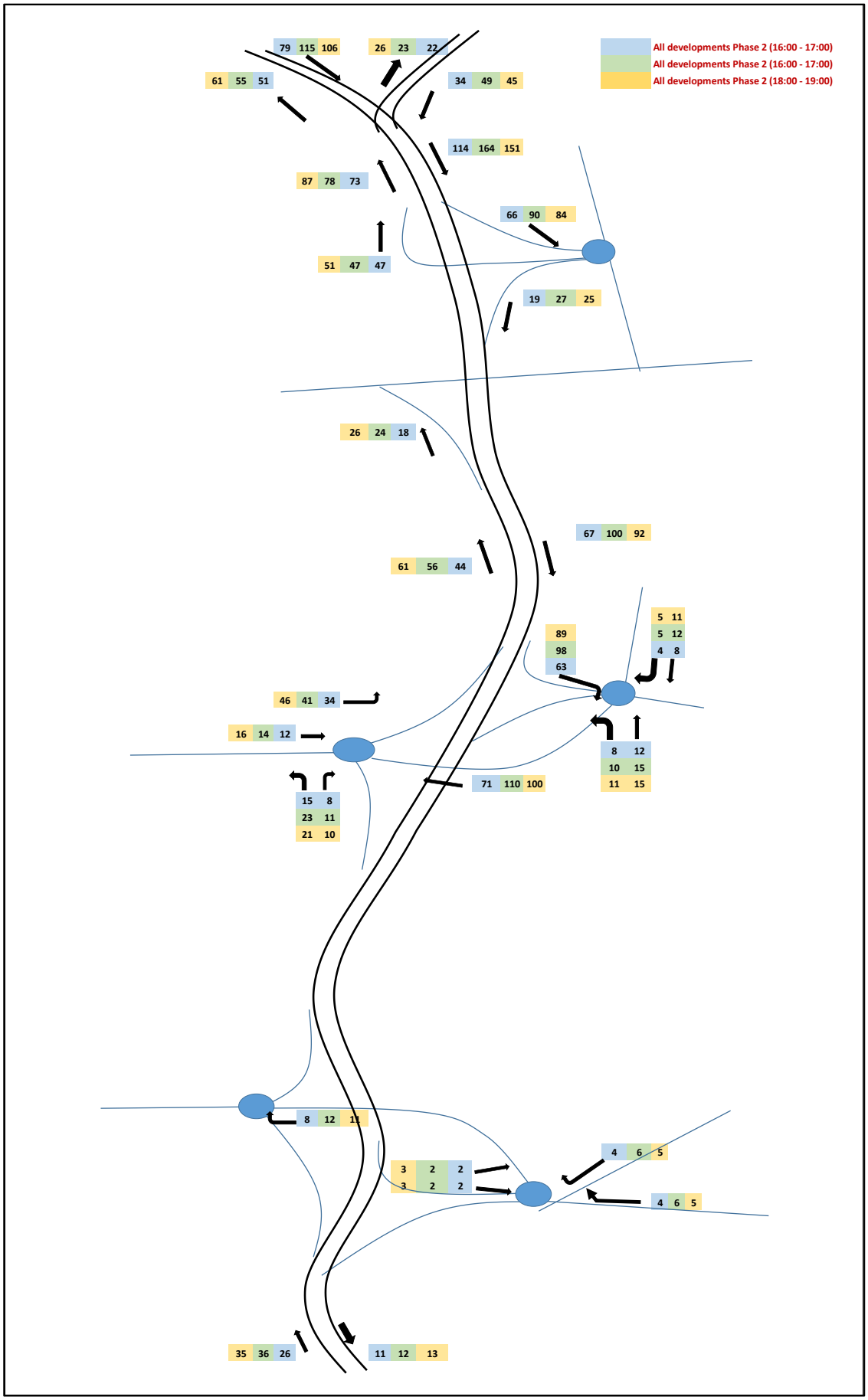
D.10. All Development Traffic (Base + 4) – PM Peak



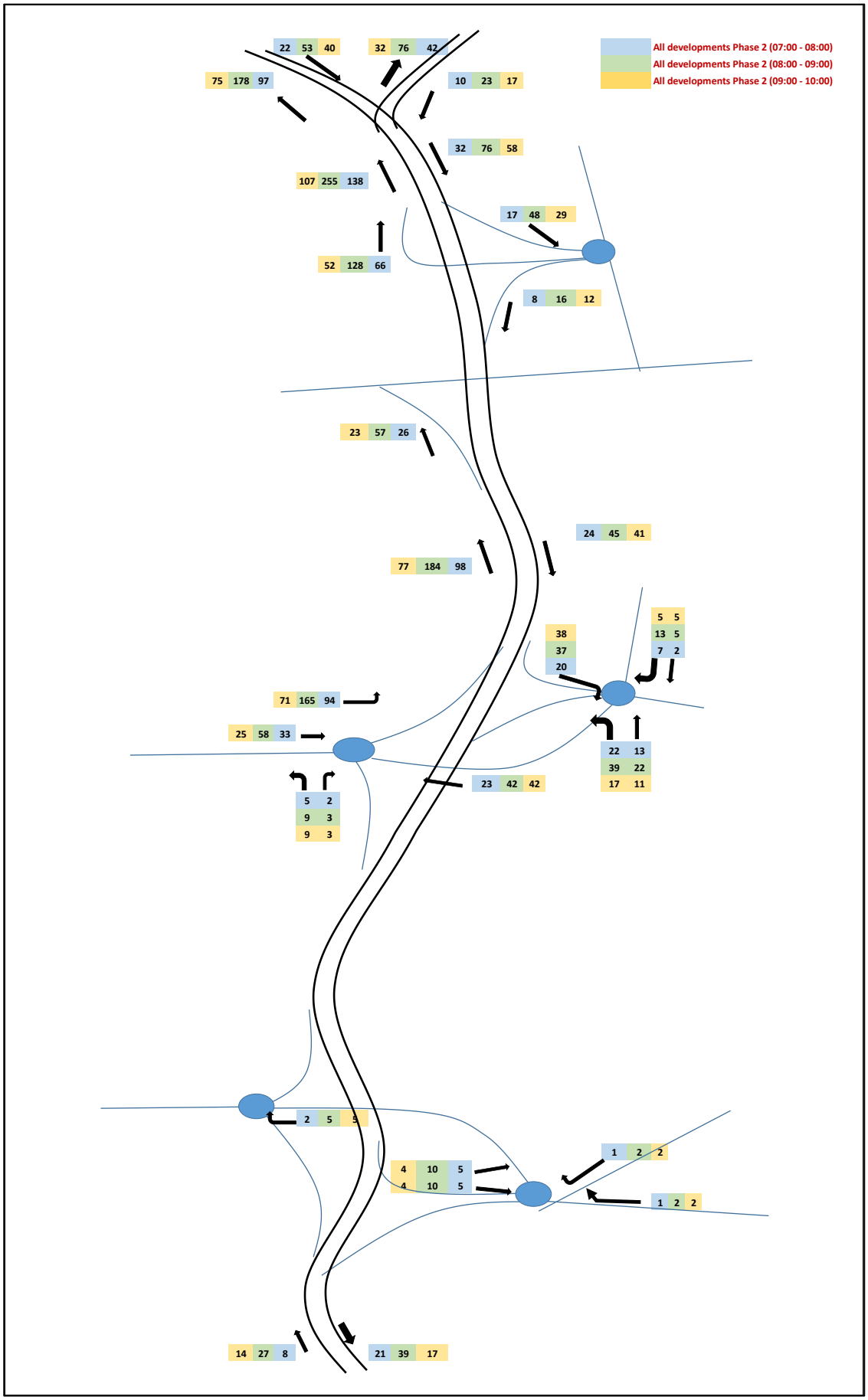
D.11. All Development (Base + 9 with 650 units) – AM Peak



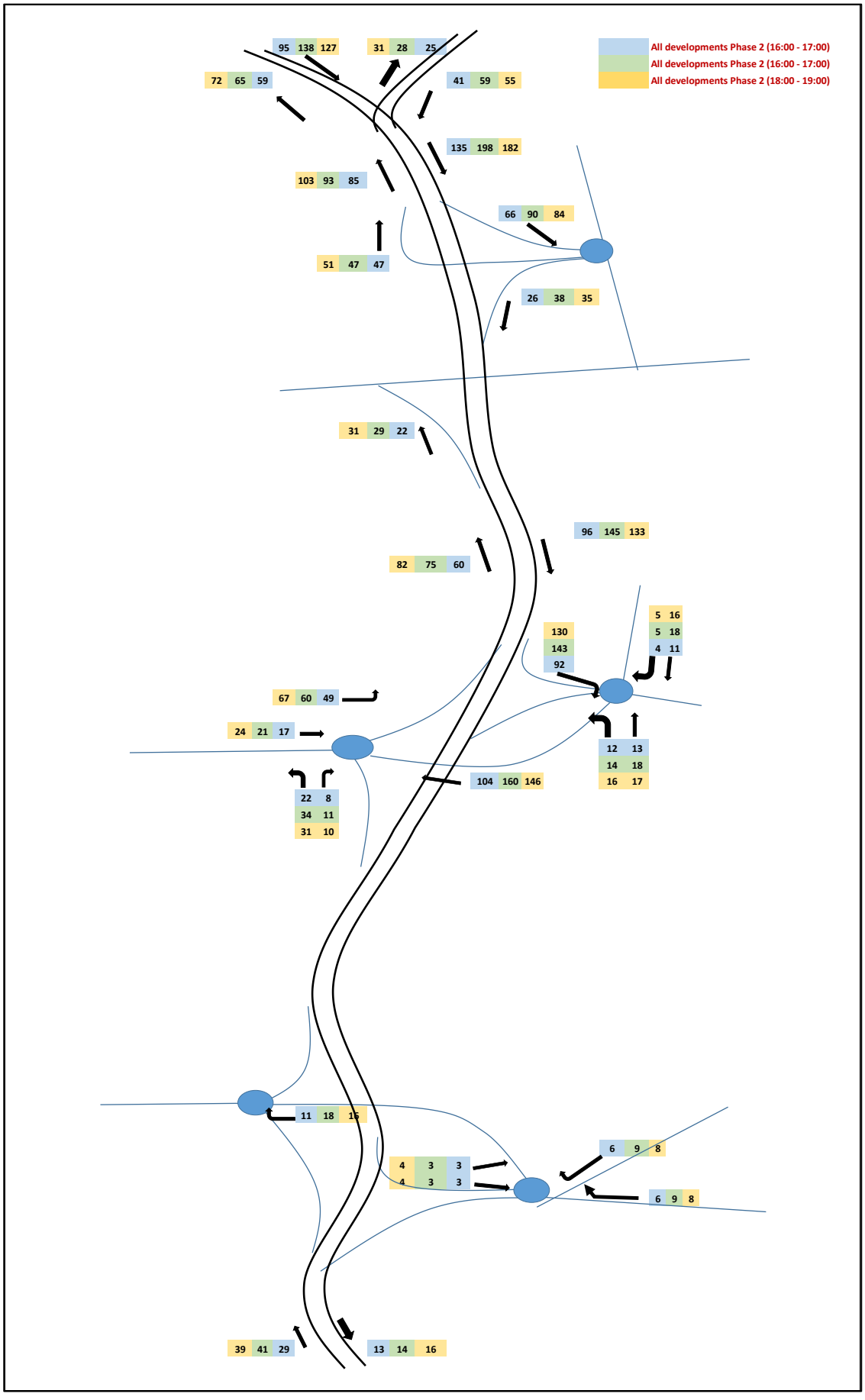
D.12. All Development (Base + 9 with 650 units) – PM Peak



D.13. All Development Traffic (Base + 9 with 1200 units) – AM Peak



D.14. All Development Traffic (Base + 9 with 1200 units) – PM Peak



Appendix E. Background Traffic Growth

Table E-1 - N11 Traffic Growth During Peak Hours 2014 – 2018 (Between Jn 16 and Jn 17)

Year	Northbound	Southbound	Growth N/B	Growth S/B
AM Peak				
2014	7591	3429		
2015	7780	3577	2.49%	4.32%
2016	7939	3615	2.04%	1.06%
2017	7928	3626	-0.14%	0.30%
2018	7869	3584	-0.74%	-1.16%
		Average Growth	**0.91%**	**1.13%**
PM Peak				
2014	4505	6412		
2015	4637	6423	2.93%	0.17%
2016	4545	5930	-1.98%	-7.68%
2017	4318	5825	-4.99%	-1.77%
2018	4176	5814	-3.29%	-0.19%
		Average Growth	**-1.83%**	**-2.37%**

Table E-2 - N11 Traffic Growth During Peak Hours 2014 – 2018 (Between Jn 17 and Jn 5)

Year	Northbound	Southbound	Growth N/B	Growth S/B
AM Peak				
2014	11885	5296		
2015	12090	5447	1.72%	2.85%
2016	12304	5497	1.77%	0.92%
2017	12285	5474	-0.15%	-0.42%
2018	12175	5397	-0.90%	-1.41%
		Average Growth	**0.61%**	**0.49%**
PM Peak				
2014	6842	10809		
2015	6957	10893	1.68%	0.78%
2016	6878	10440	-1.14%	-4.16%
2017	6697	10256	-2.63%	-1.76%
2018	6528	10195	-2.52%	-0.59%
		Average Growth	**-1.15%**	**-1.43%**

Table E-3 - N11 Traffic Growth During Peak Hours 2014 – 2018 (Between Jn 5 and Jn 6)

Year	Northbound	Southbound	Growth N/B	Growth S/B
AM Peak				
2014	10626	4643		
2015	10816	4748	1.79%	2.26%
2016	11017	4890	1.86%	2.99%
2017	11066	4846	0.44%	-0.90%
2018	10901	4808	-1.49%	-0.78%
		Average Growth	**0.65%**	**0.89%**
PM Peak				
2014	6014	10224		
2015	6150	10393	2.26%	1.65%
2016	6084	10286	-1.07%	-1.03%
2017	5963	10117	-1.99%	-1.64%
2018	5803	10064	-2.68%	-0.52%
		Average Growth	**-0.87%**	**-0.39%**

Appendix F. N11 Traffic Volume Impact

F.1. PM Peak

Table F-1 - Traffic Volume Increase Due to All Development: PM Peak (Between Jn 17 and 5)

Design Year	Volume	Volume Increase	Percentage Increase	Comments
Base year	9941			
+4 design year	10534	593	5.97%	Background growth
+4 design year with all development	10884	350	3.32%	Increase due to development
+9 design year	11326	1385	13.93%	Background growth
+9 design year with all development (Fassaroe – 650 units)	11755	429	3.79%	Increase due to development
+9 design year with all development (Fassaroe – 1200 units)	11872	546	4.82%	Increase due to development

Table F-2 - Traffic Volume Increase Due to All Development: PM Peak (Between Jn 5 and 6)

Design Year	Volume	Volume Increase	Percentage Increase	Comments
Base year	9883			
+4 design year	10473	590	5.97%	Background growth
+4 design year with all development	10736	263	2.51%	Increase due to development
+9 design year	11260	1377	13.93%	Background growth
+9 design year with all development (Fassaroe – 650 units)	11519	259	2.30%	Increase due to development
+9 design year with all development (Fassaroe – 1200 units)	11674	414	3.68%	Increase due to development

F.2. AM Peak

Table F-3 - Traffic Volume Increase Due to All Development: AM Peak (Between Jn 17 and 5)

Design Year	Volume	Volume Increase	Percentage Increase	Comments
Base year	12269			
+4 design year	13001	732	5.97%	Background growth
+4 design year with all development	13354	353	2.72%	Increase due to development
+9 design year	13979	1710	13.93%	Background growth
+9 design year with all development (Fassaroe – 650 units)	14400	421	3.01%	Increase due to development
+9 design year with all development (Fassaroe – 1200 units)	14507	528	3.78%	Increase due to development

Table F-4 - Traffic Volume Increase Due to All Development: AM Peak (Between Jn 5 and 6)

Design Year	Volume	Volume Increase	Percentage Increase	Comments
Base year	10990			
+4 design year	11646	656	5.97%	Background growth
+4 design year with all development	11902	256	2.20%	Increase due to development
+9 design year	12521	1531	13.93%	Background growth
+9 design year with all development (Fassaroe – 650 units)	12776	255	2.04%	Increase due to development
+9 design year with all development (Fassaroe – 1200 units)	12916	395	3.15%	Increase due to development

Appendix G. Travel Time Results

G.1. PM Peak

Table G-1 – Travel Times PM Peak Southbound (M50-Jn 17 to N11-Jn 8)

Scenario	Scenario Name	16:00 – 17:00	17:00 – 18:00	18:00 – 19:00	19:00- 20:00	20:00 – 21:00	Average
Base +4 design year scenarios							
2	Do Minimum	13.65	19.28	14.58	7.99	N/A	**13.88**
3	Do minimum with Fassaroe	13.58	19.19	14.82	8.46	N/A	**14.01**
4	Do minimum with Fassaroe and Traffic signals at Junction 6	13.56	18.69	14.59	8.33	N/A	**13.79**
6	Do minimum with All Development	13.69	18.82	14.86	8.66	N/A	**14.01**
7	Do minimum with All Development and Traffic signals at Junction 6	13.65	18.83	14.85	8.50	N/A	**13.96**
Base + 9 design year scenarios							
8	Do minimum	16.54	22.09	17.17	12.82	7.90	**15.30**
9	Do minimum with All Development (Fassaroe – 650 Units)	16.53	21.95	17.40	13.37	8.03	**15.46**
10	Do minimum with All Development (Fassaroe – 650 Units) and Traffic signals at Junction 6	16.27	21.13	17.45	14.03	7.98	**15.37**
11	Do minimum with All Development (Fassaroe – 1200 units)	16.47	21.50	17.15	13.58	8.02	**15.34**
12	Do minimum with All Development (Fassaroe – 1200 Units) and Traffic signals at Junction 6	16.26	20.83	17.40	13.52	8.10	**15.22**
13	Do minimum with All Development (Fassaroe – 1200 Units) and Ramp metering at N11-Junction 6	16.37	21.11	17.20	13.85	8.20	**15.34**

G.2. AM Peak

Table G-2 – Travel Times AM Peak Northbound

Scenario	Scenario Name	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		Average	
		N11 J8 - M50 J17 NB	R117 - M50 J17 NB	N11 J8 - M50 J17 NB	R117 - M50 J17 NB	N11 J8 - M50 J17 NB	R117 - M50 J17 NB	N11 J8 - M50 J17 NB	R117 - M50 J17 NB
Base Year +4 Scenarios									
2	Do Minimum	10.70	4.53	10.32	4.40	9.35	3.99	**10.12**	**4.31**
3	Do minimum with Fassaroe	11.35	4.76	10.77	4.63	9.36	4.01	**10.49**	**4.47**
4	Do minimum with Fassaroe and Traffic signals at Junction 6	10.85	4.60	10.74	4.61	9.40	3.99	**10.33**	**4.40**
6	Do minimum with All Development	11.01	4.67	10.45	4.55	9.41	3.99	**10.29**	**4.40**
7	Do minimum with All Development and Traffic signals at Junction 6	10.86	4.69	10.64	4.50	9.25	3.99	**10.25**	**4.39**
Base Year +9 Scenarios									
8	Do minimum	12.95	5.06	12.96	4.37	11.12	3.95	**12.34**	**4.46**
9	Do minimum with All Development (Fassaroe – 650 Units)	13.07	5.21	13.48	4.27	10.83	3.98	**12.46**	**4.49**
10	Do minimum with All Development (Fassaroe – 650 Units) and Traffic signals at Junction 6	11.65	4.70	12.68	4.11	10.78	3.91	**11.70**	**4.24**
11	Do minimum with All Development (Fassaroe – 1200 units)	13.64	5.28	13.62	4.25	10.96	3.94	**12.74**	**4.49**
12	Do minimum with All Development (Fassaroe – 1200 Units) and Traffic signals at Junction 6	12.08	4.88	13.14	4.23	11.10	3.89	**12.11**	**4.33**
13	Do minimum with All Development (Fassaroe – 1200 Units) and Ramp metering at N11-Junction 6	13.57	5.27	13.15	4.25	11.09	3.98	**12.60**	**4.50**

Appendix H. Overall Network Performance

H.1. PM Peak

Table H-1 – Overall Network Performance PM Peak

Scenario	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00			Overall results			
	Latent delay (hrs)	Total Delay (hrs)	Veh Arr	Latent delay (hrs)	Total Delay (hrs)	Veh Arr	Latent delay (hrs)	Total Delay (hrs)	Veh Arr	Latent delay (hrs)	Total Delay (hrs)	Veh Arr	Latent delay (hrs)	Total Delay (hrs)	Veh Arr	Net delay (hours)	Total vehicles arrived	Avg. Delay	Diff
Base +4 design year scenarios																			
2	148	468	8868	494	648	9077	506	555	8405	46	163	6454				3028	32804	332.3	
3	165	469	8973	563	648	9197	636	574	8527	103	194	6792				3351	33489	360.3	28.0
4	163	483	8958	556	666	9228	579	584	8572	76	200	6732				3306	33490	355.4	23.1
5	180	473	9047	615	643	9334	665	579	8654	124	215	6954				3495	33989	370.1	37.8
6	177	485	9059	596	675	9318	656	600	8653	122	213	6962				3525	33992	373.3	41.0
7	199	567	1054	238	699	1682	238	636	1902	221	509	700				3028	32804	332.3	
Base + 9 design year scenarios																			
8	466	567	9081	1395	699	9264	1900	636	8473	1401	509	7512	107	127	5259	7808	39589	710.0	
9	495	572	9277	1549	704	9519	2149	647	8745	1792	547	7660	283	156	5886	8893	41087	779.2	69.2
10	494	581	9282	1501	733	9544	2077	676	8754	1751	586	7581	294	162	5917	8855	41078	776.1	66.1
11	515	570	9336	1590	695	9619	2213	637	8831	1886	559	7705	335	160	6050	9161	41541	793.9	84.0
12	508	581	9348	1547	733	9599	2144	684	8841	1846	567	7737	326	169	6009	9106	41534	789.3	79.3
13	507	571	9357	1560	694	9645	2158	651	8814	1864	567	7675	347	168	6053	9087	41544	787.4	77.4

H.2. AM Peak

Table H-2 – Overall Network Performance AM Peak

Scenario	Scenario Name	07:00 – 08:00			08:00 – 09:00			09:00 – 10:00		
		Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)	Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)	Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)
Base Year +4 scenarios										
2	Do Minimum	142	356	325	138	372	933	128	320	1234
3	Do minimum with Fassaroe	154	387	397	144	399	1000	125	318	1286
4	Do minimum with Fassaroe and Traffic signals at Junction 6	149	377	359	152	418	990	135	343	1299
5	Do minimum with Fassaroe and improvement of merges and diverges at Junction 6	151	382	371	146	399	1048	127	320	1364
6	Do minimum with All Development	146	371	389	137	385	958	127	325	1308
7	Do minimum with All Development and Traffic signals at Junction 6	149	382	380	149	416	1041	134	345	1323
Base Year +9 scenarios										
8	Do minimum	189	466	1550	171	444	3288	172	415	4631
9	Do minimum with All Development (Fassaroe – 650 Units)	194	490	1569	172	462	3490	182	457	4759
10	Do minimum with All Development (Fassaroe – 650 Units) and Traffic signals at Junction 6	178	470	981	173	472	2767	193	489	3976

Scenario	Scenario Name	07:00 – 08:00			08:00 – 09:00			09:00 – 10:00		
		Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)	Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)	Average Delay (s)	Total Delay (hrs)	Latent Demand (vehs)
11	Do minimum with All Development (Fassaroe – 1200 units)	204	516	1619	191	532	3617	200	507	4936
12	Do minimum with All Development (Fassaroe – 1200 Units) and Traffic signals at Junction 6	184	488	1039	179	510	2811	211	536	4138
13	Do minimum with All Development (Fassaroe – 1200 Units) and Ramp metering at N11-Junction 6	205	518	1651	180	506	3553	189	477	4874

Appendix I. Junction Impact Analysis

I.1. PM Peak

I.1.1. N11-Junction 6 Eastern Roundabout

Table I-1 - N11 Junction 6 (Eastern Roundabout) PM Results

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 2 - +4 Years with No Development and No J6 Improvements															
N11 S/B Off Slip	0.004	1.699	0.73	0.002	1.409	0.92	0.003	1.769	0.70	0.003	1.421	0.85	N/A	N/A	N/A
Upper Dargle Road	0.003	1.580	1.08	0.005	2.052	1.15	0.004	1.941	0.89	0.001	1.034	0.80	N/A	N/A	N/A
Local Access	0.000	0.383	1.05	0.001	1.249	1.27	0.000	0.387	0.66	0.000	0.000	0.65	N/A	N/A	N/A
Bridge	0.098	8.104	1.38	0.482	13.057	3.08	0.120	7.429	1.70	0.017	3.050	0.68	N/A	N/A	N/A
Overall Junction	0.018	8.107	0.91	0.082	13.057	1.89	0.021	7.429	0.96	0.003	3.050	0.27	N/A	N/A	N/A
Scenario 3 - +4 Years with Fassaroe Phase 1 (650 units) and No J6 Improvements															
N11 S/B Off Slip	0.007	2.322	0.86	0.012	2.524	1.14	0.013	3.181	0.84	0.002	1.037	0.55	N/A	N/A	N/A
Upper Dargle Road	0.007	1.998	1.16	0.026	4.826	1.46	0.018	3.155	1.47	0.007	1.907	1.05	N/A	N/A	N/A
Local Access	0.000	0.584	1.07	0.001	1.271	1.39	0.000	0.804	2.02	0.000	0.210	0.61	N/A	N/A	N/A
Bridge	0.078	6.555	1.35	0.406	11.497	2.93	0.158	9.702	1.81	0.021	3.590	0.63	N/A	N/A	N/A
Overall Junction	0.016	6.555	0.84	0.074	11.497	1.87	0.032	9.702	0.97	0.005	3.603	0.27	N/A	N/A	N/A

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 4 - +4 Years with Fassaroe Phase 1 and Signalised Roundabouts at J6															
N11 S/B Off Slip	2.583	15.047	33.49	3.504	16.108	37.28	5.173	16.411	30.73	2.268	14.705	24.36	N/A	N/A	N/A
Upper Dargle Road	4.568	19.313	41.98	9.175	31.176	77.72	4.565	23.750	60.48	1.416	10.582	31.52	N/A	N/A	N/A
Local Access	0.577	5.073	52.29	2.211	4.702	76.25	1.042	4.697	69.47	0.417	4.691	47.77	N/A	N/A	N/A
Bridge	5.447	27.382	32.94	11.072	28.465	42.83	7.931	28.191	38.27	2.615	17.478	26.77	N/A	N/A	N/A
Overall Junction	3.294	27.382	37.76	6.490	31.906	52.97	4.678	28.592	44.94	1.679	18.549	29.08	N/A	N/A	N/A
Scenario 6 - +4 Years with all Phase 1 BETS Development and no signals at J6															
N11 S/B Off Slip	0.009	2.857	0.89	0.012	2.263	1.04	0.014	3.141	0.90	0.003	1.289	0.61	N/A	N/A	N/A
Upper Dargle Road	0.018	4.026	1.36	0.018	3.836	1.38	0.014	2.525	4.03	0.007	2.345	1.17	N/A	N/A	N/A
Local Access	0.001	0.595	1.89	0.001	1.053	1.67	0.000	0.197	0.84	0.000	0.188	0.71	N/A	N/A	N/A
Bridge	0.104	7.469	1.94	0.445	15.417	3.31	0.142	9.194	1.62	0.024	3.468	0.77	N/A	N/A	N/A
Overall Junction	0.022	7.652	1.01	0.080	15.417	1.88	0.028	9.200	1.00	0.006	3.693	0.31	N/A	N/A	N/A
Scenario 7 - +4 Years with all BETS development along with signalised roundabouts at Jn6															
N11 S/B Off Slip	2.258	13.958	29.94	3.783	15.609	37.59	4.692	16.189	31.00	2.373	13.798	25.81	N/A	N/A	N/A
Upper Dargle Road	4.661	21.005	42.39	10.203	32.511	79.06	4.823	24.511	62.26	1.584	11.333	31.37	N/A	N/A	N/A
Local Access	0.594	4.878	55.31	2.196	4.699	72.76	0.916	4.694	58.50	0.413	4.695	42.76	N/A	N/A	N/A
Bridge	5.220	26.962	31.53	11.547	28.409	43.64	7.590	28.224	37.14	2.625	18.686	26.35	N/A	N/A	N/A
Overall Junction	3.183	26.962	36.54	6.932	32.511	55.17	4.505	28.893	43.81	1.749	18.686	29.41	N/A	N/A	N/A
Scenario 8 - +9 Years With No Development and No J6 Improvements															

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
N11 S/B Off Slip	0.004	1.414	0.77	0.006	2.344	1.01	0.002	1.015	0.74	0.002	1.453	0.70	0.000	0.573	0.39
Upper Dargle Road	0.006	2.216	2.24	0.005	2.104	1.08	0.006	2.007	1.44	0.002	1.064	0.82	0.001	0.430	0.77
Local Access	0.000	0.386	1.06	0.001	1.370	0.99	0.000	0.175	0.69	0.000	0.000	0.57	0.000	0.000	0.53
Bridge	0.127	6.603	1.75	0.506	12.680	3.78	0.195	8.323	1.99	0.017	2.816	0.75	0.005	1.446	0.41
Overall Junction	0.023	6.603	1.11	0.086	12.680	2.02	0.034	8.323	1.23	0.003	2.844	0.31	0.001	1.457	0.09
Scenario 9 - +9 Years with All Development (Fassaroe – 650 units) and No J6 Improvements															
N11 S/B Off Slip	0.007	2.086	0.97	0.012	2.415	1.12	0.011	2.440	0.89	0.007	1.654	0.86	0.001	1.012	0.42
Upper Dargle Road	0.014	3.077	1.16	0.030	4.100	2.21	0.014	3.124	1.43	0.006	2.139	1.14	0.003	1.672	0.89
Local Access	0.001	0.986	2.60	0.001	2.489	1.68	0.000	0.741	1.64	0.000	0.000	0.67	0.000	0.000	0.78
Bridge	0.173	9.656	2.47	0.800	19.593	4.11	0.219	11.418	2.00	0.033	4.009	0.88	0.006	1.707	0.35
Overall Junction	0.033	9.656	1.24	0.141	19.593	2.40	0.041	11.418	1.24	0.008	4.009	0.38	0.002	2.061	0.03
Scenario 10 - +9 Years with All Development (Fassaroe – 650 units) and Signalised Roundabouts at J6															
N11 S/B Off Slip	2.259	13.104	31.91	3.144	15.912	36.29	4.264	16.225	31.86	3.162	16.459	25.63	1.508	11.847	21.47
Upper Dargle Road	5.665	23.382	50.50	19.530	45.021	107.30	11.579	47.706	114.69	1.926	12.368	33.96	0.921	7.976	26.24
Local Access	0.596	4.878	53.34	2.304	4.702	71.18	1.224	4.697	86.28	0.520	4.690	51.02	0.285	4.684	42.70
Bridge	6.003	28.186	32.56	14.235	28.350	47.63	10.610	28.609	42.23	3.339	19.719	30.33	1.645	12.953	24.76
Overall Junction	3.631	28.186	38.74	9.803	45.021	65.82	6.919	47.706	54.62	2.237	20.252	31.86	1.090	13.772	25.71
Scenario 11 - +9 Years Sensitivity Test and No J6 Improvements															

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
N11 S/B Off Slip	0.009	2.506	0.87	0.028	3.599	1.38	0.021	3.668	1.00	0.008	1.864	0.73	0.004	1.524	0.58
Upper Dargle Road	0.016	3.622	1.36	0.036	7.313	1.65	0.040	4.997	1.87	0.013	2.660	1.41	0.010	2.533	1.45
Local Access	0.000	0.393	1.79	0.003	2.851	1.85	0.000	0.395	1.39	0.000	0.395	1.43	0.000	0.362	1.84
Bridge	0.212	13.283	2.08	0.702	18.550	4.21	0.305	14.838	2.42	0.030	4.794	0.85	0.006	1.910	0.45
Overall Junction	0.040	13.283	1.27	0.129	18.550	2.32	0.061	14.838	1.50	0.008	4.973	0.40	0.003	2.982	0.11
Scenario 12 - 9 Years with All Development (Fassaroe – 1200 units) and Signalised Roundabouts at J6															
N11 S/B Off Slip	2.842	15.802	32.29	4.326	16.481	35.72	8.070	16.525	33.74	4.904	16.268	25.16	2.201	14.603	20.94
Upper Dargle Road	7.336	29.590	63.02	24.322	53.924	143.09	16.676	55.518	113.22	1.914	11.627	33.44	0.984	8.518	27.06
Local Access	0.663	4.881	57.51	2.488	4.700	79.36	1.306	4.698	77.85	0.521	4.693	46.80	0.301	4.686	42.71
Bridge	6.288	28.184	34.23	14.690	28.319	51.18	11.923	28.463	45.46	3.494	24.134	29.97	1.505	11.737	22.23
Overall Junction	4.282	30.965	42.89	11.457	53.924	70.10	9.494	55.518	61.99	2.708	24.134	33.21	1.248	14.712	25.87
Scenario 13 - +9 Years with All Development (Fassaroe – 1200 units) and Ramp meters at J6															
N11 S/B Off Slip	0.007	2.495	0.85	0.016	2.708	1.29	0.028	4.459	1.12	0.012	2.667	0.79	0.003	1.281	0.52
Upper Dargle Road	0.019	3.891	1.95	0.036	5.083	4.27	0.032	4.349	3.45	0.011	1.858	1.31	0.006	1.288	1.29
Local Access	0.000	0.581	1.54	0.005	3.119	3.36	0.000	0.400	3.00	0.000	0.542	1.67	0.000	0.202	1.31
Bridge	0.209	12.931	2.84	0.913	20.415	7.32	0.305	9.965	4.86	0.028	3.720	0.79	0.005	1.684	0.50
Overall Junction	0.039	12.931	1.63	0.163	20.415	4.09	0.061	9.965	2.59	0.009	3.923	0.42	0.002	2.117	0.08

I.1.2. N11-Junction 6 Western Roundabout

Table I-2 - N11 Junction 6 (Western Roundabout) PM Results

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 2 - +4 Years with No Development and No J6 Improvements															
N11 N/B Off Slip	0.006	2.275	1.50	0.008	2.585	1.51	0.003	2.103	1.41	0.001	1.219	1.11			
Fassaroe Link	0.076	5.367	3.00	0.224	8.508	4.69	0.126	6.214	4.16	0.013	2.579	1.96			
Bridge	0.000	0.000	0.06	0.000	0.000	0.02	0.000	0.000	0.04	0.000	0.000	**-0.10**			
Overall Junction	0.038	5.367	1.69	0.112	8.508	2.46	0.063	6.214	2.09	0.005	2.579	1.15			
Scenario 3 - +4 Years with Fassaroe Phase 1 (650 units) and No J6 Improvements															
N11 N/B Off Slip	0.012	2.986	1.65	0.038	4.554	2.06	0.017	3.671	1.77	0.007	2.138	1.46			
Fassaroe Link	0.083	6.538	3.07	0.343	9.181	5.54	0.153	6.510	4.49	0.021	3.269	2.13			
Bridge	0.000	0.000	**-0.03**	0.000	0.000	0.01	0.000	0.000	**-0.02**	0.000	0.000	**-0.08**			
Overall Junction	0.043	6.538	1.64	0.181	9.514	2.73	0.079	6.981	2.03	0.011	3.371	1.12			
Scenario 4 - +4 Years with Fassaroe Phase 1 and Signalised Roundabouts at J6															
N11 N/B Off Slip	1.964	14.025	27.25	3.278	19.293	30.52	2.508	17.758	26.16	1.318	9.515	22.70			
Fassaroe Link	1.578	10.202	25.28	2.779	15.710	33.21	1.701	14.378	29.88	0.711	5.540	21.68			
Bridge	1.193	10.675	25.79	1.995	13.949	30.98	1.471	12.162	28.40	0.791	9.214	20.14			
Overall Junction	1.578	14.247	24.18	2.684	19.293	30.96	1.893	18.084	26.33	0.940	10.043	20.99			

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 6 - +4 Years with all Phase 1 BETS Development and no signals at J6															
N11 N/B Off Slip	0.014	2.920	1.69	0.051	4.355	2.26	0.019	3.410	2.08	0.008	2.254	1.45			
Fassaroe Link	0.090	5.831	3.34	0.256	7.940	4.94	0.150	6.687	4.26	0.022	2.848	2.27			
Bridge	0.000	0.000	0.00	0.000	0.000	**-0.03**	0.000	0.000	**0.00**	0.000	0.000	**-0.09**			
Overall Junction	0.047	5.831	1.75	0.141	7.940	2.59	0.079	6.687	2.00	0.012	2.888	1.15			
N11 N/B Off Slip	0.014	2.920	1.69	0.051	4.355	2.26	0.019	3.410	2.08	0.008	2.254	1.45			
Scenario 7 - +4 Years with all Phase 1 BETS Development and Signalised Roundabouts at J6															
N11 N/B Off Slip	1.908	14.765	23.98	3.182	18.775	29.37	2.442	19.298	25.13	1.258	9.638	20.94			
Fassaroe Link	1.519	11.259	24.23	2.776	15.093	32.92	1.775	12.910	30.52	0.708	5.452	21.43			
Bridge	1.336	11.816	25.28	1.865	13.641	28.72	1.345	11.470	25.53	0.838	8.320	21.12			
Overall Junction	1.588	14.855	23.81	2.608	18.775	29.89	1.854	19.573	25.91	0.935	9.884	20.40			
Scenario 8 - +9 Years With No Development and No J6 Improvements															
N11 N/B Off Slip	0.004	1.868	1.46	0.014	3.822	1.62	0.007	2.663	1.50	0.002	1.568	1.17	0.001	0.602	0.99
Fassaroe Link	0.102	6.171	3.51	0.325	8.313	5.65	0.121	5.450	4.11	0.023	3.448	2.25	0.006	1.996	1.54
Bridge	0.000	0.000	0.03	0.000	0.000	**-0.02**	0.000	0.000	0.06	0.000	0.000	**-0.06**	0.000	0.000	**-0.12**
Overall Junction	0.050	6.171	1.84	0.166	8.313	2.86	0.059	5.593	2.13	0.011	3.448	1.26	0.003	1.996	0.94
Scenario 9 - +9 Years With all development (Fassaroe – 650 units) and no Jn 6 improvement															

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
N11 N/B Off Slip	0.017	3.682	1.83	0.046	5.440	2.22	0.029	4.804	1.99	0.005	1.438	1.40	0.005	2.119	1.35
Fassaroe Link	0.119	5.859	3.73	0.343	8.147	5.63	0.140	5.490	4.37	0.027	3.468	2.32	0.009	2.206	1.70
Bridge	0.000	0.000	**-0.03**	0.000	0.000	0.01	0.000	0.000	**-0.02**	0.000	0.000	**-0.05**	0.000	0.000	**-0.10**
Overall Junction	0.061	5.986	1.92	0.183	8.147	2.89	0.075	5.847	2.13	0.014	3.468	1.21	0.005	2.620	0.92
Scenario 10 - +9 Years with All Development (Fassaroe – 650 units) and Signalised Roundabouts at J6															
N11 N/B Off Slip	2.178	13.506	26.88	3.937	21.039	37.40	3.336	20.542	32.41	1.387	11.088	21.11	0.819	7.032	20.86
Fassaroe Link	1.822	11.469	26.63	7.694	31.382	71.02	3.687	28.462	61.34	0.827	7.348	23.06	0.449	5.306	19.78
Bridge	1.363	10.760	27.51	2.135	12.664	35.95	1.686	12.729	30.17	0.869	9.494	21.68	0.590	8.511	19.73
Overall Junction	1.788	14.489	25.24	4.589	31.528	46.44	2.903	29.285	38.69	1.028	11.861	21.05	0.619	8.788	18.58
Scenario 11 - +9 Years With all development (Fassaroe – 1200 units) and no Jn 6 improvement															
N11 N/B Off Slip	0.022	3.546	1.93	0.059	5.502	2.38	0.034	3.884	2.17	0.014	3.000	1.65	0.009	1.838	1.56
Fassaroe Link	0.134	7.534	3.78	0.391	8.487	5.94	0.183	6.499	4.82	0.031	3.391	2.54	0.007	2.463	1.49
Bridge	0.000	0.000	**-0.01**	0.000	0.000	0.01	0.000	0.000	0.00	0.000	0.000	**-0.04**	0.000	0.000	**-0.04**
Overall Junction	0.071	7.534	1.91	0.210	8.487	2.95	0.099	6.499	2.22	0.019	3.574	1.28	0.006	2.830	0.88
Scenario 12 - +9 Years with All Development (Fassaroe – 1200 units) and Signalised Roundabouts at J6															
N11 N/B Off Slip	2.455	16.066	28.03	4.919	27.962	41.88	4.259	24.061	37.61	1.638	10.484	25.09	0.919	8.046	20.63
Fassaroe Link	1.920	12.141	26.67	7.005	31.361	67.69	5.379	30.450	71.20	1.091	8.003	26.56	0.560	5.704	21.98

	16:00 – 17:00			17:00 – 18:00			18:00 – 19:00			19:00 – 20:00			20:00 – 21:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Bridge	1.665	13.479	30.43	2.561	14.565	36.60	2.105	13.816	29.37	1.244	11.125	22.37	0.919	9.897	22.17
Overall Junction	2.013	16.468	26.06	4.828	34.694	46.26	3.914	31.113	42.05	1.324	11.234	22.88	0.799	9.897	19.88
Scenario 12 - +9 Years with All Development (Fassaroe – 1200 units) and ramp-meter at J6															
N11 N/B Off Slip	0.017	4.439	1.86	0.071	5.974	2.47	0.074	6.537	2.53	0.011	2.147	1.66	0.008	1.668	1.49
Fassaroe Link	0.112	6.402	3.51	0.369	8.858	5.75	0.178	6.187	4.75	0.040	4.003	2.74	0.008	2.847	1.58
Bridge	0.000	0.000	0.13	0.000	0.000	0.14	0.000	0.000	0.16	0.000	0.000	0.11	0.000	0.000	0.09
Overall Junction	0.058	6.538	1.85	0.202	8.858	2.94	0.107	7.271	2.38	0.021	4.079	1.34	0.006	2.920	0.91

I.2. AM Peak

I.2.1. N11 Junction 6 Eastern Roundabout

Table I-3 - N11 Junction 6 (Eastern Roundabout) - AM Peak

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 2 - +4 Years with No Development and No J6 Improvements									
N11 S/B Off Slip	0.001	1.034	0.63	0.007	1.911	0.94	0.015	3.574	1.50
Upper Dargle Road	0.002	1.236	0.90	0.009	2.266	1.15	0.005	2.275	0.93
Local Access	0.001	0.998	0.67	0.001	1.376	0.95	0.000	0.788	0.69
Bridge	0.005	2.380	0.38	0.070	7.237	1.18	0.079	7.788	1.49
Overall Junction	0.002	2.761	0.43	0.015	7.237	0.82	0.017	7.788	0.95
Scenario 3 - +4 Years with Fassaroe Phase 1 (650 units) and No J6 Improvements									
N11 S/B Off Slip	0.005	2.465	1.00	0.014	3.461	1.25	0.016	3.866	1.41
Upper Dargle Road	0.006	2.841	0.94	0.009	2.419	1.16	0.008	1.865	1.11
Local Access	0.001	1.018	0.88	0.001	1.267	1.13	0.000	0.361	0.72
Bridge	0.006	2.385	0.44	0.076	7.001	1.27	0.069	5.392	1.43
Overall Junction	0.003	3.714	0.49	0.017	7.087	0.86	0.015	5.425	0.97
Scenario 4 - +4 Years with Fassaroe Phase 1 and Signalised Roundabouts at J6									
N11 S/B Off Slip	1.219	9.300	43.79	3.996	14.285	44.90	3.781	15.892	45.16
Upper Dargle Road	2.795	16.720	41.18	4.105	16.154	48.02	2.940	16.395	41.58
Local Access	2.269	4.702	121.70	3.431	5.081	151.97	3.408	4.709	132.97
Bridge	2.309	14.058	32.18	6.566	25.236	38.65	6.618	26.493	40.30
Overall Junction	2.148	16.833	45.16	4.524	25.236	51.33	4.187	26.493	50.51
Scenario 6 - +4 Years with all Phase 1 BETS Development and no signals at J6									
N11 S/B Off Slip	0.002	1.581	0.73	0.010	2.920	1.03	0.015	3.401	1.35

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Upper Dargle Road	0.003	1.638	0.95	0.010	2.949	1.14	0.011	2.935	1.20
Local Access	0.001	0.810	0.78	0.001	1.201	1.12	0.000	0.405	0.62
Bridge	0.005	2.016	0.34	0.068	5.991	1.30	0.075	7.341	1.51
Overall Junction	0.002	2.094	0.42	0.015	5.991	0.82	0.017	7.646	0.92
Scenario 7 - +4 Years with all BETS development along with signalised roundabouts at Jn6									
N11 S/B Off Slip	1.356	8.993	46.59	3.290	14.129	42.85	3.264	15.588	44.50
Upper Dargle Road	4.927	23.645	67.12	7.657	24.908	76.04	6.073	26.909	80.51
Local Access	2.365	4.699	107.39	3.362	5.075	124.86	3.374	5.460	136.19
Bridge	1.419	9.297	27.99	5.068	21.902	36.10	4.720	20.208	36.49
Overall Junction	2.517	23.645	50.73	4.845	25.368	54.22	4.358	26.919	52.39
Scenario 8 - +9 Years With No Development and No J6 Improvements									
N11 S/B Off Slip	0.000	0.819	0.44	0.005	2.037	0.88	0.008	2.252	1.06
Upper Dargle Road	0.004	1.820	0.96	0.016	3.191	1.18	0.007	2.117	1.08
Local Access	0.001	0.764	0.59	0.001	1.286	0.98	0.000	0.771	0.88
Bridge	0.003	1.495	0.36	0.058	5.885	1.09	0.069	6.623	1.36
Overall Junction	0.001	2.056	0.44	0.014	5.943	0.76	0.014	6.623	0.91
Scenario 9 - +9 Years with All Development (Fassaroe – 650 units) and No J6 Improvements									
N11 S/B Off Slip	0.001	1.026	0.49	0.028	4.962	1.27	0.012	2.248	1.16
Upper Dargle Road	0.006	2.451	1.08	0.022	3.730	1.40	0.007	2.055	1.29
Local Access	0.001	1.040	0.80	0.004	2.170	1.59	0.000	0.576	0.95
Bridge	0.006	2.095	0.36	0.070	7.192	1.25	0.085	7.893	1.40
Overall Junction	0.003	2.640	0.49	0.022	7.192	0.96	0.017	7.893	0.88
Scenario 10 - +9 Years with All Development (Fassaroe – 650 units) and Signalised Roundabouts at J6									
N11 S/B Off Slip	1.384	8.231	46.61	3.967	15.472	40.91	3.254	15.289	44.00

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Upper Dargle Road	6.052	27.583	85.91	15.752	37.564	120.32	9.631	33.326	100.99
Local Access	2.421	4.697	108.01	3.411	4.702	124.50	3.503	5.079	137.64
Bridge	1.489	9.842	28.42	4.604	22.741	36.81	4.002	20.562	37.92
Overall Junction	2.837	27.583	54.11	6.933	37.564	69.76	5.097	33.326	61.22
Scenario 11 - +9 Years Sensitivity Test and No J6 Improvements									
N11 S/B Off Slip	0.004	2.183	0.68	0.017	3.224	1.02	0.015	2.340	1.10
Upper Dargle Road	0.006	2.139	1.05	0.015	3.429	1.25	0.015	3.337	1.32
Local Access	0.002	1.360	1.00	0.002	1.074	1.55	0.001	1.526	0.75
Bridge	0.009	2.823	0.51	0.071	5.521	1.55	0.073	8.671	1.34
Overall Junction	0.004	3.579	0.52	0.018	5.558	0.89	0.017	8.947	0.88
Scenario 12 - 9 Years with All Development (Fassaroe – 1200 units) and Signalised Roundabouts at J6									
N11 S/B Off Slip	1.618	9.550	45.87	4.958	16.214	42.80	4.350	15.854	42.82
Upper Dargle Road	6.042	26.735	88.51	17.632	39.680	133.57	10.039	35.928	101.79
Local Access	2.388	4.697	104.90	3.361	5.072	118.54	3.431	5.079	133.68
Bridge	1.779	10.623	31.13	4.884	21.435	37.69	3.836	21.118	37.57
Overall Junction	2.957	26.735	53.82	7.709	39.680	72.68	5.414	35.928	61.67
Scenario 13 - +9 Years with All Development (Fassaroe – 1200 units) and Ramp meters at J6									
N11 S/B Off Slip	0.004	2.303	0.72	0.015	3.281	1.09	0.010	2.138	0.95
Upper Dargle Road	0.006	1.939	1.04	0.016	3.437	1.26	0.016	3.221	1.35
Local Access	0.002	1.404	1.04	0.002	1.515	1.42	0.000	1.535	0.79
Bridge	0.008	2.502	0.34	0.081	5.965	1.43	0.084	7.510	1.42
Overall Junction	0.004	2.986	0.52	0.019	6.187	0.95	0.019	7.570	0.94

I.2.2. N11 Junction 6 western roundabout

Table I-4 - N11 Junction 6 (Western Roundabout) - AM Peak

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 2 - +4 Years with No Development and No J6 Improvements									
N11 N/B Off Slip	0.008	2.269	1.60	0.030	5.568	2.15	0.028	5.311	2.36
Fassaroe Link	0.015	2.603	3.00	0.092	4.397	4.75	0.056	3.773	4.91
Bridge	0.000	0.000	0.10	0.000	0.000	0.07	0.000	0.000	0.13
Overall Junction	0.008	2.729	0.97	0.053	6.686	2.03	0.034	6.020	2.15
Scenario 3 - +4 Years with Fassaroe Phase 1 (650 units) and No J6 Improvements									
N11 N/B Off Slip	0.008	1.915	1.62	0.047	6.211	2.41	0.036	5.341	2.38
Fassaroe Link	0.023	3.391	2.88	0.225	6.949	5.46	0.066	4.345	4.65
Bridge	0.000	0.000	0.05	0.000	0.000	0.06	0.000	0.000	0.04
Overall Junction	0.013	3.526	1.14	0.124	7.547	2.54	0.042	6.125	2.15
Scenario 4 - +4 Years with Fassaroe Phase 1 and Signalised Roundabouts at J6									
N11 N/B Off Slip	1.227	10.152	23.15	3.065	20.760	26.71	4.442	24.399	31.24
Fassaroe Link	1.038	6.687	32.94	2.666	13.695	36.31	1.253	7.708	34.74
Bridge	2.121	10.983	36.29	2.582	13.479	42.04	1.494	9.518	38.24
Overall Junction	1.462	12.037	27.94	2.771	20.760	31.55	2.396	24.399	30.98
Scenario 6 - +4 Years with all Phase 1 BETS Development and no signals at Roundabouts at J6									
N11 N/B Off Slip	0.012	3.058	1.70	0.078	6.033	2.99	0.069	8.197	2.56
Fassaroe Link	0.019	2.826	2.70	0.190	5.885	5.02	0.062	3.337	4.66
Bridge	0.000	0.000	0.06	0.000	0.000	0.04	0.000	0.000	0.02
Overall Junction	0.013	3.344	1.16	0.115	6.900	2.66	0.048	8.197	2.24
Scenario 7 - +4 Years with all Phase 1 BETS Development and signals at Roundabouts at J6									

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
N11 N/B Off Slip	1.950	12.636	33.20	4.687	26.985	38.05	6.204	32.882	39.94
Fassaroe Link	1.184	7.986	37.39	2.822	15.263	37.39	1.366	8.621	35.51
Bridge	3.504	15.506	56.60	4.235	15.592	64.41	2.450	12.960	58.53
Overall Junction	2.213	15.506	39.17	3.915	26.985	40.48	3.340	32.882	39.64
Scenario 8 - +9 Years With No Development and No J6 Improvements									
N11 N/B Off Slip	0.009	2.107	1.76	0.038	5.682	2.50	0.028	4.565	2.17
Fassaroe Link	0.019	3.502	3.23	0.085	4.931	4.00	0.034	3.780	3.38
Bridge	0.000	0.000	0.09	0.000	0.000	0.05	0.000	0.000	0.07
Overall Junction	0.012	3.502	1.01	0.052	6.423	1.92	0.023	4.695	1.74
Scenario 9 - +9 Years with All Development (Fassaroe- 650 units) and No J6 Improvements									
N11 N/B Off Slip	0.014	2.368	1.77	0.062	5.084	2.87	0.020	4.105	2.10
Fassaroe Link	0.024	3.906	2.50	0.168	6.101	4.21	0.048	3.625	3.76
Bridge	0.000	0.000	0.10	0.000	0.000	0.07	0.000	0.000	**-0.01**
Overall Junction	0.015	4.103	1.12	0.100	6.101	2.31	0.029	4.311	1.78
Scenario 10 - +9 Years with All Development (Fassaroe – 650 units) and Signalised Roundabouts at J6									
N11 N/B Off Slip	1.836	13.111	31.04	3.543	21.013	36.42	5.139	32.025	39.94
Fassaroe Link	1.276	8.429	34.26	3.002	14.644	37.44	1.408	8.850	35.34
Bridge	3.788	15.676	55.96	4.876	15.891	65.74	2.722	13.714	60.04
Overall Junction	2.300	15.714	38.56	3.807	21.013	40.55	3.090	32.025	39.53
Scenario 11 - +9 Years with All Development (Fassaroe- 1200 units) and No J6 Improvements									
N11 N/B Off Slip	0.016	2.722	1.86	0.078	8.882	3.03	0.048	6.571	2.46
Fassaroe Link	0.042	4.833	2.69	0.220	6.627	4.65	0.066	4.253	3.70
Bridge	0.000	0.000	0.04	0.000	0.000	0.05	0.000	0.000	0.01
Overall Junction	0.025	4.835	1.28	0.130	9.406	2.54	0.045	6.571	1.95

	07:00 - 08:00			08:00 - 09:00			09:00 - 10:00		
	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)	Avg Queue (pcus)	Max Queue (pcus)	Avg Delay (s)
Scenario 12 - +9 Years with All Development (Fassaroe – 1200 units) and Signalised Roundabouts at J6									
N11 N/B Off Slip	1.864	11.956	31.50	3.720	25.074	36.41	4.532	27.551	36.90
Fassaroe Link	1.675	9.479	35.35	3.749	17.907	38.77	1.768	10.465	38.06
Bridge	3.896	15.580	56.99	5.070	15.755	66.97	2.813	14.917	60.03
Overall Junction	2.478	15.580	38.66	4.180	25.074	40.84	3.038	27.551	37.94
Scenario 13 - +9 Years with All Development (Fassaroe – 1200 units) and Ramp meters at J6									
N11 N/B Off Slip	0.012	2.466	1.97	0.070	6.057	2.78	0.048	7.849	2.51
Fassaroe Link	0.032	3.902	2.64	0.233	6.523	4.74	0.066	3.737	3.82
Bridge	0.000	0.000	0.19	0.000	0.000	0.39	0.000	0.000	0.14
Overall Junction	0.019	3.976	1.33	0.134	7.121	2.71	0.045	7.849	2.07

Appendix J. Proposed Agenda for Draft Traffic Management Framework Agreement

NTA Bray and Environs Transport Study

Item: Proposed Agenda for Draft Traffic Management Framework Agreement

As described in the NTA coordinated Bray and Environs Transport Study, a traffic management framework is to be established between Wicklow County Council and TII. The aim of the Framework is to identify appropriate local and national road mitigation measures which will facilitate traffic monitoring and management of queuing in the vicinity of the Junction 6, N11 Interchange and also facilitate phase 1 (a) Fassaroe development proposal of 658 houses and associated supporting facilities.

The agenda for the Framework should include for following:

1. The identification of appropriate traffic modelling to be undertaken to establish the capacity of the junction within the existing N11/M11 traffic regime. The scope of the modelling and its nature to be agreed between TII and Wicklow County Council.
2. Subsequent to item no. 1, identification of required existing Bray North internal road network modifications to alleviate/manage/limit traffic congestion on the N11 and associated local road network (bus priority, widening, dedicated left/right turns, signalling etc.),
3. The identification of appropriate physical demand management measures to “limit” the amount of traffic accessing the N11 at agreed peak hours. Infrastructural requirements to be investigated as part of this process include:
4. CCTV camera at the interchange to be connected to the Dublin Traffic Management and Incident Centre, together with traffic counters to monitor traffic movements exiting and entering M11 at J6.
5. Queue detection technology, and traffic monitoring units on the mainline N11 in advance of the off ramps.
6. Appropriate Traffic signals Junction 6 and local road network in the vicinity including Upper Dargle Road, La Vallee and Fassaroe Link Road to be connected to the Dublin Traffic Management and Incident Centre.
7. Assessment of potential for modification to Interchange to give additional storage on diverge lanes.
8. Demonstration that all appropriate safety standards can be addressed.
9. Demonstration that the outcomes of the Framework will need to be compatible and complementary to the progression of the M11 N11/M11 Junction 4 to Junction 14 Improvement Scheme.
10. Appropriate mechanisms for delivery. The cost of the design and implementation of this infrastructure shall not be borne by TII therefore Wicklow County Council will devise the appropriate mechanisms for delivery.

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