Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Chapter 5: Description of Proposed Scheme

BARRY TRANSPORTATION
egis GROUP
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Project Ireland 2040
Building Ireland's Future

Table of Contents

Appendices

List of Figures

List of Tables

GLOSSARY OF FREQUENTLY USED TERMS

Acronym	Term
AA	Appropriate Assessment
bgl	Below Ground Level
CDM	Cycle Design Manual
CPO	Compulsory Purchase Order
DCC	Dublin City Council
DMURS	Design Manual for Urban Roads and Streets
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMC	Electromagnetic Compatibility
ESBN	ESB Networks
EPR	Emerging Preferred Route
FCC	Fingal County Council
GGBS	Ground Granulated Blast-furnace Slag
ICW	Integrated Constructed Wetland
IÉ	Iarnród Éireann
LOD	Limits of Deviation
LRT	Light Rail Transit
LRV	Light Rail Vehicle
NCM	National Cycle Manual
NIS	Natura Impact Statement
NTA	National Transport Authority
OCS	Overhead Conductor System; Overhead Contact System
PR	Preferred Route
RO	Railway Order
S&C	Switches and Crossings
SCADA	Supervisory Control and Data Acquisition
SID	Strategic Infrastructure Development
SOR	Structures Options Report
sqm	Square metres (m^2)
SuDS	Sustainable Drainage Systems
TII	Transport Infrastructure Ireland
UNECE	United Nations Economic Commission for Europe

SECTION 5: DESCRIPTION OF THE PROPOSED SCHEME

5.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the Luas Finglas Scheme (hereafter referred to as the proposed Scheme).

Article 5(1)(a) of the EIA Directive requires that the EIAR contains:

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

The Chapter begins with the proposed Scheme Overview (section 5.2). This is followed by sections describing the Sustainable Design process (section 5.3), the Design Iteration process (section 5.4) and the overall Design Principles applied to the proposed Scheme (section 5.5). Following this, there is a detailed description of the proposed Scheme (section 5.7) and a section describing key infrastructural elements associated with the proposed Scheme (section 5.8), including Operations (section 5.8.14). These sections should be read in their entirety in order to gain a full understanding of the proposed Scheme and its associated key infrastructural elements.

This Chapter should be read in conjunction with Chapter 6 (Construction Activities).

5.2 Outline Scheme Description

The proposed Scheme, presented in Volume 4 – Map Figure 1-1, is the next phase of the development of Dublin's integrated light rail network, and is 3.9km in length and will extend the Luas Green Line northwards from its current terminus at Broombridge to a new proposed terminus at Charlestown. It is a largely segregated running scheme, primarily located within the administrative area of Dublin City Council (DCC) with the exception of the proposed Charlestown terminus, which is in the administrative area of Fingal County Council (FCC).

The identification of the Preferred Route (PR) was the result of an Option Selection Process including Stage 1 and Stage 2 assessments. The 'Luas Finglas Option Selection Report – Stage 1', published in August 2019, identified and brought forward a number of light rail options which could extend from the existing Luas network to the Finglas area. The 'Luas Finglas Option Selection Report – Stage 2', published in January 2020, built on the outcomes of Stage 1 and identified the Emerging Preferred Route (EPR) for a light rail line extending from the existing Luas network at Broombridge to the Finglas area. The EPR was published in July 2020. Taking cognisance of the EPR, public consultation feedback together with further assessment by the design team, the PR for the scheme was launched in December 2021. Further details of the option selection process can be found in Chapter 4 (Alternatives Considered) of this EIAR.

The proposed Scheme starts at the existing Luas stabling area just south of the current Broombridge Stop where the Hamilton Depot will be enlarged with the addition of four new track lines in order to accommodate an increase in Light Rail Vehicle (LRV) storage. A modified points connection will facilitate access to the line and to the depot itself.

At Broombridge Luas Stop, the layout of the existing bus interchange will be modified to facilitate easier interchange and improved pedestrian flow.

The Luas twin tracks leaves Broombridge Stop heading westwards via an inclined ramp and then turns north where it will overpass both the Maynooth railway line and the Royal Canal, adjacent to the existing Broome Bridge (Royal Canal) (RPS 909) on a new bridge structure. It is proposed that the existing pedestrian access ramp from Broome Bridge onto the Iarnród Éireann inbound platform be removed. Alternative access to the Iarnród Éireann platform is available via the Luas platforms from Broombridge Road and the existing overbridge between the Iarnród Éireann platforms.

The proposed Scheme then runs to the east of Broombridge Road and the Dublin Industrial Estate on a ramp structure before crossing Lagan Road at-grade, then crossing Ballyboggan Road. Proposed works here include provision of new boundary walls, footpaths and cycle lanes. Thereafter, Luas Finglas enters the Tolka Valley Park adjacent to a protected structure, namely the Finglaswood Bridge (RPS 906), which will be protected in situ.

From here, the line crosses the park, including a new bridge over the River Tolka, before crossing Tolka Valley Road, close to the Carrigallen Estate. The new bridge over the River Tolka will carry twin tracks and a combined pedestrian and cycle track. The overall length of the bridge is 65m.

Having crossed Tolka Valley Road, the proposed Scheme runs northwards up an incline in open grassland towards St Helena's Road. Proposed works in this area include new footpaths and cycle lanes parallel to the tracks as well as landscaping and provision of public amenity space. St Helena's Stop is located just south of the road junction adjacent to St Helena's Childcare Centre and St Helena's Family Resource Centre, for which a revised access and new internal circulation system with repositioned parking will be provided. Other works here include reconfigured bus stop arrangements, traffic calming and improved pedestrian crossing facilities.

The proposed Scheme proceeds northwards through the eastern side of the GAA pitch, parallel to Farnham Drive, with the pitches being relocated within Farnham Park, and through a green space opposite Casement Road, where a footpath will also be provided adjacent to the alignment. The Farnham Drive roadway will be reduced in width and traffic-calmed for pedestrian safety and to facilitate a proposed future cycle lane, which is to be provided as part of the NTA cycle strategy. At Wellmount Road, a new signal-controlled junction will be located at the existing roundabout with Patrickswell Place, and which will be realigned to the west to facilitate the proposed Scheme and this road will intersect with Wellmount Road at a new priority junction.

Thereafter, the proposed Scheme progresses northwards across Cappagh Road. Between Cappagh Road and Mellowes Park, the Luas alignment proceeds parallel to Cardiff Castle Road. The proposed Scheme passes west of Ravens Court and then travels through the current Finglas Garda station car parking area. It then crosses Mellowes Road to proceed northwards through Mellowes Park. The proposed Luas Finglas Village Stop will be located in front of the Finglas Youth Resource and Sport Centre and adjacent to the fire station. Other works to take place in this location include: the reconfiguration of the street to include protected cycle tracks; the reconfiguration of the Garda station parking areas; reconfiguration of the car park for the childcare/resources/sports centre; proposed cycle storage facilities and provision of a bus stop beside the Luas Stop platform.

A Luas substation is located to the east of the alignment adjacent to the existing Uisce Éireann (Irish Water) pumping station, located just north of the Finglas Village Stop. A crossover is provided at this location to facilitate LRV turnback and short running, if required.

The proposed Scheme then passes through the eastern side of Mellowes Park with footpaths realigned and the adjacent pitch goalposts being moved. The proposed Scheme then crosses the Finglas Road / North Road to reach the proposed St Margaret's Road Stop located to the east of the road, opposite the existing Lidl supermarket. A proposed Park & Ride (P&R) facility is to be located near the St Margaret's Road Stop.

The Finglas Road / North Road junction will be converted from an existing four-arm roundabout to a signalised junction and the existing footbridge south of that junction will be demolished. This will facilitate the LRT crossing of the junction and will provide at-grade pedestrian and cyclist crossing facilities at the junction.

The second of two substations will be located within the residual space left over following demolition of the spiral access ramp at the eastern end of the existing footbridge. The Stop at St Margaret's Road will have cycle storage facilities and improved pedestrian access as well as reconfigured interchange arrangements for buses.

The proposed Scheme continues northwards across the reconfigured McKee Avenue junction, along St Margaret's Road. The alignment crosses the front of a number of premises along this part of St Margaret's Road. In order to limit uncontrolled crossing of the LRT, alternative roadways at the rear of these properties are proposed to allow access to the premises directly impacted by the LRT. The proposed Scheme continues past St Margaret's Court, the access road for which is to be rearranged to avoid crossing the LRT, and instead, access will be provided to the north via Jamestown Business Park. The access road for Jamestown Business Park is being reconfigured to facilitate future anticipated traffic volumes and the St Margaret's Court access.

The proposed Scheme then crosses the access road to the Electrical Supply Board Network (ESBN) premises – which will be an uncontrolled crossing – before reaching the proposed terminus Stop at Charlestown. The works here include a major reconfiguration to the Charlestown Place / Melville Road junction in order to provide better pedestrian and cycling infrastructure to current standards. An LRV crossover is located just before the terminus Stop to facilitate LRVs entering or leaving either of two proposed platforms.

Table 5-1 highlights the key features of the proposed Scheme with approximate lengths of tracks, cycle facilities, etc. Refer to section 6.5.13 of Chapter 6 (Construction Activities) of this EIAR for a more detailed description of the track types.

Table 5-1: Summary of the key features of the proposed Scheme

Key Features	Feature Details	Drawing Reference
Luas Line		
Grass (Green) Track	2.9 km	Refer to Alignment / Landscape Arrangement Drawings provided in the RO Drawing Pack
Embedded Track	0.7 km	
Plinth / Structure Track	0.4 km	
Luas Stops		
4 Luas Stops	St Helena's	Refer to Architectural Drawings provided in the RO Drawing Pack
	Finglas Village	
	St Margaret's Road	
	Charlestown	
Structures		
2 New Bridge Structures	Bridge over the Iarnród Éireann (IÉ) railway line and Royal Canal after Broombridge Stop	Refer to Structural Drawings provided in the RO Drawing Pack
	Bridge crossing over the River Tolka	
Road Junctions		
Signalised junctions	12 at-grade signalised junctions	Refer to Landscape Arrangement Drawings provided in the RO Drawing Pack
Uncontrolled Junctions	13 at-grade uncontrolled crossings	

Key Features	Feature Details	Drawing Reference
Pedestrian Crossings		
Pelican Crossings	Two existing Pelican Crossings to be reconfigured	Refer to Landscape Arrangement Drawings provided in the RO Drawing Pack
Toucan Crossings	Four Toucan Crossings	
Uncontrolled Road Crossings	20 Uncontrolled Road Crossings	
Uncontrolled Alignment Crossings	35 Uncontrolled Alignment Crossings	
Cycle Facilities		
Off-road or protected cycle lanes	3km	Refer to Structural Drawings provided in the RO Drawing Pack
On-road cycle lanes	100m	
Substations		
Two new power substations	One near Finglas Village Stop	Refer to Landscape Arrangement Drawings provided in the RO Drawing Pack
	One near the Finglas Road / North Road junction before St Margaret's Road Stop	
One new substation for the Park & Ride Facility	Located at the P&R building	
Other Features		
A new stabling facility	A new stabling facility just south of the existing Broombridge Terminus, as an extension to the Hamilton depot area.	Refer to Alignment / Landscape Arrangement Drawings provided in the RO Drawing Pack
A 350-vehicle P&R facility	A 350-space P&R multistorey structure with e-Charging substation, located adjacent to the St Margaret's Stop	Refer to Architectural Drawings provided in the RO Drawing Pack
Other Features		
Uncontrolled vehicular access across alignment	Three locations where there is uncontrolled vehicular access across alignment	Refer to Landscape Arrangement Drawings provided in the RO Drawing Pack

In addition to the figures presented in this Chapter illustrating specific aspects of the proposed Scheme, the description of the proposed Scheme (section 5.7) is supported by a full series of drawings provided in the Railway Order (RO) Drawing Pack, and these should be read in conjunction with this Chapter.

5.3 Sustainable Design

5.3.1 Policy Framework for Sustainability

As outlined in Chapter 3 (Need for the proposed Scheme), Luas Finglas incorporates a significant focus on achieving the UN Sustainable Development Goals in national policy and this is central to the National Planning Framework to ensure that Ireland has a more sustainable future.

The Environmental Protection Agency (EPA) Sustainable Transport Performance Measures (EPA, 2023) – highlights that sustainable transport is central to efforts to control greenhouse gas emissions, air pollution and environmental damage. The benefits of sustainable transport extend beyond environmental considerations, delivering less congestion and improvements in productivity, health and quality of life.

5.3.2 Sustainability Objectives for Future Delivery Stages

Chapter 2 (Planning and Policy Context) sets the planning and policy context for the development and implementation of Luas Finglas including those related to climate and sustainability.

TII's Environmental Strategy (TII, 2019), Section 2.1 *'commits to incorporate sustainability principles into the development and operation of the national road, light rail and metro networks; therefore, contributing to social wellbeing, supporting economic efficiency, and protecting, restoring and enhancing environmental systems for future generations.'*

TII's Statement of Strategy 2021-2025 (TII, 2021 [Updated 2023]) sets out TII's sustainability goals. These goals include:

- *"New Infrastructure – Deliver national road, light railway, metro and Active Travel infrastructure, contributing to compact growth, sustainable mobility, enhanced regional accessibility and the transition to a low-carbon future".*

The strategic objectives to deliver the New Infrastructure goal includes the following:

- *"Deliver infrastructure that supports low-carbon transport systems and emission reductions".*

TII's goals and strategic objectives are aligned with those of the Department of Transport.

In 2018, TII developed its Corporate Sustainability Statement. This document presented policy drivers for sustainability within the organisation and its operations. Following the development of this statement, TII has also produced a Sustainability Implementation Plan – Our Future (TII, 2024), which articulates how the sustainability strategy and vision will be carried out through all TII Projects, investments and operations.

TII's SIP sets out the vision to lead in the delivery and operation of sustainable transport, enabling their networks to drive inclusive growth, create job opportunities and enhance the well-being of all persons, including vulnerable groups, strengthen resilience to climate change, maintain commitment to the environment and continuing to prioritise safety. The Plan recognises that the need to rethink, reimagine and redesign approaches to ensure sustainability is at the heart of everything that TII does, requiring it to be the leading provider of sustainable infrastructure. The plan is based on the following six key principles:

- To provide effective efficient and equitable mobility – Enable compact growth and regional accessibility through networks and services that support more efficient journeys, more effective connectivity and increased accessibility;
- To enable safe and resilient networks and services – Enable safe secure, accessible and inclusive travel though the provision of transport networks, systems and services that are resilient to future change;
- To collaborate for a holistic approach – To develop smart and sustainable assets and services through innovating and improving the planning, design, construction, operation and maintenance of the transport network, increasing collaboration and systems-thinking to seek mutual gains and mitigate negative externalities;
- To deliver end to end Improvements – Deliver enhanced whole life-cycle value through impact and influence on stakeholders, partners and suppliers;
- To transition to net zero – Reduce the carbon impact of construction, operation and use of the transport network through responsible use of resources, reuse and repurposing, as well as driving the net zero transition and enabling customers to make more sustainable choices; and
- To create total value for society – Maintain and enhance the balanced delivery of economic, environmental and social value through robust planning, rigorous appraisal and decisions that prioritise sustainability.

The proposed Scheme has been developed to ensure compliance with the TII Sustainability Implementation Plan principles set out above.

5.3.3 Implementation of Sustainability Policy Areas in Luas Finglas Design

Sustainability for the proposed Scheme means delivering and operating an efficient, low carbon and climate-resilient Luas system, which better connects passengers as part of an integrated transport system, unlocks regeneration opportunities and enables compact growth for present and future generations, while also being designed to be responsive to future demand requirements. The design includes the following sustainability initiatives in order to meet the project sustainability aims outlined in TII's Sustainability Implementation Plan.

5.3.3.1 Sustainability Plan

A Sustainability Plan has been developed for Luas Finglas outlining how the proposed Scheme will address key sustainability challenges, risks and opportunities. Luas Finglas incorporates sustainability objectives into its design, construction and operation, and thereby contributes to the economic efficiency, to develop, to protect, and to enhance the environment and contribute to the overall well-being of society.

Sustainability workshops were held on 9th November 2021 and 15th December 2021 and these workshop discussions focused on sustainable policy, the development of a sustainability tracker and associated metrics.

These sustainability trackers were developed for preliminary design and reference design stages to track sustainability performance and support evidencing of progress towards fulfilling sustainability targets. The ongoing review and updating of the sustainability tracker allows new sustainability opportunities to be incorporated into the scheme as the project evolves. The development sustainability metrics at the early stages of the design allows the project to achieve maximum carbon reduction potential. The Luas team have used the TII 'Carbon Assessment and Reduction Tool' to evaluate the lifecycle carbon impacts of design options at each stage of the project. The Sustainability Plan outlines a number of specific measures that resulted in a quantifiable reduction in carbon. Such measures include, but are not limited to:

- Incorporating nature-based SuDS solutions to provide attenuation rather than oversized concrete culverting (where possible);
- The proposed *Vignole* grass-track indicates >50% reduction in structural concrete;
- The proposed solar array on the roof of the P&R provides an alternative renewable energy source; and
- The trackform, bridges and P&R structures will include ground granulated blast-furnace slag (GGBS) concrete.

These measures, alongside those that form an intrinsic part of the design (e.g. optimised gradients), will play a fundamental role in reducing the carbon footprint of the proposed scheme.

Luas Finglas is a pilot project for incorporating circular economy objectives and principles. Circular economy couples growth with positive environmental and social outcomes. The key principles of the circular economy include designing out waste pollution, regenerating natural systems and retaining products and materials in use. Luas Finglas is a pilot scheme to incorporate circular economy objectives and principles. A number of circular economy workshops were held on 27th October 2021, 9th March 2022 and 23rd September 2022, where project-specific design opportunities were identified to incorporate the circular economy within the proposed Scheme, followed by integration and implementation across all disciplines and stages of the proposed Scheme.

Some of additional measures considered as part of the sustainability and circular economy workshops include:

- Incorporating circular economy throughout the different phases of the proposed Scheme;
- A sustainable design based on the theme of space relocation to enhance public transport and to prioritise active travel above road traffic;
- Design and construction phases to be focused on waste reduction;
- Adoption of flexible construction lengths to reduce concrete waste;
- Adopting smaller footprint for construction elements;
- Refraining from oversizing and overengineering;

- Coordinated approach and sharing of infrastructure and overlap design needs to avoid overspecification;
- Promoting active travel by reduced carriageway, increased pedestrian space and more accessible public areas;
- Sustainable design process to take into account track alignment and optimise gradients to reduce operational energy demand;
- Reducing stop and go by combining road junctions and stops in close proximity and increasing fully segregated / off road sections to allow trams longer coasting at low energy consumption;
- Reducing energy needs /requirements for substation buildings, provision of vegetal roof or photovoltaic panel on top; provision of natural ventilation, using equipment standing wide range of temperature to avoid air conditioning;
- Considering concrete with 50% ground granulated blast-furnace slag (GGBS) to be used to reduce the carbon footprint and improve the overall sustainability of finished structures and this will be considered in future design stages. Concrete is a highly durable material, however, the production process of one of its main constituents – cement, is highly energy demanding and has a larger carbon footprint.
- Regenerative design and nature-based solutions;
- Corridor design to provide for ecological and landscape connectivity and pollinator friendly spaces;
- All new roadside planting to have a significant proportion of pollinator-friendly plants;
- Designing to include for ease of recovery and disassembly of the trackform;
- Design accommodates future environmental conditions including accounting for climate change effects on rainfall, storm occurrences and temperature;
- Design includes soil testing plan and strategy for enabling soil reuse;
- New landscaping to include tree pits for bioretention and stormwater management on hard surfaces along Broombridge and Finglas Road. Soil from construction site to be used to fill the tree pit post assessment for suitability of the soil. Stormwater tree pits provide a versatile stormwater management device for passive irrigation of street trees, stormwater quality treatment, peak flow and volume attenuation, canopy interceptions, evapotranspiration and infiltration and reduction in pollutants entering the waterways;
- Quantifying infiltration for new tree planting as part of landscaping to assist drainage design for the scheme;
- Carbon sequestration by new tree planting as part of landscaping and quantifying the sequestering value;
- Creating safe, segregated, family-friendly cycle and walking paths along much of the route, improving the quality of life for all. Also, to provide sufficient, secure and adequate cycle storage facilities and safe, efficient and convenient access to different transport modalities;
- Applying gender lens to enable inclusion of public life opportunities into the design process;
- Providing accessibility and social inclusion as the Luas will be fully accessible to people with a mobility impairment, the elderly and also to those with a hearing or visual impairment;
- Undertaking public life tools surveys along the route and also capturing data by questionnaires circulated to stakeholders in the area. The public life survey is aimed at capturing data for physical and social elements along the proposed Scheme;
- Emphasis on place-making, public realm and greening infrastructure;
- Social aspect of sustainability is as important as economic and environment. To prevent anti-social behaviour, social development around the proposed project before, during and after construction is integral to this plan;
- During environmental studies and public consultation, consider specific presentations to present positive aspects of transportation and urban renewal in schools along the Luas corridor, to ensure the students then educate their families about the Luas Finglas scheme as a sustainable transport option thereby increasing the acceptability of the scheme in the community;
- For the Construction Phase, TII may introduce in contracts some proposals for local employment, so that local unemployed people take the opportunity to make their skills known and have a significant experience for their future jobs after completion of construction;
- For the long term, the Luas corridor can be a positive opportunity for social development around different themes such as sport (Farnham pitches), nature (Royal Canal and River Tolka valley are high value places linked to others in the city), cultural heritage (protected walls and bridges can be highlighted

through story maps and expanding on previous Luas Cross City Story Maps, famous people appearing in city's road names can be emphasised, and contemporary culture can be developed);
- Citizens should be able to use it not only as transport corridor but for dedicated activity, sport, nature, culture, be proud of it, this is key for general enhancement of the area.

These sustainable topics are considered in more detailed in Volume 5 – Appendix A5.1.

As part of the creation or enhancement of ecological habitats, a biodiversity net gain approach has been applied to deliver ecological habitats improvements, and an extensive landscape strategy has been developed to replant many more trees than will be removed during construction. Design mitigation measures, especially in sensitive areas crossing Tolka Valley Park and Mellowes Park are provided to avoid, negate, or minimise adverse construction and Operational Phase impacts on identified ecological features. Where possible, the design of the proposed Scheme includes the use of grass track to integrate with the surrounding areas and improve the visual impact.

Public Life surveys were undertaken in March 2022 and January 2023 to capture pedestrian, age, gender, and stationary activities for the existing public spaces and to get a better sense of who is using the existing open space around the proposed Scheme and how. The surveys also evaluated the urban quality of the existing open spaces close to the proposed route. The surveys captured a spectrum of social activities such as active social activities categorized by an active engagement like walking, playing etc. and passive social activities such as sitting in the open spaces together. The tools used for the process encompassed the research methods developed by Jan Gehl, Gehl Institute. The information gathered from these surveys was used to inform the design. The outcome of the Jan Gehl surveys is presented in Volume 5 - Appendix A8.1.

5.3.3.2 Climate Change Mitigation and Adaption

The design of the proposed Scheme has been developed to ensure that the proposed Scheme can be constructed and operated to reduce climate change effects and to be resilient to climate change in line with the Climate Action Plan 2024 (CAP 2024).

The risk of flooding and pollution to nearby watercourses has been assessed by the data and surveys as part of the EIAR process. Relevant water quality and flood mitigation measures will be implemented as identified. Furthermore, the project design will also incorporate the following sustainability measures as part of the proposed Scheme:

- Providing suitable, mainly native and low maintenance landscaping along the track corridor along with integration and improvement of the landscaping;
- Creation or enhancement of ecological habitats;
- Maximising use of green track, for landscaping, infiltration (SDC, 2022), visual amenity, reducing of urban heat intensity;
- Sustainable Drainage Systems (SuDS) and minimising attenuation measures;
  - Sand trapping via the drainage system;
  - Rainwater infiltration (infiltration in soil and plantation tree holes / tree pits);
  - Rainwater harvesting, green buildings and water savings measures.
- Implementing sustainable building management systems;
- Facilitating sustainable material use, such as green cement and recyclable materials;
- Providing hazardous waste management; and
- Provision for cyclists including routes and cycle parking.

As part of the design process, a carbon quantification for the Construction and Operational Phases of the proposed Scheme has been established against which further progress will be measured through these phases, to drive delivery of a reduction in capital and embodied carbon against a baseline. The carbon assessment is further detailed in Chapter 14 (Climate) of this EIAR.

5.3.3.3 Materials and Resources

The volumes and types of materials that will be needed to construct and operate the proposed Scheme have been estimated, establishing a baseline for the EIAR. The proposed Scheme design has been based on the principle of ensuring a low environmental footprint. The key principles of the circular economy include designing out waste pollution, regenerating natural systems and keeping products and materials in use. Project specific design opportunities were identified to incorporate circular economy followed by integration and implementation across all disciplines and stages of the proposed Scheme. The following strategies have been adopted in this regard:

- Value capture and reducing consumption of natural resources;
- Cycle lanes and footpaths can use surplus materials from construction to prevent removal from site e.g. demolition aggregate and recycled asphalt;
- Assessment of key materials to focus carbon calculations as appropriate. Details of carbon calculations populated and continuously updated in the TII "Carbon Assessment and Reduction Tool" and coordinated with standardisation of designs;
- The proposed Scheme will source material sustainably such as use of green cement and recyclable materials. In particular, it is proposed to use concrete with 50% ground granulated blast-furnace slag (GGBS) and also investigate the potential of using recycled aggregate types from footpaths, walls, pedestrian bridge, etc. under Article 28 – End of Waste of the EU (Waste Directive) Regulations 2011;
- Ground investigation was conducted to establish a route-wide ground model to inform structures, earthworks, drainage design and environmental assessments. An accurate ground model reduces ground-related construction risks, facilitating more efficient design, thereby reducing the unnecessary use of carbon intensive materials;
- The re-use of site-won materials and minimisation of off-site disposal. Laboratory testing of soil and rock samples will allow appropriate material classifications which in turn will inform re-use and disposal options during the Construction Phase;
- The Waste Management Plan for the proposed Scheme will be implemented and updated (if necessary) by the contractor(s) to manage the construction and demolition waste;
- Demolition waste will be generated by the proposed Scheme as described in the EIAR Chapter 6 (Construction Activities) and Chapter 19 (Material Assets: Resource and Waste Management). It is predicted that an overall recovery rate of 95% can be achieved for construction and demolition (C&D) wastes (excluding soils and stones);
- Procurement of low carbon and sustainable materials and equipment will be incorporated;
- Reduction of mains water use will be achieved through the design of efficient water systems and devices at Stops and buildings;
- Design for disassembly of track infrastructure; and
- As outlined in section 5.8.9 of this Chapter, SuDS have been incorporated into the design to reduce mains water usage, to reuse water and to manage potential pollution of waterbodies. SuDS measures include the implementation of rainwater harvesting, green roofs, swales and retention basins.

The key principles of circular economy include designing out waste pollution, regenerating natural systems and keeping products and materials in use.

5.3.4 Community Engagement

The design of the proposed Scheme has been informed by ongoing public consultation with engagement of a wide range of stakeholders. Extensive public consultation has taken place on the EPR, the PR and on other significant changes as described in section 1.9 of Chapter 1 (Introduction) of this EIAR.

Overall, 82% of respondents asked during the PR non-statutory consultation period said they supported the principle of extending the Luas Green line to Finglas. Of those that provided a response, just under a third (30%) of respondents rated the proposals as 'very good / good', with a quarter (25%) stating it was 'ok'.

The proposed Scheme will continue to progress community engagement by:

- Regularly reviewing and updating stakeholder and community engagement plans, including centralised complaint reporting lines and minimum standards for resolution for construction and programme for virtual and face-to-face events during design and operation;
- Providing a dedicated and responsive helpline and social media channels for the community before construction starts;
- Actively maintaining partnerships and design focus groups established with the community;
- Open space studies and gender studies to help inform the design;
- Ongoing engagement and contingency planning with other transport agencies to maintain the level of service during disruptive events, such as mass power outage and flooding; and
- Communicating in a timely and open manner.

5.3.5 Health and Wellbeing

The proposed Scheme will deliver health and wellbeing benefits by providing active travel options for a wide range of people in the areas served. Using public transport will enable users to include walking and cycling in their commute and reduce commuting times and stress associated with vehicular travel. Extensive assessments have been undertaken as part of the EIAR process to understand the potential impacts of noise, air quality and traffic on the communities. Public Life surveys were undertaken in March 2022 and January 2023 to capture pedestrian, age, gender, and stationary activities for the existing public spaces and to get a better sense of who is using the existing open space around the proposed Scheme and how. The surveys also evaluated the urban quality of the existing open spaces close to the proposed route.

Mitigation measures have been developed to manage identified impacts. These include:

- Mitigate potential noise and vibration impacts and monitoring to ensure limits are adhered to during the Construction and Operational Phases - Chapter 15 (Noise and Vibration);
- The establishment of an air quality baseline and implementation of measures in collaboration with other key stakeholders as required to ensure limits are adhered to - Chapter 13 (Air Quality);
- Footpaths and cycle lanes alongside the proposed Scheme will enhance accessibility providing further benefits in terms of safer and more convenient journeys and health benefits. Chapter 7 (Human Health) of this EIAR details further the potential health impacts and benefits of the proposed Scheme.

5.3.6 Connectivity

The design for the proposed Scheme has been developed to maximise connectivity and interchange opportunity between the LRT and other sustainable transport modes. Specific design measures that have achieved this are as follows:

- High quality, safe and attractive access to all facilities, stations, trains and public spaces – designed to promote independent mobility;
- Bus interchange development for many stations which are integrated with existing bus services as well as future proposed BusConnects;
- Cycle lanes and cycle parking facilities provided at each of the new Stops to support cycle-LRT trips and further encourage sustainable travel choices; and
- Implementation and maintenance of electronic connectivity services on all Stops.

5.4 Design Iteration

The design of the proposed Scheme has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the proposed Scheme are attained. Chapter 4 (Alternatives Considered) of this EIAR details further the alternatives. In addition, where appropriate, feedback received from the comprehensive consultation programme, described in Chapter 1 (Introduction), undertaken throughout the option selection and design development process has been incorporated.

5.5 Design Principles

The Luas has a strong identifiable image and design language, which encourages and promotes its use. The design maintains the consistency of this design language across the network.

The Luas Finglas design philosophy has been developed based on the key principles outlined in the following subsections:

5.5.1 Roads, Access, Vulnerable Users and Landscaping

- Luas Finglas should not create barriers to connectivity;
- Changes in levels should not reduce opportunities for mobility for all users. Design for children and more vulnerable users by creating spaces to rest, sit and regroup;
- High levels of movement and use by different groups at different times will promote urban integration and result in safe spaces;
- Changes in levels should not limit how more vulnerable cyclists use the spaces. Design with a varied topography to take advantage of the slopes;
- Ensure steeper gradients are only for short distances and provide safe and regular resting spots for vulnerable users. Landings can be combined with lay-bys with space for mobility impaired users;
- Use planting to create safe and connected spaces that are multifunctional, low maintenance and ecologically sensitive. High levels of movement and use by different groups at different times will promote urban integration;
- Adopt a strong Landscape Design Strategy to allow the proposed Scheme to address carbon and climate adaptation in a positive way. Create environments that enhance the blue and green infrastructure in Finglas;
- Create Green Links between the parks to provide a safe transition for pedestrians and cyclists crossing over the Tolka Valley Road, St Helena's Road and Wellmount Road;
- Encourage active travel usage and modal shift between active travel and public transport by providing active travel infrastructure and suitable bike parking facilities close to Luas Stops;
- Implement earthworks in line with the principles of the Circular Economy and sustainable principles (SuDS, local seed banks, soil enrichment, carbon opportunities);
- Design for various timescales from short-term intervention such as grasslands to long-term tree cover aspirations;
- Ensure that the principle of safe, accessible spaces and safe transport routes can be balanced against the need to maintain wilder areas with enhanced habitat opportunities. Maintenance will be focused on creating safe routes while reducing herbicide use and allowing a degree of landscape wildness;
- Follow a simple palette of planting to create connected green spaces along the route. Planting will be multifunctional with all plant types chosen with reference to their adaptability, robustness and ease of maintenance; and
- Provide safe road infrastructure and Non-Motorised User (NMU) facilities at interfaces with the Luas alignment.

5.5.2 Track Alignment and Trackform

The standards used for the design of the track alignment, both horizontal and vertical are:

- CTD.DMr.0001.02 Track Alignment Tramway Clearances (March 1, 2003); and
- CTD.DMr.0002.01 Track Alignment – Design Handbook.

The Track Alignment – Design Handbook has been established to achieve the clearances introduced in the Track Alignment Tramway Clearances.

The Track Alignment (both Horizontal and Vertical) has been developed with three principles in mind while complying with the alignment standards and maintaining the geometry within more comfortable limits (avoiding as much as possible the use of extreme limits):

- Reduce the runtime;
- Reduce the land footprint; and
- Reduce the carbon footprint.

The trackform design sought to reduce the carbon footprint of the project and to reduce the import of materials while prioritising local production wherever possible and reducing import and transportation costs and impacts.

5.5.3 Drainage

The proposed Scheme approach to SuDS aligns with Nature-based Solutions as detailed in Dublin City Council's Climate Change Action Plan 2019-2024 (DCC, 2019) and recent Inland Fisheries Ireland (IFI) Planning for Watercourses in the Urban Environment guidelines (Inland Fisheries Ireland, 2020). SuDS principles adopt vegetated open systems such as swales and attenuation ponds which facilitate filtration of surface water runoff from paved areas. SuDS features not only allow surface water infiltrate to ground but also facilitate storm water attenuation and treatment of water quality.

The Luas Finglas has extensive sections off road running through either parks, or green strips of land or grass verges, where it is proposed to adopt SuDS for visual aesthetic and environmental reasons. SuDS (Sustainable Drainage Systems) are designed to manage stormwater locally (and as close to source as possible) in order to mimic natural drainage and encourage its infiltration attenuation and passive treatment.

A number of principles incorporated into the design are outlined below:

- SuDS-based systems are incorporated to dispose of surface water runoff generated by the proposed Scheme. Where possible vegetative based SuDS will be used;
- Design to minimise the environmental impact on the receiving environment;
- Outfall rates from attenuation areas based on greenfield and brownfield assessments, that will determine an allowable outfall rate which does not exceed the pre-development condition;
- Systems designed with the aim of keeping future maintenance requirements to a minimum; and
- Where connections to watercourses and existing drainage systems are proposed, attenuation provided as required. Surface water runoff from new drainage networks attenuated to the critical 1 in 100-Year Storm event (including 20%) for climate change.

5.5.4 Accessibility

Accessibility for mobility impaired users is a core element of the proposed Scheme design and it has been informed by:

- DMURS, Building for Everyone: A Universal Design Approach (National Disability Authority, 2020);
- How Walkable is Your Town (National Disability Authority, 2015), Shared Space, Shared Surfaces and Home Zones from a Universal Design Approach for the Urban Environment in Ireland (National Disability Authority, 2012);
- Best Practice Guidelines, Designing Accessible Environments (Irish Wheelchair Association, 2020);
- Inclusive Mobility: A Guide to Best Practice and Access to Pedestrian and Transport Infrastructure ; (Department for Transport, UK, 2021);
- Guidance on the Use of Tactile Paving Surfaces (UK Department of Transport, 2021); and
- BS8300:2018 Volume 1 Design of an accessible and inclusive built environment – External Environment – code of practice (BSI, British Standards Instituition, 2018).

Further detail on accessibility for mobility impaired users is given in Section 5.8.4.18.

5.5.5 General Design Principles

Design principles applied to the proposed Scheme include universal access provision providing a safe convenient system for all users. The proposed Scheme has been developed after consideration of reasonable alternatives and it achieves the required aim and objectives. The proposed Scheme is described in greater detail in section 5.7. Section 5.8 provides further detail on the key infrastructural elements that comprise the proposed Scheme.

5.6 Limits of Deviation

The Limits of Deviation (LOD) is the maximum distance that a railway undertaking is authorised to deviate from the lines of the plans and drawings lodged with a successful application for a RO.

In constructing or maintaining any of the light railway works TII may:

(1) (a) where such works are situated in a public road:

(i) deviate laterally by an amount not exceeding 2.5 metres from the lines or situations shown on the deposited plan

(ii) deviate vertically by an amount not exceeding 1 metre upwards or downwards from the levels shown on the deposited plan

(iii) deviate longitudinally by an amount not exceeding 20 metres in respect of any light rail work.

(1) (b) where such works are situated otherwise than in a public road:

(i) deviate laterally by an amount not exceeding 5 metres from the lines or situations shown on the deposited plan

(ii) deviate vertically by an amount not exceeding 2 metres upwards or downwards from the levels shown on the deposited plan

(iii) deviate longitudinally by an amount not exceeding 20 metres in respect of any light rail work.

The purpose of these powers of deviation is to facilitate onsite construction and allow a limited degree of flexibility to react to on-site circumstances which may be unforeseeable at this stage.

It should be noted that any amendments to the alignment are expected to generally occur within construction tolerances, which are much lower than the potential variance indicated above. However, the LODs set are to accommodate any unknowns that might be encountered at the construction phase of the proposed Scheme.

Volume 5 – Appendix A5.2 assesses whether the power to deviate within the proposed limits of deviation (LOD) for the proposed Scheme, as identified on the Property Drawings provided in the RO Drawing Pack, would alter the predicted significant impacts reported in the EIAR by creating new or different (usually increased) significant impacts.

5.7 Description of the Proposed Scheme

The proposed Scheme runs from Broombridge to Charlestown through Tolka Valley and Finglas Village and is shown in Volume 4 – Map Figure 1-1. The proposed Scheme is described from south to north, has been sub-divided into four distinct areas as per the following geographical sections:

- Area 30 Broombridge Depot;
- Area 31 Broombridge to Tolka Valley Road;
- Area 32 Tolka Valley Road to Finglas Village Stop; and
- Area 33 North of Finglas Village Stop to the Terminus (Charlestown Stop).

5.7.1 Area 30: Broombridge Depot

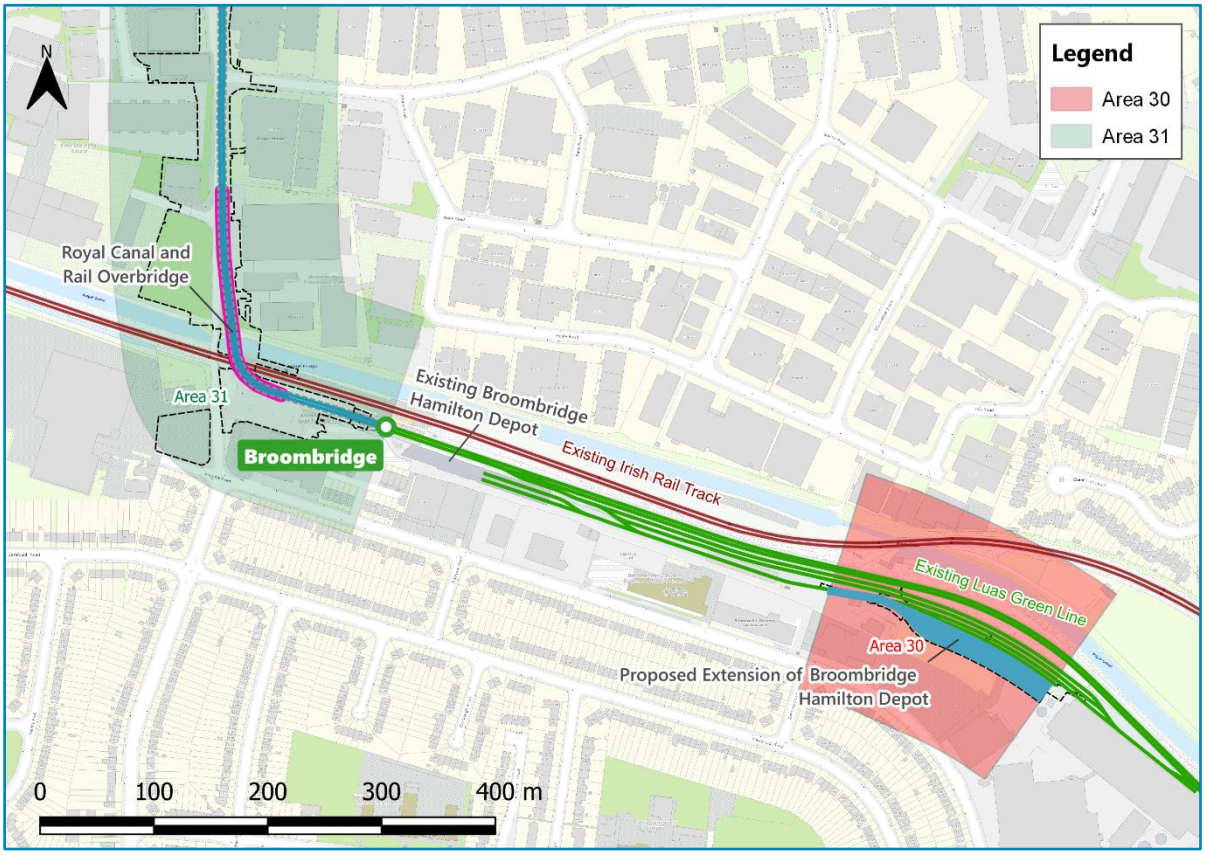

Figure 5-1: Area 30 Broombridge Depot

5.7.1.1 General overview

Area 30 is shown in Figure 5-1. The extension of the Luas with the addition of 3.9km of track to Charlestown Terminus will ultimately require additional vehicles to provide for the increased demand generated by the combined new and existing alignments and the increased frequency of LRVs. The current stabling facilities at Broombridge Hamilton Depot are at capacity and therefore it is necessary to provide new stabling lanes for these additional vehicles. Following a full assessment of alternative locations for this additional stabling (see Chapter 4 (Alternatives Considered) of this EIAR) a site at Bannow Road was selected as the most viable option. Following design optimisation, the footprint of the stabling area was reduced by one lane to four lanes. This has a positive impact of reducing land take from DCC and thereby reducing impacts on the potential development of the adjacent DCC property. The site was formerly a light industrial premises which was demolished some time ago. The area has not been maintained and is significantly overgrown. The site is shown in Figure 5-2 and the proposed stabling site layout is shown in Figure 5-3.

The extended stabling area consists of three ballasted tracks and a fourth as an embedded track lane to facilitate vehicular access. The stabling area will have provision for eight LRVs. The site requires re-levelling,

a retaining wall and a new boundary fence to the southern side. Other facilities include amended overhead line installation, modification of the existing points to link to the existing trackwork, lighting, signalling, water supply (for cleaning) and an extended CCTV system. There will also be modifications to the existing substation although these are internal changes only and do not give rise to any visual impact externally.

A future DCC housing scheme is proposed to the south of the stabling area and suitable planting with a noise and visual buffer strip is provided as part of that scheme. Construction of the stabling area is proposed to be facilitated via the existing depot access road and will not require access via this proposed housing development site.

Figure 5-2: Aerial view of existing site for Luas Finglas stabling area

Figure 5-3: 3D Rendered Image at proposed Broombridge Depot Stabling Site

5.7.1.2 Luas Stops

Area 30 contains the existing Luas Broombridge Stop, which the location and type is indicated in Table 5-2. The proposed Scheme does not require any modifications to this Stop. The existing terminal poles for the Overhead Contact System (OCS) system will be modified to enable the connection to the new OCS for the extension. No new Luas Stops are proposed in Area 30 as part of the proposed Scheme.

Table 5-2: Luas Stops within Area 30 of the proposed Scheme

Luas Stop Name	Location	Description
Broombridge Stop	Existing Broombridge rail / Luas station off Broombridge Road	Existing Luas Stop to remain as it is now

5.7.1.3 Junction Information

There are no existing or proposed road junctions in Area 30 as part of the proposed Scheme.

5.7.1.4 Landscape and Public Realm

The stabling site is within an area inaccessible to the public and is a constrained site with four stabling tracks. Thus, limited opportunities exist for landscape treatment apart from boundary treatment with the adjacent DCC site. This is proposed to take the form of a retaining wall with chain link fence above which can be used for climber planting, to act as an effective visual and sound barrier for the proposed adjacent future housing development.

Within the stabling site there are both ballasted and embedded track for vehicular access and the existing type of trackbed treatment is proposed for the extension. A recently constructed concrete boundary wall exists to the east of the alignment. The current boundary fence to the existing stabling will be removed.

It is noted that the proposed Scheme requires the removal of existing trees at the eastern end of the stabling area. Refer to Chapter 21 (Landscape and Visual Impact) and Volume 5 – A21.2 of this EIAR, for further detail on the number of trees to be removed and impact assessment.

5.7.1.5 Utilities and Diversions

There are no records of existing utilities within the Area 30 stabling site. Any unchartered existing underground utilities will be required to be diverted where conflicting with the proposed Scheme. Identified service conflicts and recommended diversions are described and assessed in Chapter 17 (Material Assets: Infrastructure and Utilities) of this EIAR.

5.7.1.6 Land Acquisition and Use

Temporary land acquisition will be required within Area 30 along the southern side the new boundary line of the stabling site. Depending on the timing of the proposed DCC housing development on the adjacent site, this boundary wall could potentially be in place prior to construction of the stabling site works commencing. Should this be the case, temporary land take will not be required.

Permanent land acquisition is required within Area 30 to facilitate the additional stabling lanes.

Land requirements are detailed in Chapter 12 (Land Take) of this EIAR and are illustrated on the Property Drawings provided in the RO Drawing Pack. The impacts on residential amenity arising from land acquisition in Area 30 of the proposed Scheme are addressed in Chapter 8 (Population). Similarly, the impacts on landscape amenity arising from land acquisition in Area 30 of the proposed Scheme are addressed in Chapter 21 (Landscape & Visual Amenity).

5.7.2 Area 31: Broombridge to Tolka Valley Road

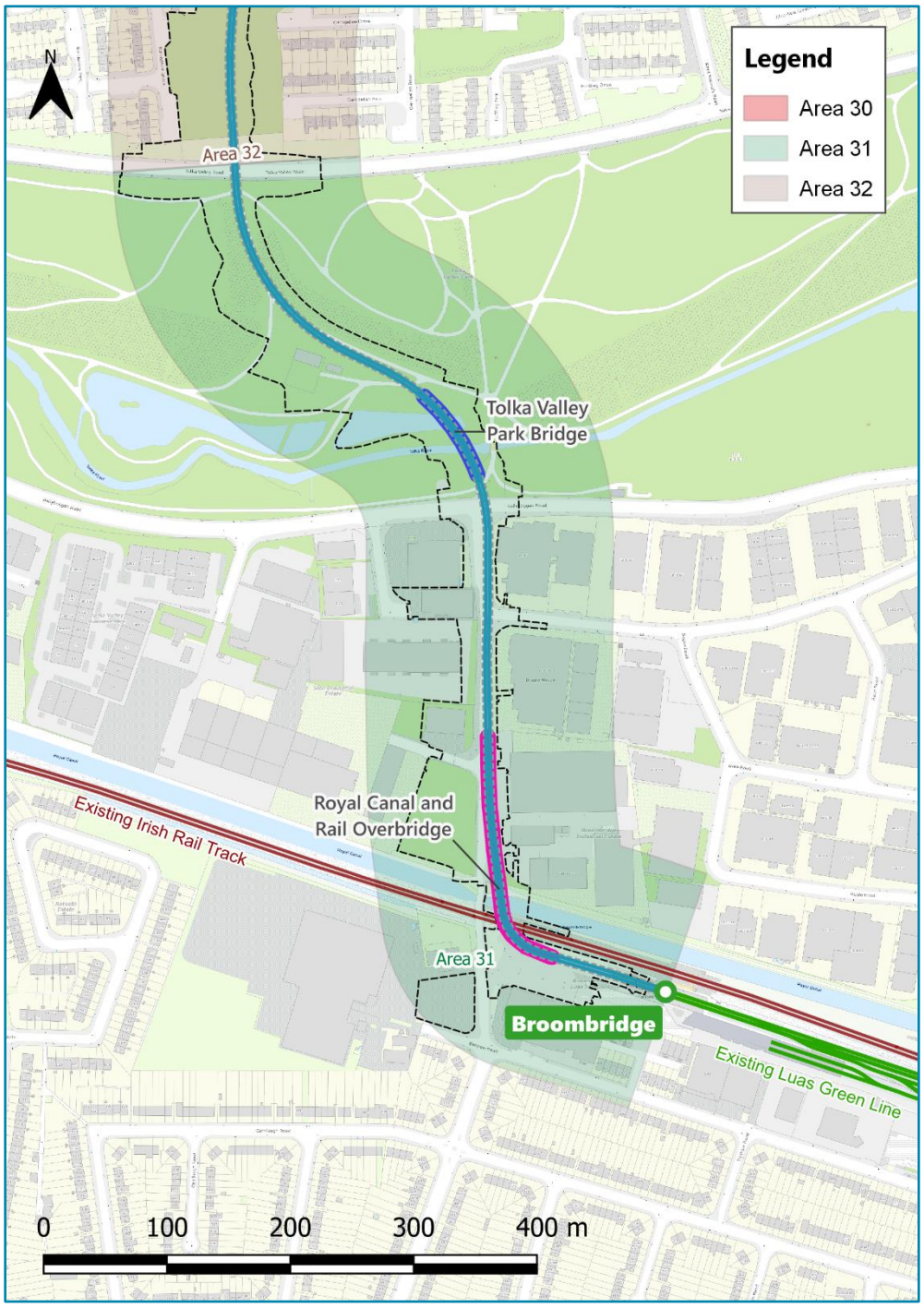

Figure 5-4: Area 31 Broombridge to Tolka Valley Road

5.7.2.1 General Overview

This area is approximately 850m long, extending from the existing Luas Green Line at Broombridge to Tolka Valley Road. This section will include two major structures: the crossing of the existing Maynooth Railway line, Royal Canal and Greenway; and the crossing of Tolka Valley Park and River Tolka. No new Luas Stops are included in this section. The area is shown in Figure 5-4.

The proposed Scheme in this location will entail removal of the existing OCS end poles at Broombridge Stop and connection to the new OCS. Trackwork connections will require the removal of the current LRT arrestor

and provide for connection of the new track. The work also includes reconfiguration of the interchange area which is described further in the Landscape section 5.7.2.6.

The new track will commence to rise on a new solid ramp structure just west of the Broombridge Stop platform. This ramp connects to the proposed bridge above the Maynooth railway line and the Royal Canal. The height of the bridge deck has been determined by the clearance requirements for both the canal and railway line, taking into account the future electrification of the Maynooth railway line. The area under the bridge will be used to accommodate a cycle storage facility which will further accommodate and encourage cycle-LRT trips.

The proposed Royal Canal and rail bridge has been designed with input from both Waterways Ireland and Iarnród Éireann, as well as consultations with DCC and it takes account of the existing heritage structure and visual impacts while at the same time seeking to provide a landmark and visually attractive structure. The bridge spans clear across both the railway line and the canal with a set of piers on the south side adjacent to the Iarnród Éireann platforms (effectively forming an arched opening to allow access to the Iarnród Éireann platforms) and a set of piers on the northern side just beyond the existing wing walls of Broome Bridge. Access beneath the bridge deck on this side is provided for Waterways Ireland maintenance vehicles and for both pedestrians and cyclists using the canal towpath and greenway. The proposed bridge is for the exclusive use of the LRT and does not accommodate pedestrians or cyclists.

The current steel pedestrian access ramp to the Iarnród Éireann northern platform at Broombridge has to be removed, due to lack of clearance beneath the proposed bridge, and the stone bridge parapet reconstructed at the existing gap. Alternative access to the Iarnród Éireann platform is available via the Luas platforms from Broombridge Road and the existing overbridge between the Iarnród Éireann platforms. Iarnród Éireann have submitted an RO application for the DART+ West project which includes the modification of the existing Broome Bridge structure to accommodate the increase in clearance due to the electrification of the line. This has been taken into account in the design of the proposed Scheme.

These works include a proposed diversion of a water main at Broombridge Road/Bridge which requires construction of a pipe duct beneath the Royal Canal and main line Railway. This work will be carried out by means of pipe-jacking underneath both these locations to minimise disruption.

The proposed Royal Canal and rail bridge structure continues along the eastern boundary of the Colorman factory. A new vehicular access is to be provided to the Colorman business premises beneath the bridge. The structure terminates in a solid ramp structure just south of Lagan Road where the track reaches existing ground level to proceed northwards via a new signalled junction. The alignment continues past the business Fashionflo, where the boundary walls are to be relocated. At the Westrock premises, demolition of an existing retaining wall and reconstruction of a new wall in a position closer to the building is proposed. Some modification works are required to accommodate access for goods vehicles and staff to Fashionflo, including provision of new access gates on Lagan Road. The track construction in this area consists of slab track construction for structures, embedded track for road crossings and grass track elsewhere.

Road works at Broombridge Road include road re-alignment both horizontally and vertically to accommodate the track alignment and access to adjacent properties. Additional widening is required to provide the necessary cycle lanes, footpaths and landscape buffer zones. The proposed Scheme includes changes to the access arrangements and boundary walls along both sides of Broombridge Road. The existing mini-roundabout at the entrance of the Glen Industrial Estate will be changed to a priority junction and measures will be put in place at Lagan Road junction to indicate to drivers that access is restricted across the bridge in a southbound direction, utilising surfacing treatment, signage and landscaping measures. Differences in level require the construction of a new retaining wall along the front of the Glen Industrial Estate south of the current entrance location. A building located in Glen Industrial Estate to the north of the existing entrance must be demolished as a result of the widening of the roadway. Further north, works include new boundaries and the demolition of Unit 124, Broombridge Close.

Other works at Broombridge Road include utilities diversion works and provision of new public lighting as well as below ground construction for track bed, ducts, pole and structure foundations.

The proposed Scheme crosses Ballyboggan Road at grade via a new signalled junction and then enters Tolka Valley Park. The existing access gates will be removed and a more open access point will be provided. (See details in section 5.8.11).

The proposed Scheme crosses the River Tolka via a new bridge which will feature a grass/green deck. A parallel cycle lane is also provided. The overall length of the bridge is 65m, consisting of a central span of 45m and two 10m edge spans. The two 10m end spans have side walls which block the space beneath them. The south pier is approximately 5m from the riverbank whereas the north pier is set back approximately 22m from the riverbank to minimize the impact on the existing Integrated Constructed Wetland (ICW).

The proposed Scheme continues north, rising towards Tolka Valley Road. Here the proposed Scheme passes through an area of contaminated land associated with the old municipal dump. The proposed Scheme also passes in two locations beneath a set of ESBN high tension wires. This has been assessed for clearance and safety/EMC impacts and is not of concern. The existing footpaths and cycle lanes within the park are modified to ensure safe crossing points for both pedestrians and cyclists alike.

The proposed Scheme crosses Tolka Valley Road at grade via a new signal-controlled crossing. Existing railings around the park will be modified to facilitate the LRT crossing and new landscape layouts will be provided (See details in section 5.8.11)

5.7.2.2 Other Minor Works

Some works are required within the curtilage of adjacent owner/occupiers' premises to facilitate new circulation and access movements due to loss of space or points of access. There will also be minor works for the provision of electrical and control cabinets for the various systems such as public lighting and signalling. Works within the park include new footpaths, cycle lanes and public lighting.

5.7.2.3 Luas Stops

No Luas Stops are proposed in Area 31 as part of the proposed Scheme.

5.7.2.4 Junction Information

An overview of the approach to junction review and design is provided in section 5.8.4.15. The proposed scheme junctions within Area 31 are outlined in Table 5-3.

Table 5-3: Junctions within Area 31 of the proposed Scheme

Junctions	Junction Detail
Broombridge Road – Colorman Business	▪ New access to be provided underneath the elevated track structure. Footpath on Broombridge Road for continuous access across. ▪ A 7m width on access for the swept path. ▪ Gate to be located within Colorman site.
Broombridge Road – Glen Industrial Estate	▪ Replacement of existing mini-roundabout with T-junction. ▪ A 6m road width, and 6m junction corner radii to facilitate informal U-turns. A ramped crossing for paths with drivers required to give priority to path users.
Broombridge Road / Lagan Road	▪ Replacement of existing priority junction with a signalised junction incorporating a Luas crossing of Lagan Road. ▪ 6m junction corner radii.
Broombridge Road / Ballyboggan Road	▪ Replacement of the existing priority junction with a signalised junction incorporating a Luas crossing of Ballyboggan Road. ▪ 6m junction corner radii. ▪ A segregated 2-way north-south running cycle track retained through junction and provided with dedicated traffic signal phase.

5.7.2.5 Structures

Major Structures

Two principal structures currently exist in Area 31. The location and type of structures is indicated in Table 5-4.

Table 5-4: Summary of Existing Principal Structures in Area 31 of the proposed Scheme

Identity	Description
Broome Bridge (RPS ref. 909)	It currently carries Broombridge Road over both the Royal Canal and, with a later incorporated archway, the Maynooth Rail Line (former Midland Great Western Railway Line). The Broombridge Iarnród Éireann station and Broombridge Luas Terminus are located adjacent to the eastern elevation of the bridge.
Finglaswood Bridge (RPS Ref: 906)	An existing two-arch structure that crosses the River Tolka and provides mostly pedestrian and park maintenance vehicle access across the river within the Tolka Valley Park amenity area.

Two new structures are proposed in this Area as part of the proposed Scheme.

- Royal Canal and Rail Bridge; and
- Tolka Valley Park Bridge.

The location and type of these structures is indicated in Table 5-5 and described in further detail in Section 5.8.10.

Table 5-5: Summary of New Structures in Area 31 of the proposed Scheme

Identity	Location	Description
Royal Canal and Rail Bridge	Approximately 10m east of the existing Broome Bridge and then continuing north, parallel with Broombridge Road on its east side	The proposed bridge is an eight-span structure consisting of two main parts: a variable depth weathering steel composite box girder followed by a constant depth solid concrete slab. The bridge has the following span arrangement: 35 + 47.5 + 30 + 17 + 3x22 + 17m. Steel superstructure extends over the first three spans. The bridge deck is continuous over the full length of 212.5m and has solid approach ramps at both ends.
Tolka Valley Park Bridge	Approximately 30m west of the existing Finglaswood Bridge	A three-span structure with buried end spans, thus appearing as a single span bridge. End spans as well as part of the main span consist of post-tensioned concrete variable depth girder, the central section of the main span is a suspended weathering steel composite box girder. The overall length of the bridge is 65m with spans 10m, 45m, 10m. Abutments and piers are set at 0 degrees skew and the superstructure is fully integral with the substructure.

Retaining Walls

There are several retaining walls proposed within this section of the proposed Scheme at the locations below:

- Just north of the existing Broome Bridge on the western side of Broombridge Road, along the frontage of Glen Industrial Estate;
- On the western side of Broombridge Road opposite the junction with Lagan Road;

- The Eastern side of Broombridge road between Lagan Road junction and start of the Royal Canal and Rail Bridge approach ramp; and
- South of the Ballyboggan Road / Broombridge Road Junction on the eastern side of Broombridge Road, in front of the Westrock premises.

5.7.2.6 Landscape and Public Realm

The proposed new layout for the Broombridge Stop provides for improved access for bus, pedestrian and mobility-impaired passengers and it frees up space for additional soft landscaping together with a reduction in the area of hard surfaces. On Broombridge Road, there are extensive landscape changes proposed. The design intent is to transform what is currently a somewhat unfriendly pedestrian and cycle area into a more appropriate environment to facilitate and encourage walking and cycling, and to tie into the proposed Royal Canal Greenway along the Canal tow path as well as providing enhanced access to and from the Luas Stop and the Iarnród Éireann platforms.

The landscape works through Tolka Valley address issues at the entrances of the park which move away from having boundary fencing / gates to a more open aspect due to the LRT crossing. In line with DCC policy only minimal lighting is provided within the parks where safety dictates it is necessary.

5.7.2.7 Utilities & Diversions

Existing underground utilities will be diverted due to the proposed development. The following utilities have been identified as requiring works in Area 31:

- Uisce Éireann (Irish Water): asset owners for potable water, foul drainage and combined drainage;
- Local Authorities – DCC:
  - Asset owners of: Public Lighting, Traffic, Local CCTV Fibre, and surface drainage.
- ESBN: High voltage and Medium / Low voltage overhead and undergrounded network;
- Gas Networks Ireland: High pressure and low-pressure mains; and
- Various communications networks.

Information regarding location-specific utility clashes and the required diversions are covered in detail in Chapter 17 (Material Assets: Infrastructure and Utilities) of this EIAR.

5.7.2.8 Land Acquisition and Use

Temporary land acquisition is required within this Section at several locations, including the construction compound and laydown / storage space in the DIT site opposite the Luas Interchange, temporary land within the Glen Industrial Estate lands for bridge construction and space within the Tolka Valley Park to facilitate bridge and track construction. Other temporary lands are required for boundary wall and retaining wall construction.

Permanent land acquisition is required within this Area 31 facilitate track and road alignment, pedestrian / cyclist facilities and structures.

Land requirements are detailed in Chapter 12 (Land Take) of this EIAR and are illustrated on the Property Drawings provided in the RO Drawing Pack.

The impacts on residential amenity arising from land acquisition in Area 31 of the proposed Scheme are addressed in Chapter 8 (Population). Similarly, the impacts on properties arising from land acquisition in Area 31 of the proposed Scheme are addressed in Chapter 12 (Land Take). Finally, the impacts on landscape amenity arising from land acquisition in Area 31 of the proposed Scheme are addressed in Chapter 21 (Landscape and Visual Amenity).

5.7.3 Area 32: Tolka Valley Road to Finglas Village Stop

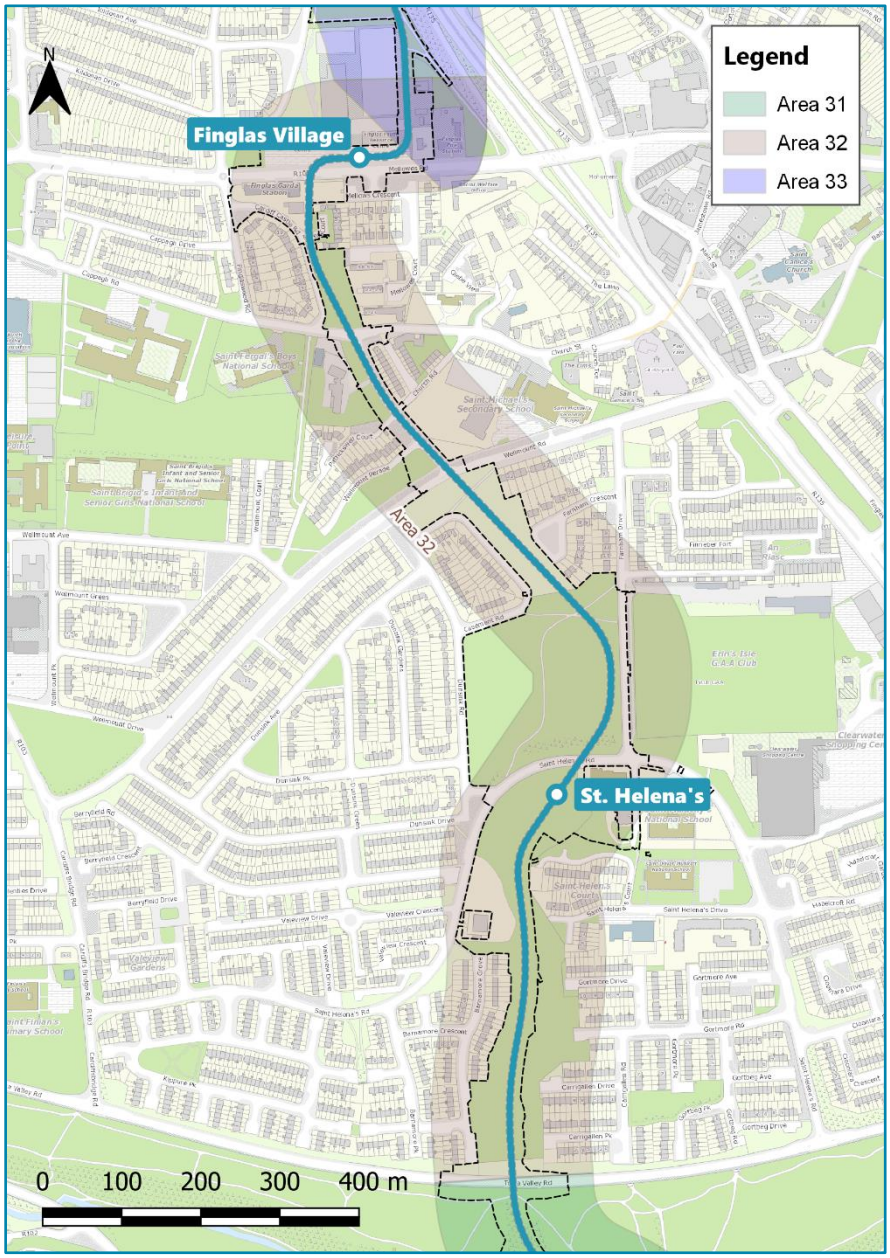

Figure 5-5: Area 32 Tolka Valley Road to Finglas Village Stop

5.7.3.1 General Overview

This area is approximately 1.45km long running from Tolka Valley Road to Finglas Village Stop and includes two Stops: St Helena's and Finglas Village. The area is shown in Figure 5-5.

The alignment rises through the grassed area between Tolka Valley Road and St Helena's Road, a former valley, (locally known as "The Valley"), which contained the Finglaswood Stream that has since been culverted and infilled. This culvert is proposed to be diverted as part of the proposed Scheme. Parallel to the alignment there are new footpaths and a cycle lane. The area currently has no formal footpaths although an existing strong "desire line" worn path is clearly evident. The introduction of the proposed Scheme is likely to increase the use of that desire line and in order to avoid informal usage of the track footprint, a parallel layout of cycle lanes and footpaths is proposed. The design of the footpaths has taken into account accessibility and issues such as antisocial behaviour and public safety.

The first Stop on the proposed Scheme is located just south of St Helena's Road adjacent to the St Helena's Family Resource Centre and the St Helena's Childcare Centre. The location of the Stop has taken into consideration pedestrian access and bus interchange with services on St Helena's Road. In order to facilitate safer crossings at the Luas line and St Helena's Road junction, the access arrangements for the Resource Centre and Childcare Centre have been modified so that all vehicular access will be via Farnham Drive extension. The internal layout of the Resource Centre and Childcare Centre car park is being reconfigured to suit. A small turning hammerhead is proposed at the end of Farnham Drive extension to facilitate the parents of children attending St Malachy's primary school. Farnham Drive extension will be re-engineered to re-balance its function more towards the needs of vulnerable road users and to reflect its location beside a school access.

A new signal-controlled junction is created on St Helena's Road and from here, the proposed Scheme crosses into the area of Farnham pitches and runs parallel to Farnham Drive. There are two pitches at this location for both gaelic games (GAA) and soccer. In order to accommodate the proposed Scheme, the pitches are to be modified and relocated. Due to space limitations, the alignment will have ball-stop net protection at the corners of the GAA pitch. The alignment is slightly elevated above the pitch level and the resulting embankment will provide a viewing area for spectators. Within the pitch areas, the existing footpath dividing the current playing fields will be removed and the entire area will be re-levelled. Safe crossing points for pedestrians have been provided at the alignment and Farnham Drive to facilitate access for the Erin's Isle GAA club. A small equipment storage structure is proposed at this location.

North of the Farnham pitches, the track continues through the parklands alongside Casement Road before arriving at a controlled crossing of Wellmount Road. The alignment continues northwards through Patrickswell Place where the existing road is realigned westwards to accommodate the proposed Scheme within the existing corridor. This area may contain archaeological remains of King William's Ramparts. The impacts on this have been assessed in Chapter 20 (Cultural Heritage). The alignment then continues to cross Cappagh Road via a new signal-controlled junction. Continuing at grade parallel to Cardiff Castle Road, the alignment then crosses the entrance to Ravens Court, a residential complex of 12 units. Works here include relocation of the existing boundary wall and changes to the entrance to the complex in order to ensure intervisibility and safe crossing of the proposed Scheme.

At this point, the alignment runs through the Finglas Garda station where it effectively bisects the current parking area and necessitates the demolition of an existing building structure at the rear of the station as part of the proposed Scheme. The relocation of the facility is being planned by An Garda Síochána and the Office of Public Works (OPW) and close coordination with the OPW is required in regard to timing of construction. At this point, the proposed Scheme will create a new cut-through street linking Cardiff Castle Road to Mellowes Road, with a footpath provided adjacent to and crossing the alignment.

Having crossed Mellowes Road via a new signal-controlled junction, the proposed Scheme turns sharply eastwards to arrive at the Finglas Village Stop. The Stop is positioned parallel to Mellowes Road and is incorporated into a new civic plaza which will enhance access to the nearby community facilities. The location of the Stop also facilitates better connectivity with the bus services running along Mellowes Road and provides a more direct visual link to Finglas village centre. A secure cycle parking facility is provided at this location.

5.7.3.2 Other Minor Works

Within Area 32, cycle storage facilities at Finglas Village Stop and additional equipment storage facilities needed for the pitches at Farnham are being provided. Provision of minor retaining walls and boundary fences at the Garda station and near Cardiff Castle Road are also required.

5.7.3.3 Luas Stops

Two Luas Stops are included in Area 32 as part of the proposed Scheme. The Luas Stop locations are outlined in Table 5-6 and are illustrated on the Architectural and Landscaping Drawings provided in the RO Drawing Pack.

Table 5-6: Luas Stops within Area 32 of the proposed Scheme

Luas Stop Name	Location
St Helena's Stop	South of St Helena's Road beside the St Helena's Family Resource Centre and the St Helena's Childcare Centre
Finglas Village Stop	North of Mellowes Road and in front of the Finglas Youth Resource Centre

5.7.3.4 Junction Information

An overview of the approach to junction review and design is provided in Section 5.8.4.15. The proposed Scheme junctions within Area 32, Tolka Valley Road to Finglas Village Stop are outlined in Table 5-7.

Table 5-7: Junctions within Area 32 of the proposed Scheme

Junctions	Junction Detail
Tolka Valley Road	▪ Signalised intersection for the alignment crossing of Tolka Valley Road. ▪ Separate pedestrian and cyclist crossings incorporated into the traffic signals. ▪ Whole junction area to be on a raised table for traffic calming and to create a change in road character passing through the park setting.
St Helena's Road	▪ Signalised intersection for the alignment crossing of St Helena's Road. ▪ Pedestrian and cyclist crossings incorporated into the traffic signals. ▪ Access to St Helena's Family Resource Centre and the St Helena's Childcare Centre at the junction location, to be closed off for vehicle access and an upgraded 2-way access provided instead off Farnham Drive extension.
Wellmount Road	▪ Signalised intersection for the alignment crossing of Wellmount Road. ▪ Pedestrian crossing incorporated into the traffic signals.
Cappagh Road / Patrickswell Place	▪ Signalised intersection for the alignment crossing of Cappagh Road. ▪ Patrickswell Place and pedestrian and crossings incorporated into the traffic signals to form a 3-arm junction.
Ravens Court	▪ Uncontrolled intersection for the alignment crossing of Ravens Court.
Mellowes Road	▪ Signalised intersection for the alignment crossing of Mellowes Road. ▪ Pedestrian crossings incorporated into the traffic signals.

5.7.3.5 Structures

Retaining Walls

There are several minor low level retaining walls proposed within Area 32 at the following locations:

- West of Farnham Drive near the crossing with St Helena's Road between the proposed Luas track and adjacent sports grounds (Farnham pitches);
- West side of Patrickswell Place near junction with Cappagh Road;
- North side of Cardiff Castle Road at the boundary with Garda Station grounds; and
- Eastern boundary of the Garda Station where the new road/track alignments cuts through.

All these retaining walls are of masonry construction and where necessary, function also as boundary walls.

5.7.3.6 Landscape and Public Realm

Within Area 32, the landscape and public realm treatment follows a similar pattern to that established in the southern section of the proposed Scheme, namely grass track through park areas, some minor footpath alterations and boundary treatments such as walls and fences. The amount of embedded track is minimised to junctions, road crossings and Stops.

The area south of St Helena's Stop is currently unmaintained grass lands and lacks designated footpaths and cycle lanes. The proposed treatment is this area includes new accessible footpaths and a separate parallel cycle lane. Residual areas are landscaped in sympathetic local finishes and materials and planted with appropriate native and climate resilient species. A SuDS-based approach has again been applied to drainage with a view to creating a more sustainable low maintenance scheme.

Public realm areas around the two Stops includes hard surfacing to facilitate access and the design has been configured to eliminate the need for handrails and balustrades as much as possible at the Stops. Cycle parking areas have been included and links to nearby bus stops and significant attractors such as schools and resource centres have been taken account of.

5.7.3.7 Utilities and Diversions

Existing underground utilities will be required to be diverted due to the proposed works. The following utilities have all been identified as requiring works in Area 32:

- Uisce Éireann (Irish Water): asset owners for potable water, foul drainage and combined drainage;
- Local Authorities - DCC:
  - Asset owners of: Public Lighting, Traffic, Local CCTV Fibre, and surface drainage.
- ESBN: High voltage and Medium / Low voltage overhead and undergrounded network;
- Gas Networks Ireland: High pressure and low-pressure mains; and
- Various communications networks.

Information regarding location-specific utility clashes and the required diversions are covered in detail in Chapter 17 (Material Assets: Infrastructure and Utilities) of this EIAR.

5.7.3.8 Land Acquisition and Use

Temporary land acquisition is required within this area at several locations, including construction compounds at St Helena's and just north of Cappagh Road. It is also proposed to use the site of the Park Superintendent's house as a construction compound to facilitate construction of the Stop at Finglas Village and the substation. Other minor temporary acquisition is required along the alignment to facilitate construction of boundary walls and crossings.

Permanent land acquisition is required within this area at various locations including through the parklands, along the front of Ravens Court, across the Garda Station and in front of the Community Centre on Mellowes Road.

Land requirements are detailed in Chapter 12 (Land Take) of this EIAR and are illustrated on the Property Drawings provided in the RO Drawing Pack.

The impacts on residential amenity arising from land acquisition in Area 32 of the proposed Scheme are addressed in Chapter 8 (Population). Similarly, the impacts on properties arising from land acquisition in Area 32 are addressed in Chapter 12 (Land Take). Finally, the impacts on landscape amenity arising from land acquisition in Area 32 of the proposed Scheme are addressed in Chapter 21 (Landscape and Visual Amenity).

5.7.4 Area 33: North of Finglas Village Stop to the Terminus at Charlestown Stop

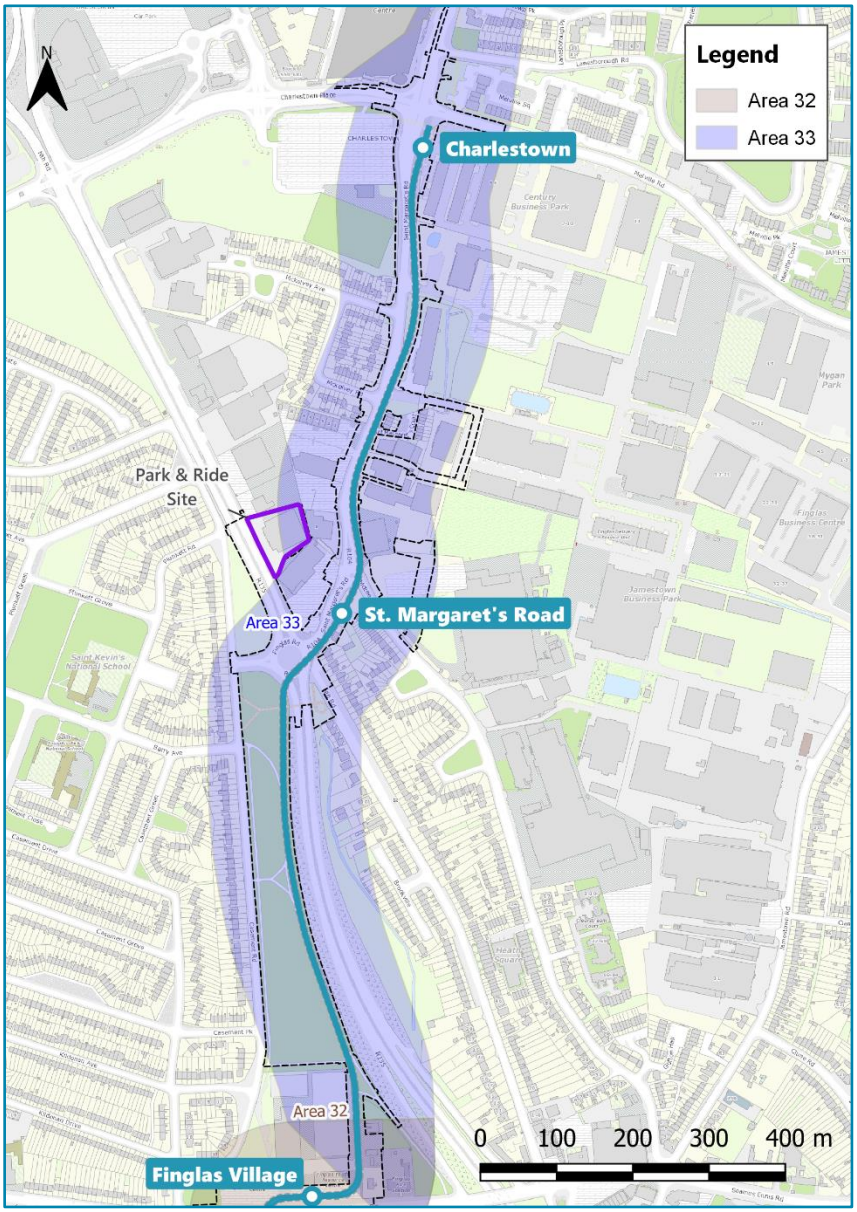

Figure 5-6: Area 33 North of Finglas Village Stop to the Terminus at Charlestown Stop

5.7.4.1 General Overview

This area is approximately 1.42km long and includes two Stops: St Margaret's Road and Charlestown Terminus. This area also includes a major road junction with Finglas Road / North Road, and a major upgrade of the whole section along St Margaret's Road. This area also includes a 350-space P&R facility accessible off North Road and the two substations which are required for the extension of the Luas network. The area is shown in Figure 5-6.

Exiting Finglas Village Stop, the proposed Scheme alignment turns sharply northwards and continues until it reaches the boundary of Mellowes Park. The alignment curvature necessitates the reconfiguration of an external storage area and the relocation of a boundary fence of the former Park Superintendent's house, now used as a counselling services office. In this area, the first of the two substations is located. Existing external storage facilities for DCC Parks Department are to be relocated and the current buildings will be demolished. The substation has been positioned within the cleared space sharing a yard space with the adjacent Uisce Éireann (Irish Water) pumping station. The DCC Housing Department has been consulted

extensively regarding a future development of the site of the superintendent's house to provide housing and some mixed-use development. The alignment and access road layout take this into consideration.

The proposed Scheme enters Mellowes Park at the southern end next to the existing Uisce Éireann (Irish Water) pumping station. There is a crossover located just south of this point to facilitate turnback of LRVs for emergency or operational reasons. The proposed Scheme proceeds northward on the eastern side of Mellowes Park using a grass track system. A minor adjustment of the soccer pitch in Mellowes Park is required to accommodate the LRT alignment and adjacent footpath. The proposed Scheme then approaches the existing footbridge near the Liam Mellows memorial garden. This bridge is in conflict with the proposed Scheme and becomes redundant with the introduction of the at-grade Finglas Road / North Road crossing and therefore will be demolished.

The Finglas Road / North Road roundabout is reconfigured to provide a signal-controlled junction with the LRT and pedestrian crossings integrated into the signalling sequence. After crossing the Finglas Road / North Road, the proposed Scheme proceeds northwards along St Margaret's Road where the next Luas Stop is located. The Stop sits between the Finglas Road / North Road junction and McKee Avenue junction. McKee Avenue junction is currently also a roundabout and will be changed to a signal-controlled junction. The Stop is on a slight curve due to the constrained nature of the site. Space is provided for a public plaza around the Stop and connections to the proposed P&R, located across the road. The proposed Scheme has also taken account of future connections proposed as part of the Jamestown Business Park redevelopment. A bus interchange is provided for proposed BusConnects routes as well as coach stops on Finglas Road / North Road. Provision is made for cycle storage and connections to the GDA cycle network proposed by the NTA.

Just south of the Stop is the proposed second substation. This is to be constructed within a residual area following the demolition of the spiral ramp on the northeastern side of the pedestrian overbridge referred to above. The substation will be accessible via the old North Road which ends in a cul-de-sac adjacent to the site.

An access to the rear of St Margaret's Stop has been provided to facilitate access to land severed by the proposed Scheme. A secure cycle storage facility is proposed at the rear of this Stop.

Having crossed McKee Avenue, the proposed Scheme continues northwards on the eastern side of St Margaret's Road. The need to provide space for increased landscaped areas and cycling facilities means there are property and boundary wall impacts on both sides of the roadway. The proposed Scheme necessitates the demolition and relocation of an electrical substation at the Manhattan Peanuts premises. The scheme proposes to remove access from the front of a number of premises along St Margaret's Road and a proposed rear access road is included in order to preserve vehicular access to these businesses. These alternative accesses will integrate with the Jamestown Masterplan infrastructure under development by DCC. Consultations with regard to the proposed accesses with DCC and the impacted landowners/leaseholders are ongoing.

The proposed Scheme encroaches on four private gardens at St Margaret's Court. The existing access road to the court at the rear of these four houses is to be closed and alternative access and parking is provided via the Jamestown Business Park access road which will be signalised. A small area of green space is to be re-purposed for the additional parking and the original access road to St Margaret's Court will be converted into a cul de sac for parking. This junction has an existing offset arm at McKelvey Road and on the western side a little further north there is an access to and from McKelvey Avenue. It is proposed to close vehicular access at McKelvey Road and convert the end of McKelvey Road to a hammerhead turning area. This will significantly reduce the junction complication and signalling phases. Resident's vehicular access to McKelvey Road is preserved via McKelvey Avenue.

The proposed Scheme continues northwards to cross the access road into the ESBN premises. This access is slightly reconfigured to allow safer crossing of the LRT and to provide some stacking / waiting space for traffic entering and exiting the site.

The proposed Scheme continues northwards until it reaches the terminus station of Charlestown, located just south of Melville Road. A set of crossovers switches will facilitate entry or exit to either platform at the terminus. The junction at this location is reconfigured with lane reductions and improved access for pedestrians and cyclists in line with DMURS principles. Bus interchange is provided for and there is a proposed cycle parking located next to the Stop.

5.7.4.2 Other Minor Works

The proposed Scheme in this area will require removal and / or relocation of boundary walls (both residential and business premises) and a number of minor retaining walls will be required. The impact of the land acquisition will necessitate reconfiguration of internal circulation and car parking arrangements for a number of the premises fronting St Margaret's Road.

5.7.4.3 Luas Stops

Two Luas Stops are included in Area 33 as part of the proposed Scheme. The Luas Stop locations are outline in Table 5-8 and are illustrated on the Architectural and Landscaping Drawings provided in the RO Drawing Pack.

Table 5-8: Proposed Luas Stops

Luas Stop Name	Location
St Margaret's Stop	East side of St. Margaret's Road and south of McKee Avenue junction
Charlestown Terminus	East side of St. Margaret's Road and south of Charlestown junction

5.7.4.4 Junction Information

An overview of the approach to junction review and design is provided in Section 5.8.4.15. The proposed Scheme junctions within Area 33 – North of Finglas Village Stop to terminus at Charlestown Stop are outlined in Table 5-9.

Table 5-9: Junctions within Area 33 of the proposed Scheme

Junctions	Junction Detail
St Margaret's Road / Finglas Road / North Road / Casement Road	▪ The existing roundabout is to be replaced with a signalised junction. ▪ The junction is designed to be as compact as possible in accordance with DMURS. ▪ Protected and segregated cycle tracks are proposed for the east-west movement through the junction. ▪ Pedestrian crossings are proposed on all 4 arms with staggered crossings used on the north and south arms.
North Road / Park & Ride	▪ A 3-arm signalised junction is proposed on North Road to provide access for the proposed P&R facility to the east of North Road. ▪ Right-turns into the facility from North Road will not be permitted. ▪ Signalised pedestrian crossings will be provided on two of the arms of the junction.
St Margaret's Road / McKee Avenue	▪ The existing roundabout is to be replaced with a signalised junction with protected cycle tracks. ▪ Southbound bus stop located on north side of junction to avoid having congested pedestrian / cyclist activity and interactions beside the Luas Stop. ▪ Upgrade of McKee Ave extended south-eastwards to incorporate proposed priority junction for access road proposal.
St Margaret's Road / McKelvey Road /Jamestown Business Park	▪ The existing uncontrolled operation of these junctions will change to a controlled, traffic signalled junction. ▪ The traffic signals will also effectively cater for the needs of vulnerable road users.

Junctions	Junction Detail
	▪ McKelvey Road vehicular access at the junction will be closed off. ▪ Pedestrian and bicycle access would be retained, a turning area would be provided at the end of McKelvey Road, and all vehicular access to and from St Margaret's Road would be via McKelvey Avenue. ▪ Cycle tracks are kept off-road, they are segregated and protected.
St Margaret's Road / McKelvey Avenue	▪ The existing uncontrolled junction will remain as uncontrolled but with a ramped crossing for paths with, drivers required to give priority to pedestrian and cyclists are per normal convention.
St Margaret's Road / ESBN	▪ The existing uncontrolled junction will remain as uncontrolled with a 6m dwell area between St Margaret's Road and the cycle track / alignment. This will allow for vehicles to navigate crossing the cycle track / alignment line and the uncontrolled junction in two movements.
St Margaret's Road / Charlestown	▪ The proposed signalised junction upgrade at Charlestown will involve provision of a more compact and VRU-friendly junction consistent with current best design practice and DMURS. ▪ The other main change to Charlestown junction is the introduction of protected cycle track infrastructure. ▪ Pedestrian crossings have been kept as short as feasible. It is proposed to upgrade the east arm (Melville Road) for 100m in order to provide cycle track connectivity to the existing cycle tracks to the east. ▪ The existing off-road cycle track left-turn "bypass" lane on the northwest corner shall be retained: Similarly, a new off-road cycle track left-turn "bypass" lane is proposed on the southwest corner.

5.7.4.5 Structures

Major Structures

A new Park & Ride (P&R) facility is proposed for the scheme. The P&R site is located in the north-eastern corner of the existing North Road, Finglas Road, St Margaret's Road roundabout. The proposal is to provide a multi-storey car park on the site currently occupied by Discount DIY to the north of the Lidl site. The building is six storeys high including the ground floor. Approximately 350 car parking spaces will be provided. The facility is designed to facilitate 100% EV parking with approximately 20% of EV spaces provided from opening year. There will be pedestrian access to the North Road. Further details are provided in section 5.8.6.

The proposed Scheme also requires the removal of the existing pedestrian bridge and ramps at the Finglas Road / North Road roundabout.

Minor Structures

The proposed Scheme in Area 33 includes the installation of three new electrical substations. The first two substations, providing traction power, will be located north of Mellowes Road and near North Road, where the footbridge ramp is set for demolition, as detailed in the Architectural Drawings in RO Drawing Pack. The third substation will be situated within the Park & Ride facility.

Retaining Walls

There are a number of minor low level retaining walls proposed within this area of the proposed Scheme at the following locations:

- Four boundary / retaining wall sections along the west side of St Margaret's Road between McKee Avenue junction and the Luas terminus.
- East side of McKee Avenue at the junction with St Margaret's Road.

5.7.4.6 Landscape and Public Realm

The first section of Area 33 is through Mellowes Park where it is proposed to provide grass track to limit the visual and physical impact on the parkland public open space. A SuDS-based approach has been applied to drainage with a view to creating a more sustainable low maintenance scheme.

The LRT's insertion along the southern side of St Margaret's Road creates an opportunity to regenerate the entire length of the road into a tree - lined urban boulevard with segregated cycle lanes and footpaths. The new boulevard will provide a strong urban and landscape visual identity as a green spine for future urban regeneration along the road.

5.7.4.7 Utilities & Diversions

Existing underground utilities will be required to be diverted due to the proposed Scheme. The following utilities have all been identified as requiring works in Area 33:

- Uisce Éireann (Irish Water): asset owners for potable water, foul drainage and combined drainage;
- Local authorities - DCC and FCC:
  - Asset owners of: Public Lighting, Traffic, Local CCTV Fibre, and surface drainage.
- ESBN: High voltage and Medium/Low voltage overhead and undergrounded network;
- Gas Networks Ireland: High pressure and low-pressure mains; and
- Various communications networks

Information regarding location-specific utility clashes and the required diversions are covered in detail in Chapter 17 (Material Assets: Infrastructure and Utilities) of this EIAR.

5.7.4.8 Land Acquisition and Use

Temporary land acquisition is required within this area at various locations to facilitate the reconstruction of boundary walls and reinstatement of gardens and driveways and for the construction of the two Luas Stops. There will also be a requirement for temporary lands for a construction compound to be located just north of the Charlestown Stop.

Permanent land acquisition is required within this area at various locations to facilitate the alignment, Stops and modified road layouts to accommodate cycle lanes, footpaths and landscaping.

The P&R facility will require both temporary and permanent land acquisition.

Permanent and temporary land acquisition will be required for the rear access road to the premises on St Margaret's Road. It is anticipated that this land will form part of the new Jamestown Industrial development and its position has been designed to be consistent with the development plans.

Land requirements are detailed in Chapter 12 (Land Take) of this EIAR and are illustrated on the Property Drawings provided in the RO Drawing Pack. The impacts of this temporary and permanent land acquisition on residential and landscape amenity in this area are addressed in Chapter 8 (Population), Chapter 12 (Land Take) and Chapter 21 (Landscape and Visual Amenity) of this EIAR.

5.8 Key Infrastructure Elements

5.8.1 Track Alignment

The design of the horizontal and vertical track alignment is governed by the following key constraints:

- Broombridge Stop – tie into existing tracks;
- Iarnród Éireann and Royal Canal Structure – achieve clearance requirements;
- Lagan Road – achieve at-grade crossing where descending from the Iarnród Éireann / Royal Canal overpass;
- Tolka Valley Structure;
- Tolka Valley Road – achieve at-grade crossing;
- Wellmount Road and Mellowes Road – achieve at-grade crossing;
- Finglas Village Stop – sharp reverse curves due to Luas Stop orientation;
- North Road / Finglas Road (R135) – achieve at-grade crossing;
- Charlestown Terminus – orientation.

The main track alignment and track system details are discussed in the following sections.

5.8.1.1 Track Alignment Details

New Structure over Iarnród Éireann and Royal Canal

Two conflicting constraints lead to steeper gradients south and north of the new structure, namely the required headroom above the Iarnród Éireann tracks and the requirement to cross Lagan Road at grade. As a result, the proposed gradient is 7.5%, which is steeper than the limiting maximum gradient of 6%. The gradient has been assessed and approved.

Tolka Valley Park Bridge

The vertical alignment on Tolka Valley Park Bridge has a 0.5% gradient, which is below the desirable minimum gradient (1%) but equal to the absolute minimum gradient. This is due to the constraints on the structure. Special techniques to ensure good drainage of the structure deck will be incorporated into the design.

Finglas Village Stop

The Finglas Village Stop is located between two 25m curves of opposite direction. The general Finglas alignment runs south-north whereas the Finglas Village Stop is orientated in an east-west direction. Given the shorth length of the straight alignment to include the Luas Stop, the transition curve lengths were reduced. With this alignment, there is no scope to include enough tangent length between the end of the transition and the beginning of the platform. Therefore, the end-throw of the LRT platforms will be trimmed at both ends.

Charlestown Terminus

In order to accommodate constraints from an urban design viewpoint, the Charlestown Terminus platform starts just at the end of the preceding transition curve. The end-throw of the LRV will be trimmed at the south end of the platforms. The preceding curve has a radius of 150m, and the required trim should not be too long.

Entire Route

The design criteria state that vertical curves should not overlap horizontal transition curves, however due to several constraints this was not always possible. It is possible for vertical curves to overlap transition curves as long as the track system is concrete, the twist values are controlled and remain below the maximum value.

5.8.2 Track Systems

The proposed Scheme has extensive sections off-road running through either parks, or green strips of land or grass verges where it is proposed to adopt grass / green track. Grass will be the landscape treatment chosen in most green track areas. In some locations, such as on structures where the growing medium depths can be an issue, a more varied vegetation mix will be used. This can also provide opportunities for increased value for biodiversity.

Outside of grass areas, embedded trackform options are proposed for areas shared with traffic. The two new bridges will also have embedded trackform. A ballasted trackform is proposed for three of the four tracks in the depot area. The fourth track will be an embedded track lane to facilitate vehicular access.

There is no universally recognised norm nor international standards for LRT trackform construction. As such, there are various existing track systems in existence. Moreover, local adaptations to standard systems have been carried out in most LRT networks.

A number of options for each of the above track forms was assessed during the development of the preliminary design. The preferred option / supplier for the purposes of preliminary design is detailed below. Further analysis will be undertaken during detailed design and will consider such things as advancements in technology, sustainability and other suppliers. The assessments were carried out based on railway infrastructure used on existing Luas and European systems. The final details will be subject to further design development, market consultation and procurement.

5.8.2.1 Embedded Track

The combination of the *Rheda City* bi-block sleepers and grooved rail 59R2 with the continuous RCS encapsulation profile from *Datwyler*, is one example which achieves both the maintainability requirement and high rail-to-earth resistance. Mastic asphalt shoulder should be installed on both sides of the rail to limit crack at the interface between road surface finish and the rail. The proposed design principle is shown in Figure 5-7.

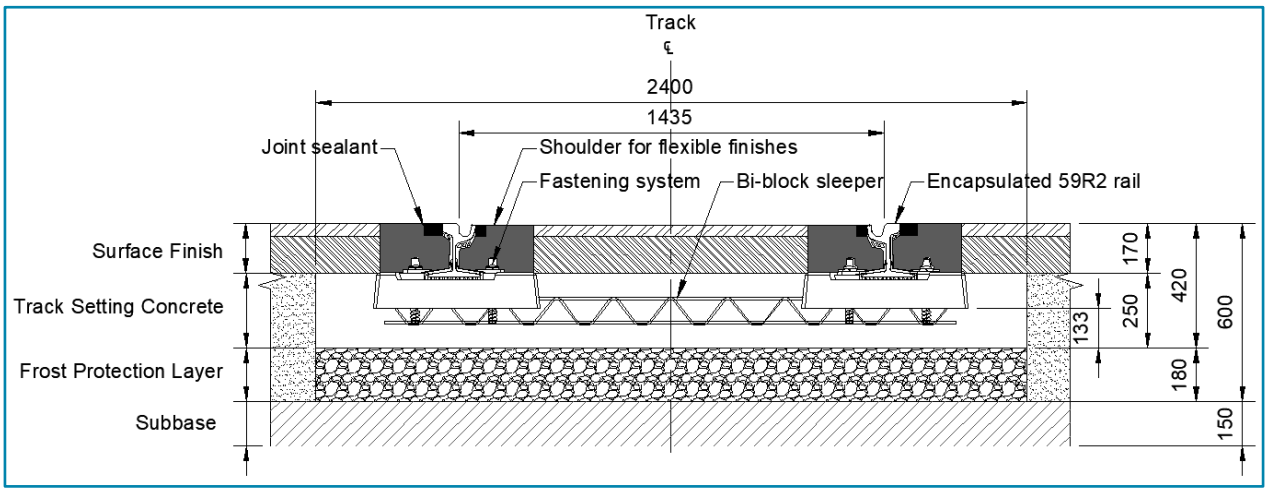

Figure 5-7: Embedded Track (Source: Barry-Egis JV)

5.8.2.2 Grass Track

The *Edilon Sedra* ERS is one example which offers a very high electrical insulation of the rail all the while providing permanent support to any rail profile. Before pouring the encapsulation polymer (*Corkelast* or equivalent), a concrete channel needs to be provided for the rail. The rail is then temporarily maintained in its design position in a preformed concrete channel, in terms of line and level, by wedges and shims, respectively.

The liquid poured encapsulation flows around any shape and therefore it can be used with, for example, a flat-bottomed *Vignole* rail. The ERS cross-section is shown in Figure 5-8.

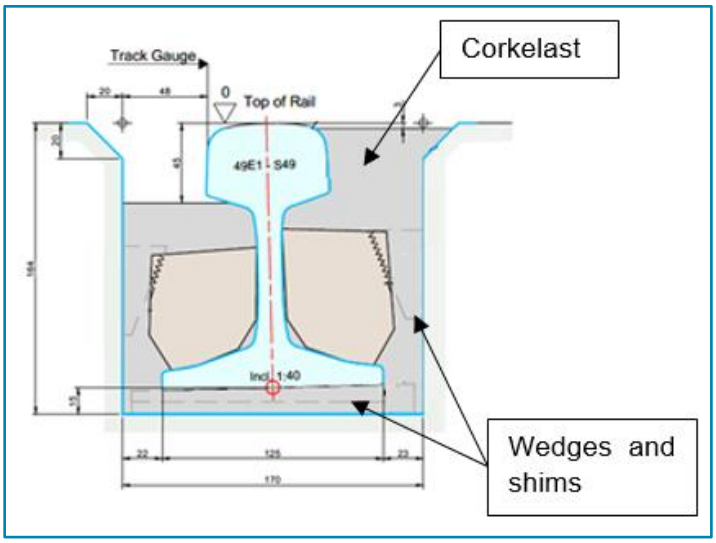

Figure 5-8: Embedded Rail System with *Vignole* Rail (Source: modified from *Edilon Sedra*)

An example of a cross-section using the proposed encapsulation is shown in Figure 5-9.

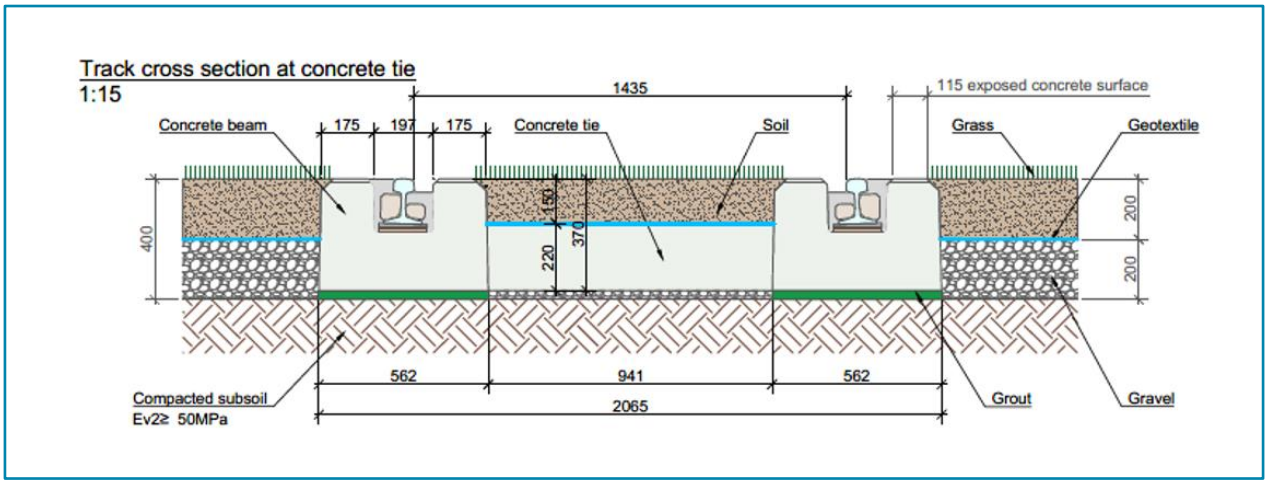

Figure 5-9: Ladder Track with *Edilon Sedra* ERS (Source: *Edilon Sedra*)

5.8.2.3 Trackform on Structures

This design is the combination of a longitudinal beam (plinth) installed on the bridge with a baseplate anchored directly to the beam. Instead of directly fixing the baseplate to the bridge deck, this additional beam allows for a better bridge and track interface in the sense that the plinth thickness compensates for the bridge installation tolerance and the base plate anchors do not interfere with the bridge design. Nevertheless, the concrete plinth will be dowelled into the bridge deck and the waterproofing interface will be managed carefully.

The plinth could be either cast-in-place or precast. Openings at regular intervals should be provided in the plinth in order to accommodate deck drainage and access for electrical system ducts.

The cross-section design principle is shown in Figure 5-10.

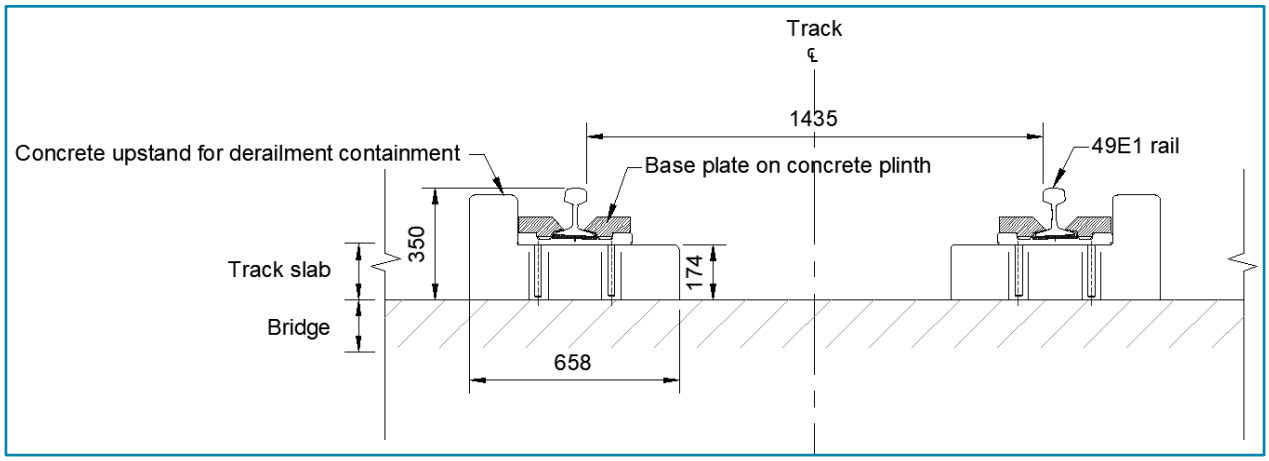

Figure 5-10: Plinth Track on Structure (Source: Barry-Egis JV)

5.8.2.4 Ballasted Trackform in Depot

At the Broombridge depot, three tracks of four will be ballasted since access by road vehicles is not required and this will help to reduce costs and concrete use.

The ballasted track will be similar to the trackform on the existing Luas in order to keep the same sleepers, fasteners and track structure design and therefore to ensure uniformity for maintenance.

The track currently proposed is *Vignole* rail 49E1 supported by monoblock sleepers and fastened with elastic rail clips. This rail type can be manufactured by several suppliers. The sleepers will be embedded in ballast and the ballast will be 200mm deep below sleepers.

The cross-section design principle is shown in Figure 5-11:

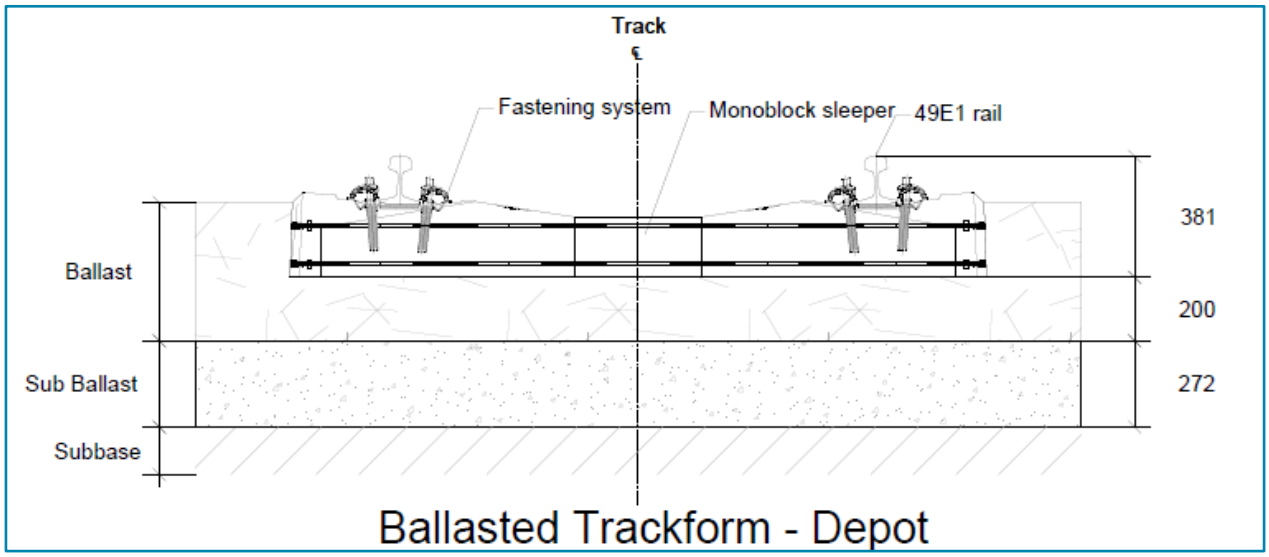

Figure 5-11: Depot Ballasted Track (Source Barry-Egis JV)

5.8.3 Power and Systems

Power and systems include the following sub-systems:

- Traction Power Supply;
- EMC and Stray Current;
- Overhead Contact Systems (OCS);
- Signalling Systems; and
- Comms and Control Systems (inc. Radio Systems).

5.8.3.1 Traction Power Supply

The proposed Scheme is supplied with energy via substations directly connected to the ESBN 10.5kV network, and to local connection points from the low-power network.

All Power Supply equipment is managed at each substation by a Programmable Logic Controller (PLC), which provides the “intelligent” control / command interface between this equipment and the existing Red Cow Central Control Room (CCR) by means of the SCADA system.

High Voltage (HV) energy is distributed at the level of each substation, between:

- The power supply to the transformer-rectifier group, via one or more dedicated HV circuit breakers, and
- The supply of Low Voltage production equipment, via a specific transformer.

Two substations for traction power are required for the proposed Scheme. The first (Finglas Village Substation) is located just north of the Mellowes Road / Finglas Village Stop and the second (St Margaret’s Substation) close to the St Margaret’s Road Stop at the location of the existing pedestrian overbridge ramp. These substation locations are shown in Figure 5-12 and Figure 5-13 respectively.

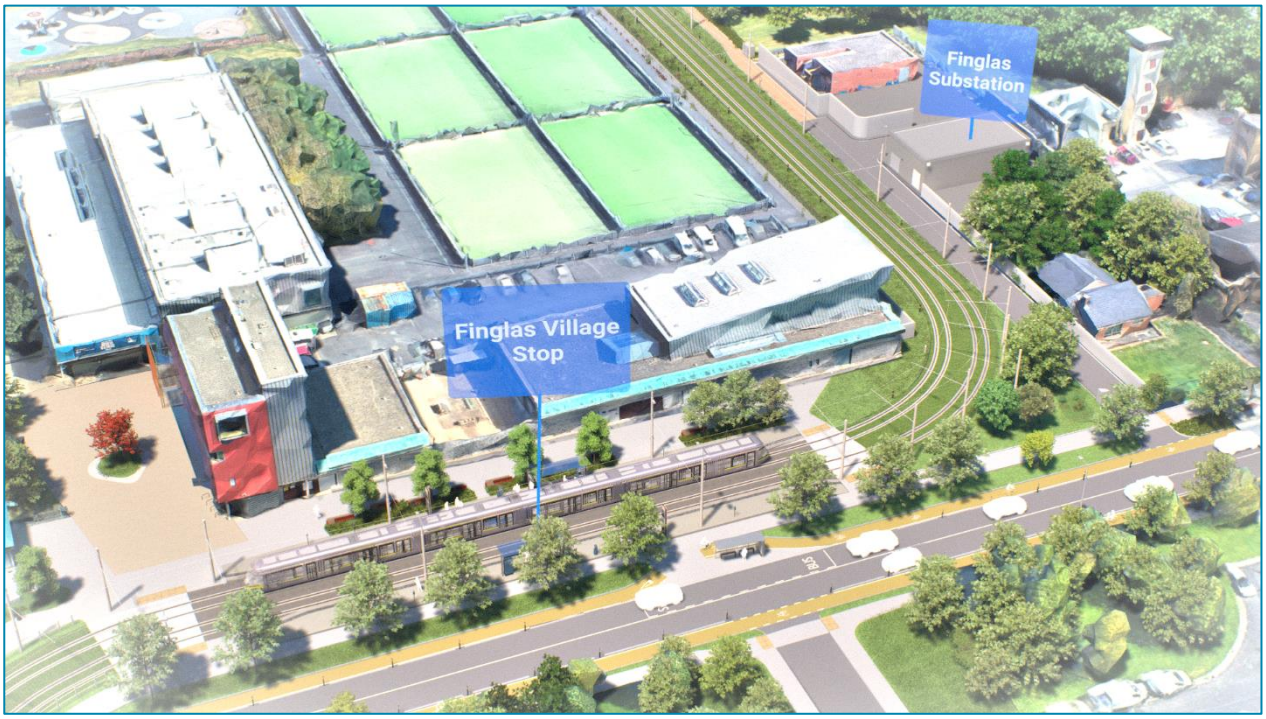

Figure 5-12: Finglas Village Substation

Figure 5-13: St Margaret's Substation

A third substation will be located inside the P&R facility, in order to provide electrical supply for the electric vehicle charging points which are to be installed as part of the proposed Scheme.

5.8.3.2 EMC and Stray Current

An Electromagnetic Compatibility (EMC) assessment has been undertaken as part of the development of the proposed Scheme. Further details of the EMC assessment are contained in Chapter 16 (Electromagnetic Compatibility and Interference) of this EIAR.

5.8.3.3 Overhead Contact System (OCS)

The proposed Scheme will be electrified. The method of electrification is by overhead line equipment at 750VDC.

To support the OCS, overhead line equipment (OLE), poles will be installed along the alignment, including at the stabling extension. The OCS support structure type will vary depending on the location and system requirements.

Vegetation clearance and management for the safe operation of the OCS equipment will ensure that vegetation is kept at least 1m from the rear of the OCS mast or 1.0m from any wire running between masts.

The OCS also generates electromagnetic fields. For that reason, EMC has been assessed for each adjacent neighbourhood to allow for safe design, including earthing and bonding. Further details of the EMC assessment are contained in Chapter 16 (Electromagnetic Compatibility and Interference) of this EIAR.

5.8.3.4 LRT Signalling

In the current urban setting, a LRT runs according to the principle of in-sight driving. Route safety depends on the vigilance of the LRVs drivers and the application of the operating instructions. A LRV driver must adapt the tram speed, taking into account line of sight, so that the driver can stop the LRV in front of any obstacle. In addition, the driver must maintain, in any circumstance, a minimum distance from the LRV which precedes it.

However, in certain areas, line of sight driving may be insufficient to avoid collisions, because of the various possible movements or other local factors that can affect safety. The signalling system aims to ensure the safety of LRV movements where there is restricted visibility.

The high level of safety associated with this system ensures operational efficiency by allowing an increase in speed and smooth route management in switches and crossing areas.

The signalling system can manage the entire Luas route to avoid the risk of collision or derailment, due to an unexpected trip movement during the passage of an LRT.

Three areas of signalling, in addition to road crossings, are identified for the proposed Scheme:

- New stabling area at the Broombridge depot;
- Finglas Village single Crossover; and
- Charlestown Terminus Scissors Crossover.

5.8.3.5 Radio Coverage

The Luas radio system is a system that accommodates both voice and data channels to ensure:

- Voice communication among operators, LRT drivers, maintenance and operational staff with hand portables; and
- Data communication with LRVs and for LRVs status messages - fundamentally for tracking the LRVs' position along the alignment.

Radio masts are currently installed in order to provide coverage on the existing Luas green and red lines. This infrastructure is composed of eight radio masts.

The current antenna configuration is not adequate to guarantee sufficient signal strength along the proposed Scheme. It is also not adequate to guarantee redundancy which would allow the system to function normally, or at least in degraded mode should an antenna fail, especially for hand portable communication.

Hence, three solutions were proposed:

- A second / modified antenna at the Broombridge site, facing the end of the proposed Scheme with the same antenna characteristics per the existing Broombridge antenna;
- A new antenna site, located near Charlestown Stop; and
- A combination of solutions above to guarantee the redundancy of the system.

The proposed solution is to provide a second antenna at the Broombridge site facing the end of the extension alignment with the same characteristics as already used in the existing Broombridge antenna and a new antenna located at the Park & Ride facility.

5.8.3.6 Communications and Control Systems

The sub-systems deployed for the operational command, control and supervision of the LRT will be:

- Cable Transmission Network;
- Closed Circuit TV;
- Public Address;
- Passenger Information Display;
- Telephone system;
- Emergency telephone system;
- Passenger Assistance Units;
- Supervisory Control and Data Acquisition (SCADA);
- Radio;
- Automatic Vehicle Localization System; and

- Automatic Fare Collection

The four new Stops will be equipped with these systems.

To house uninterruptible power systems, low voltage distribution boards and communication and control equipment, a stop cubicle will be installed at each Stop location.

The substations will include the stop technical equipment cabinets which will be integrated into the substation building where technically possible. This is possible for the substation at Finglas Village. However, the second substation is too far from St Margaret's Stop to allow co-location.

5.8.4 Roads and NMU Facilities

Table 5-10 to Table 5-22 below set out the main road and non-motorised user (NMU) criteria / facilities being provided as part of the proposed Scheme. These tables provide the approximate geometric information used in the design and which are subject to detailed design.

Details of layouts and geometric information for the proposed roads are shown on the Landscaping Drawings provided in the RO Drawing Pack.

5.8.4.1 Broombridge Road

Table 5-10: Broombridge Road main road and NMU criteria / facilities

Design Speed	30-40kph design speed from south tie-in to Glen industrial Estate. Justification: existing extreme vertical geometry and existing poor visibility on existing Broombridge Road to the south of the scheme requires drivers to moderate their speed. 50kph design speed used from Glen industrial Estate onwards.
Length	315m
Horizontal Curvature	R = 512, 1000, 1000, 512, 180, 143m
Vertical Curvature	Crest K = 4.7, 4.7, 10 Sag K = 6.4, 4.1, 10, 6.5 ± % = 12.5, 10.74, 0.9, 1.9, 2.4, 5.5, 3.8, 0.7
Crossfall and Superelevation	Normal crossfall 2.5%
Road Geometry Compliance with DMURS	12.5% longitudinal gradient. Justification: Matches existing grade at the tie-in to the rail bridge. 10.74% longitudinal gradient. Justification: Required to provide adequate clearance for Colorman business premises access.
Typical Cross-Section	2m footpath (west side) 2.5m 2-way cycle track 1.05m landscaped strip 6.5m road 1.8m footpath (east side)
Notable Features of Road Design	Start of bus lane moved south to accommodate new Colorman premises access. Structural Soil proposed under footpath and cycle track for tree planting. Footpath effective width on west side of road locally reduced to 1.2m minimum at tree locations. Footpath on east side brought under bridge viaduct to permit the placement of a landscaped strip between path and road.
Cycle Track Design	Broombridge Road is a designated Secondary route in the NTA Greater Dublin Area cycling network plan. 2.5m width for west side 2-way cycle track at constrained location to the north. 3.25m width used to the south on steep gradient. 20m minimum horizontal radius and 40m desirable radius adopted. Fully segregated and off-road cycle track.

Junction 1	**Colorman business premises.** New access to be provided underneath the elevated track structure. Footpath on Broombridge Road continuous across access. 7m width on access to allow for large vehicle swept-paths. Gate to be located within Colorman site.
Junction 2	**Glen Industrial Estate.** Replacement of existing mini-roundabout with T-junction. Provision of new roundabout would result in excessive land take and excessive horizontal deflection of off-road cycle track away from the desire line. 6m road width. 6m junction corner radii to facilitate U-turns. Ramped crossing for paths with drivers required to reinforce priority for path users. No allowance in cross-section for possible future separate cycle track infrastructure for the industrial estate as the link is unlikely to qualify for NCM provision need based on traffic speed/volume criteria.
Junction 3	**Lagan Road**. Replacement of existing priority junction with a signalised junction incorporating a Luas crossing of Lagan Road. 6m junction corner radii. HGV access for Fashionflo business premises provided on the southeast corner. Right turning exit movement from this access to be prohibited due to swept-path conflicts and safety concerns. Main access for Fashionflo premises for general use proposed further east, away from the junction. Cycle track access to Lagan Road on west side of Broombridge Road incorporated into traffic signals. No pedestrian crossing on north arm due to close proximity to Ballyboggan Rd junction crossing and due to closed off nature of western boundary. No allowance in Lagan Road cross-section for possible future separate cycle track infrastructure as link is unlikely to qualify for NCM provision need based on traffic speed/volume criteria.
Junction 4	**Ballyboggan Road**. Replacement of existing priority junction with a signalised junction incorporating a Luas crossing of Ballyboggan Road. 6m junction corner radii. Segregated and protected 2-way cycle track retained through junction to link up with proposed cycle track in Tolka Valley Park and provided with dedicated traffic signal phase.

5.8.4.2 Ballyboggan Road

Table 5-11: Ballyboggan Road main road and NMU criteria / facilities

Design Speed	50kph
Length	65m
Horizontal Curvature	R = 1000, 200m
Vertical Curvature	Crest K = 6.5, 10 Sag K = 3.5 ± % = 0.9, 0.1, 0.6
Crossfall and Superelevation	Crossfall and superelevation designed to match existing road camber at the tie-in points. Road crossfall through the intersection with the Luas to match the proposed 0.5% longitudinal gradient of the track.
Road Geometry Compliance with DMURS	0.1% longitudinal gradient. Justification: to match intersecting Luas track alignment geometry. Sag K = 3.5. Justification: minimise regrading of existing road at the intersection with the Luas track. Slower speeds anticipated through the junction would minimise the impacts of reduced K Values.
Typical Cross Section	As per existing.
Notable Features of Road Design	Existing road layout retained generally as-is.
Cycle Track Design	Ballyboggan Road does not form part of the NTA Greater Dublin Area cycling network plan. Existing on-road cycle tracks will however be retained. Existing road width is 10.5m minimum which allows for possible future possible upgraded cycle track infrastructure with 2m width lanes.

5.8.4.3 Tolka Valley Road

Table 5-12: Tolka Valley Road main road and NMU criteria / facilities

Design Speed	50kph
Length	160m
Horizontal Curvature	R = 161m
Vertical Curvature	Crest K = 4.7 Sag K = 6.7, 6.4 ± % = 0.2, 0.6, 1.3, 0.0, 0.8, 0.8.
Crossfall and Superelevation	Crossfall designed to match existing at the tie-in points. Normal crossfall 2.5% though raised table. 0.052% camber through the intersection with the Luas to match the longitudinal gradient of the track.
Road Geometry Compliance with DMURS	0.2% longitudinal gradient. Justification: to match existing road gradient. 0.0% longitudinal gradient. Justification: to match intersecting Luas track vertical geometry.
Typical Cross-Section	2.0m footpaths 5.0m landscaped strips 2.0m cycle tracks 6.5m road
Notable Features of Road Design	Two existing 10m flat-top ramps replaced with one 110m long raised table. Alternative coloured surfacing proposed for raised table area. Existing parking bays along the south side of the road will be removed due to presence of traffic signals and objective to bring landscaping close to roadway. On-street parking outside of this area on Tolka Valley Road will still be available to the public.
Cycle Track Design	Tolka Valley Road is a designated Secondary route in the NTA Greater Dublin Area cycling network plan. Segregated and protected cycle tracks are proposed for Tolka Valley Road. Advance Stacking Locations will be provided to facilitate cyclists right-turning into the park areas. Less confident cyclists may choose to use the signalised crossing.

5.8.4.4 St Helena's Road

Table 5-13: St Helena's Road main road and NMU criteria / facilities

Design Speed	40-50kph
Length	220m
Horizontal Curvature	R = 90, 125, 100m
Vertical Curvature	Crest K = 2.3, 3.3, 25, 25 Sag K = 10, 2.3, 2.3 ± % = 1.5, 1.2, 1.5, 0.5, 0.6, 1.5, 0.5, 0.8, 1.7
Crossfall and Superelevation	Crossfall and superelevation designed to match existing at the tie-in points. Superelevated 2.5%. Superelevation reversed through the intersection with the Luas line to match the 0.8% longitudinal gradient of the track.
Road Geometry Compliance with DMURS	Crest K = 2.3 & 3.3. Sag K = 2.3. Justification: minimise regrading of existing road at the intersection with the Luas track. Slower speeds anticipated through the junction would minimise the impacts of reduced K Values.
Typical Cross-Section	1.6m footpath (existing) 2.3m landscaped strip 6.5m road 2.0m landscaped strip 2.0m footpath
Notable Features of Road Design	New raised tables proposed for new pedestrian crossing at Dunsink Road and for Farnham Drive junction, replacing two existing flat top ramps on St Helena's Road. Additional two sets of speed cushions proposed for the eastern approach to Farnham Drive junction to address an existing need to control speed. Visibility for drivers emerging from the Farnham Drive extension to be improved to achieve

	the minimum requirements for 60kph, by setting back the existing palisade fence on the corner of St Malachy's School. New bus stops proposed west of the proposed Luas Stop: layby provided for the westbound bus stop due to restricted visibility on bend for drivers overtaking buses. Existing westbound bus stop east of the junction is being retained for now. Existing access to the Tusla St Helena's Family Resource Centre and the St Helena's Childcare Centre at the proposed alignment road crossing to be removed and the roadway replaced with landscaping. All access to the resource and childcare facility will be from the Farnham Drive extension.
Cycle Track Design	The off-road cycle track proposed for the park to the south will terminate at St Helena's Road, further to consultation between TII and NTA. Cyclists can leave or join the road at a Toucan Crossing. No allowance in road cross-section for possible future cycle track infrastructure as this part of St Helena's Road does not form part of NTA Greater Dublin Area cycling network plan.

5.8.4.5 Farnham Drive

Table 5-14: Farnham Drive main road and NMU criteria / facilities

Design Speed	50kph
Length	210m
Horizontal Curvature	Straight
Vertical Curvature	Sag K = 20, 20, 200 + % = 0.5, 0.8, 0.6, 0.0, 0.7, 1.2, 1.3
Crossfall and Superelevation	Normal crossfall 2.5%
Road Geometry Compliance with DMURS	0.0% longitudinal gradient. Justification: Through raised table located at in the centre of a sag curve.
Typical Cross-Section	2.0m footpath 3.3m landscaped strip 6.0m road East side as per existing
Notable Features of Road Design	The existing 7.3m wide roadway is proposed to be reduced to 6.0m as part of a traffic calming proposal for the street. An extended raised table uncontrolled pedestrian crossing is proposed at the Erin's Isle GAA Club entrance, a new raised table uncontrolled pedestrian crossing is proposed midway along the road to coincide with access to the midpoint of the playing fields. There is an allowance for likely future inclusion of 2.0m wide cycle track whilst retaining a landscaped verge on the west side of Farnham Drive. As the road is proposed to be narrowed on the west side, full pavement reconstruction of the west side of the road would be required to ensure that the crown line and pavement joint will be at the centre of the road.
Cycle Track Design	No cycle tracks proposed as part of the Luas Finglas scheme, further to consultation between TII and NTA.

5.8.4.6 Farnham Drive Extension

Table 5-15: Farnham Drive Extension main road and NMU criteria / facilities

Design Speed	30kph
Length	100m
Horizontal Curvature	Straight with R10m curvature used at chicanes.
Vertical Curvature	As per existing.
Crossfall and Superelevation	Normal crossfall 2.5%

Road Geometry Compliance with DMURS	Compliance
Typical Cross-Section	2.0m footpath 5.0m road Variable width landscaped strips
Notable Features of Road Design	The existing gateway to the Tusla centre at the end of the Farnham Drive extension is to be widened to accommodate 2-way traffic and a footpath. The internal layout of the Tusla centre car park is to be reconfigured to reflect a modified access proposal: existing staff parking outside the childcare centre will be moved southwards to a new circulatory access system, to provide space for drop-offs and pick-ups beside the childcare centre. As Farnham Drive extension is adjacent to the pedestrian access to St Malachy's National School, design principles for Safe Routes to Schools are being applied to this street: future on-street parking will be prohibited using double yellow line markings; mounting of kerbs will be discouraged by use of pencil bollards, high kerbs and landscaping; chicanes are proposed to break up the straight vista of the street with landscaped verges which will help to calm traffic and a ramp is proposed at a new uncontrolled crossing at the school pedestrian gate. A small, paved stub is proposed at the end of Farnham Drive extension, and this combined with the gate to the Tusla centre being set into the site, will allow for 3-point turns for car drivers. Pedestrian connectivity is proposed between St Malachy's National School and the proposed parklands around the St Helena's Stop, through the Tusla car park.
Cycle Track Design	Farnham Drive extension does not form part of the NTA Greater Dublin Area cycling network plan and no cycle tracks are proposed as part of this scheme.

5.8.4.7 Wellmount Road

Table 5-16: Wellmount Road main road and NMU criteria / facilities

Design Speed	50kph
Length	66m
Horizontal Curvature	R = 125, 200m
Vertical Curvature	Crest K = 4.7 Sag K = 6.4 ± % = 1.6, 1.3, 1.9, 0.6, 0.3
Crossfall and Superelevation	Designed to match existing road camber at the tie in points. Normal crossfall approximately 2.5%. Superelevated through the intersection with the Luas to match the 1.66% longitudinal gradient of the track.
Road Geometry Compliance with DMURS	0.3% longitudinal gradient. Justification: to match existing gradient.
Typical Cross-Section	As per existing.
Notable Features of Road Design	Existing mini-roundabout at intersection with Patrickswell Place relocated as a priority T-Junction, 24m to the west. A raised table is proposed at the priority junction for traffic calming and to facilitate pedestrians crossing the road. The traffic signals for the combined pedestrian and Luas crossing will be a simple 3-phase arrangement.
Cycle Track Design	Wellmount Road is a designated Secondary route in the NTA Greater Dublin Area cycling network plan.

5.8.4.8 Patrickswell Place

Table 5-17: Patrickswell Place main road and NMU criteria / facilities

Design Speed	50kph
Length	210m
Horizontal Curvature	R = 100, 311, 500, 120, 42m
Vertical Curvature	Crest K = 8.2, 8.2, 8.2 Sag K = 9.2, 9.2, 8.2 ± % = 2.5, 2.2, 2.9, 1.9, 1.3, 1.6, 0.7, 1.5, 2.0, 1.7
Crossfall and Superelevation	Normal crossfall 2.5%
Road Geometry Compliance with DMURS	R = 42m. Justification: Radius on approach to junction required to improve approach geometry. Slow speeds are anticipated and full visibility is provided.
Typical Cross-Section	2.0m footpath 2.0m landscaped strip 2.0m protected cycle track 6.0m road 2.0m protected cycle track 0.9m verge between cycle track and alignment
Notable Features of Road Design	Raised uncontrolled pedestrian crossings are proposed for the 2 no. priority junctions and one access along the road. The footpath shall be continuous and remain level at the crossings to reinforce pedestrian priority.
Cycle Track Design	Patrickswell Place is a designated Secondary route in the NTA Greater Dublin Area cycling network plan. All proposed cycle tracks to be segregated and protected using kerbing.

5.8.4.9 Cappagh Road

Table 5-18: Cappagh Road main road and NMU criteria / facilities

Design Speed	50kph
Length	56m
Horizontal Curvature	R = 185, 215m
Vertical Curvature	Crest K = 4.7 Sag K = 6.4, 6.4 ± % 2.6, 0.8, 2.5, 0.1
Crossfall and Superelevation	Designed to match existing superelevation at the tie in points. Superelevated through the intersection with the Luas to match the 1.88% longitudinal gradient of the track.
Road Geometry Compliance with DMURS	0.1% longitudinal gradient. Justification: to match existing gradient.
Typical Cross-Section	As per existing.
Notable Features of Road Design	Tighter geometry proposed for relocated Patrickswell Place Junction, consistent with current best design practice and DMURS. Junction corner radii are 2m and 4m. A raised table has been provided at the entrance to Aylward Green, replacing the existing flat top ramp with is being removed.
Cycle Track Design	Cappagh Road is a Secondary Cycle Route in the NTA GDA Cycle Network Plan only on the west side of its T-junction with Patrickswell Place. As the nature of any such future cycle track provision on Cappagh Road is not known at this stage, the proposed Luas scheme ties into the current road layout without cycle tracks.

5.8.4.10 Mellowes Road

Table 5-19: Mellowes Road main road and NMU criteria / facilities

Design Speed	50kph
Length	235m
Horizontal Curvature	R = 3500m
Vertical Curvature	Crest K = 4.7, 4.7, 10, 10, 10 Sag K = 10, 6.4 ± % = 0.1, 0.8, 0.2, 0.8, 1.2, 1.7
Crossfall and Superelevation	Crossfall and superelevation designed to match existing road camber at the tie in points. Normal crossfall approximately 2.5%. Superelevated through the intersection with the Luas to match the 0.5% longitudinal gradient of the track.
Road Geometry Compliance with DMURS	0.1% longitudinal gradient. Justification: to match existing gradient. 0.2% longitudinal gradient. Justification: to match intersecting Luas track.
Typical Cross-Section	2.0m footpaths Variable width landscaped strips 1.75m segregated and protected cycle tracks 0.3m space for cycle track protection 6.0m road
Notable Features of Road Design	The four minor road junctions / accesses are designed to clearly indicate pedestrian priority by use of ramped crossings and continuation of the footpath paving on a level grade across the junctions and accesses. As the road centreline is proposed to be offset approximately 0.42m to the south side, the crown would no longer be in the centre of the road if it were to match existing, so full pavement reconstruction may be required. Existing Garda Siochana vehicular access off Mellowes Road to the staff car park and to the rear of the Garda station will be removed and a new vehicular access will be provided off Mellowes Road further to the east for the existing car park and a new access will be provided off Finglaswood Road for a reconfigurred internal layout of the rear area of the Garda station.
Cycle Track Design	Mellowes Road is a designated Primary Orbital route in the NTA Greater Dublin Area cycling network plan. 1.75m on-road cycle tracks proposed are as per a previous DCC upgrade proposal for the street, however additional space in the cross-section has been provided for cycle track protection kerbing. Bollards are proposed to be used in conjunction with this kerbing to highlight the kerb as a potential trip hazard and to reinforce the protection of the cycle track space. The bollards are proposed to be placed at an interval of up to 10m with a reduced spacing proposed at the Luas Stop.

5.8.4.11 Finglas Road / North Road

Table 5-20: Finglas Road / North Road main road and NMU criteria / facilities

Design Speed	50kph
Length	214m
Horizontal Curvature	R = 160, 200, 285, 106, 200m
Vertical Curvature	Crest K = 8.2, 8.2, 8.2, 8.2 Sag K = 6.4 ± % = 1.7, 0.6, 2.2, 1.3, 0.8, 0.5
Crossfall and Superelevation	Crossfall and superelevation designed to match existing road camber at the tie in points. Normal crossfall approximately 2.5%. Superelevated through the intersection with the Luas to match the 1.0% longitudinal gradient of the track.

Road Geometry Compliance with DMURS	Compliance.
Typical Cross-Section	Proposed lane widths are typically 3.75m to reflect existing lane widths.
Notable Features of Road Design	The replacement of the existing roundabout to traffic signals at the Finglas Road / North Road / Casement Road / St. Margaret's Road junction was a key decision made by TII to effectively incorporate the Luas crossing at the junction and to make the junction suitable for vulnerable road users. The signalised junction has been designed to be as compact as possible, consistent with current best design practice and DMURS. Junction corner radii are of the order of 4.5m – 6.0m, which aims to strike the right balance between functionality for motor traffic and provision of protected corners for cyclists. The layout of the junction has been tailored by the requirements of HGV swept-paths. The junction has not been designed to allow sufficient space for southbound articulated heavy goods vehicles to perform a U-turn without using inside lane space. This movement can be performed by smaller vehicles. Staggered pedestrian crossings of Finglas Road and North Road are proposed to reflect pedestrian desire lines (due to skewed nature of junction) and to reduce delay for pedestrians. Lane provision is based on an initial assessment of traffic count data, subsequently validated by traffic modelling, and on possible traffic signalling staging. It is an objective to retain the existing stone wall on the southeast corner as a noise/visual barrier to the residential street there. Bus stops will be provided on the south arm of the junction as per BusConnects proposal. A median barrier will be required to deter pedestrians from crossing Finglas Road at the bus stops. Access to the proposed P&R car park, discussed in 5.8.6, is provided on Finglas Road, approximately 160m north of the St. Margaret's Road Junction. Access will be provided via a signalised junction and will incorporate a full pedestrian phase for crossing Finglas Road. Right turning movements for vehicles approaching from the south will not be permitted.
Cycle Track Design	Cycle track provision is based on the requirements of the NTA Greater Dublin Area cycling network plan. Proposed cycle facilities include 2.0m wide cycle tracks, with full segregation and cycle track protection.

5.8.4.12 St. Margaret's Road

Table 5-21: St Margaret's Road main road and NMU criteria / facilities

Design Speed	50kph
Length	750m
Horizontal Curvature	R = 120, 180, 162, 110, 300, 1000, 195, 60m
Vertical Curvature	Crest K = 8.2, 8.2, 8.2, 8.2, 8.2, 4.7 Sag K = 6.4, 9.2, 9.2, 9.2, 9.2, 8.2, 6.4, 2.3 + % = 1.6, 1.1, 0.6, 0.5, 1.7, 2.4, 0.5, 0.7, 0.5, 0.8, 0.5, 0.7, 0.6, 0.9, 0.4, 0.3, 1.9
Crossfall and Superelevation	2.5% normal crossfall and 2.5% superelevation
Road Geometry Compliance with DMURS	R = 60m. Justification: Small curve shown over 8m on the median island. Lane is wide enough to accommodate straight through movement and the curve will not impact driver manoeuvre. Sag K = 2.3. Justification: minimise regrading of existing road at the intersection with Charlestown place. Slower speeds anticipated through the junction would minimise the impacts of reduced K Value. + % =0.4, 0.3. Justification: minimise regrading of existing road at the intersection with Charlestown place. Optimising grades for effective drainage to be considered at the next phase.
Typical Cross-Section	2.0m footpaths 2.0m segregated and protected cycle tracks 1.1m landscaped strips 6.5m road

Notable Features of Road Design	There is no direct access proposed across the alignment between McKee Ave junction and Jamestown Business Park Junction. No practical or safe solutions permit this and allowing access would have a negative impact on the operation of the Luas. A new access road to the rear of the commercial properties on the east side of the alignment, is proposed to provide alternative access. A new northbound bus stop is proposed outside Aldi, as requested by the NTA. A Toucan crossing is proposed at the Aldi Centre to facilitate a likely future desire between the Aldi Centre and the redeveloped Jamestown lands. It will also permit safe cyclist movement between the southbound cycle track and the Aldi Centre. Existing on-street parking bays at nos. 27 / 33 St. Margaret's Road will be retained and reconfigured into the new street layout. The cycle track here will be placed between footpath and parking bay with a 900mm paved buffer to allow for car doors not to open into the cycle track, in accordance with current best practice. A Toucan crossing is proposed south of McKelvey Avenue priority junction and is integrated into a proposed raised table for the junction. The Toucan crossing is required to cater for a pedestrian desire line between the southbound bus stop at this location with the residential area on the west side of St. Margaret's Road. The crossing also facilitates pedestrian access to and from the ESBN site and is future-proofing for the future development of lands in Jamestown. The Toucan crossing can be used by cyclists travelling between the southbound cycle track and the residential area on the west side of St. Margaret's Road. A Toucan crossing is proposed at the south end of the Charlestown Terminus that will line up with the proposed residential development to the west. The Toucan crossing will also facilitate cycle access to the proposed bicycle parking facility on the east side of the terminus platform. An assessment was carried out to check if zebra crossings could be used on St. Margaret's Road: the existing AM peak 2-way traffic flow of 1061vph exceeds DN-GEO-03084 requirement of a limit of 500vph without a refuge, so zebra crossings are not recommended. The NTA's minimum length requirement for bus stops of 24m to permit two buses per stop has generally been adopted where feasible: • Northbound at Lidl, 24m • Southbound at Atlas Autoservice, 21m • Northbound at Aldi, 24m • Southbound at McKelvey Avenue, 26m • Northbound at McKelvey Avenue, 18m • Northbound at Charlestown, 26m • Southbound at Charlestown, 26m As the existing St. Margaret's Road is traffic-calmed using ramps, the new street layout will require reinstatement of traffic calming measures especially considering the removal of direct access on the east side of the road and the resulting increased level of unhindered southbound traffic movement. To that end, a series of four flat-top ramps or speed tables are proposed, with heights of 75mm and lengths of 6m minimum to better cater for bus traffic. No ramps or speed tables are proposed at or near signalised junctions in accordance with standard good practice.
Cycle Track Design	2.0m cycle track width is retained for the majority of the link. In restricted locations, where a 0.3m segregation kerb is required, cycle lanes are locally reduced to 1.7m. There is an incorporation of a high degree of segregation and protection from road traffic that will play a significant part in ensuring cycle tracks and their users have a reduced level of risk. This is particularly important near Luas Stops where unprotected cycle tracks otherwise could likely not be respected by drivers. Cycle tracks will have priority at accesses. All junctions have been designed as protected junctions for cyclists, with separate bicycle traffic signal head aspects being provided. All right turns will have separate bicycle signals in lieu of on-road Advance Stacking Locations.
Junction 1	**McKee Avenue.** The existing roundabout junction conflicts with the requirements of the Luas alignment and operation and is inconsistent with the future requirement to facilitate vulnerable road users. A signalised junction layout design was developed from an initial DCC upgrade proposal as part of the upgrade of McKee Ave to include cycle tracks. 2-lane traffic provision on both approaches on St Margaret's Rd will allow straight-through traffic to proceed with

	the LRT. Southbound bus stop located on north side of junction and not south side, to avoid having congested pedestrian/cyclist activity and interactions beside the Luas stop. Upgrade of McKee Ave extended southeast to incorporate proposed priority junction for access road proposal. A raised table has been included at this priority junction for traffic calming. Layout at Lidl entrance ties into the current car park layout and allows space for a proposed lift/stairwell for pedestrian access to the proposed P&R multi-story car park.
Junction 2	**McKelvey Road / Jamestown Business Park.** The existing uncontrolled operation of the Jamestown Business Park junction will be changed to a controlled traffic signalled junction due to the Luas alignment passing through here. The traffic signals will also effectively cater for the needs of vulnerable road users. No cycle tracks are proposed for McKelvey Road or Jamestown Business Park as the links are unlikely to qualify for NCM provision need based on traffic speed/volume criteria. Access to and from McKelvey Road at this junction will be removed. This will improve safety by removing staggered movements through the junction, while also increasing the overall junction capacity. Pedestrian and bicycle access would be retained however. A turning area will be provided at the end of McKelvey Road, and all vehicular access to and from St. Margaret's Road would be via McKelvey Avenue.
Junction 3	**McKelvey Avenue.** The existing uncontrolled junction will remain as uncontrolled. The whole junction will form a raised table with a controlled pedestrian / cycle crossing on McKelvey Avenue and a Toucan crossing of St. Margaret's Road located on the raised table to reinforce priority for vulnerable road users. No allowance is made in the cross-section of McKelvey Avenue for possible future separate cycle track infrastructure as the link is unlikely to qualify for NCM provision need based on traffic speed/volume criteria.
Junction 4	**ESBN.** The existing uncontrolled junction will remain as uncontrolled with a 6m dwell area between St Margaret's Road and the cycle track / alignment. This allows for vehicles to navigate crossing the cycle track / alignment and the uncontrolled junction in two movements. A traffic modelling assessment using Linsig was carried out to review the likely delays and queues associated with the combined road and Luas crossing. The junction was modelled based on the traffic data provided by ESBN (150 entering at AM and leaving at PM) and based on ATC data for St Margaret's Road.That assessment indicated that the proposed stop control junction can function satisfactorily and within capacity for a worst-case scenario, with an acceptable level of queuing predicted. Signalisation of the junction is not a viable option with three dwellings having direct access at the junction and any alternative access arrangement would involve relocation of the junction or access to the site from other roads.
Junction 5	**Charlestown.** The proposed signalised junction upgrade at Charlestown will involve a reduced capacity and provide for a more compact junction consistent with current best design practice and DMURS. A key change in this regard is the removal of all left-filter lanes (three in total). A preliminary assessment of the existing junction based on traffic data and video survey which was subsequently validated by traffic modelling indicated that there is currently excessive reserve capacity at the junction, especially when compared with the adjacent Charlestown Place / North Road Junction which has the same number of approach lanes (13) but carries 70% more traffic (32,883 AADT vs. 19,373 AADT, year 2016 counts). The existing dedicated left-turn lanes on the three arms with left-filter lanes, currently allow left turners to progress in relative free-flow, unhindered by straight-ahead queuing traffic. With the new junction layout, the dedicated left-turn lanes are not required due to the removal of left-filter lanes and due to the overall moderate level of traffic flow at the junction. Furthermore, a key objective in creating a more compact junction that is more VRU-friendly, is to rationalise the number of traffic lanes. Therefore, the existing double lane approach with lane drop / merge on exit, for both northbound and southbound on St. Margaret's Road have been replaced with single lane approaches and a no lane drop / merge arrangement. This has the added benefit of discouraging excessive speed through the junction and beyond. For the northern arm of the junction, the existing pavement in the median for the right-turn lane will be removed and landscaped. The increased median width resolves an existing issue

	of a narrow median refuge at the existing Pelican crossing. A total of 5 approach lanes and two exit lanes have been removed from the junction. Traffic modelling of the new junction layout proposal for the design year, indicated peak hour queuing for traffic within acceptable criteria. The other main change proposed to Charlestown junction is the introduction of protected cycle track infrastructure which influenced the junction corner geometry: 4m was used for the junction corner radii. The more compact arrangement required that no splitter islands could be placed to allow for the swept-path of HGVs. Pedestrian crossings have been kept as short as feasible by avoiding redundant road pavement space and profiling kerblines based on the swept-path of HGVs. It is proposed to upgrade the east arm (Melville Road) for 100m in order to provide cycle track connectivity to the existing cycle tracks to the east. The existing off-road cycle track left-turn "bypass" lane on the northwest corner shall be retained: its removal would result in cyclists using the footpath. Similarly, a new off-road cycle track left-turn "bypass" lane is proposed on the southwest corner as non-provision would likely result in cyclists using the footpath.

5.8.4.13 New Access Road off McKee Avenue for Jamestown Little Industrial Estate and the Manhattan Peanuts Premises

Table 5-22: New Access Road off McKee Avenue and NMU criteria / facilities

Design Speed	30kph
Length	345m
Horizontal Curvature	R = 120m
Vertical Curvature	Subject to detailed design
Crossfall and Superelevation	Normal Crossfall
Road Geometry Compliance with DMURS	Subject to detailed design
Typical Cross-Section	2m footpath 2m verge 6.5m road 2m verge 2m footpath
Notable Features of Road Design	Stubs provided at two locations to permit drivers to do a 3-point turn. Stub provided to allow for possible future extension into Jamestown Business Park. Access stub indicated for Manhattan Peanuts and Murdock Builders Merchants site, subject to agreement.
Cycle Track Design	No provision in cross-section for possible future separate cycle track infrastructure as link is unlikely to qualify for NCM provision need based on traffic speed/volume criteria.

5.8.4.14 Pedestrian Provision

Footpath Widths

As per DMURS, 1.8m is the desirable minimum width for a footpath for road sections based on the width required for two wheelchairs to pass each other. This width should be increased in areas catering for significant pedestrian volumes where space permits. '*Building for Everyone: A Universal Design Approach'* (NDA, 2020), defines acceptable minimum footpath widths at specific pinch points as being 1.2m wide over a two-metre length of path.

In line with the Road User Hierarchy designated within DMURS, at pinch points the width of the general traffic lane should be reduced first, then the width of the cycle lanes should be reduced before the width of the footpath is reduced.

Throughout the proposed Scheme, footpath widths of generally two metres or wider have been proposed, with the exception of a limited number of stretches where a width of 1.2m or greater is proposed due to the presence of localised space constraints (e.g. at three locations).

Pedestrian Crossings

DMURS recommends that designers provide pedestrian crossings that allow pedestrians to cross the street in a single, direct movement and that the crossing length be kept as short as possible, where feasible.

Refuge islands should be a minimum width of two metres. Larger refuge islands should be used in locations where the balance of place and movement is weighted towards vehicle movements, such as areas where the speed limit is 60kph or greater, in suburban areas or where there is an increased pedestrian safety risk due to particular traffic movements.

For the proposed Scheme, pedestrian crossings vary from 2.4m to 4m in width. Larger pedestrian crossing widths have been used in areas that are expected to accommodate a high number of pedestrians crossing or at locations where both pedestrians and cyclists share a crossing such as at a Toucan Crossing.

At signalised junctions, the footpath is to be ramped down to carriageway level to facilitate pedestrians who require an unobstructed crossing. At Pelican crossings, Toucan crossings and minor road junctions, flat top ramped crossings are provided to raise the road level up to footpath level and facilitate unimpeded crossing. Tactile paving is provided at the mouth of each pedestrian crossing and audio units will be provided on each traffic signal push button to assist mobility impaired users. A maximum length of 4m for the red blister tactile paving stem has been adopted. This length has been sometimes extended to the back of the footpath if the stem length is just over the 4m distance.

5.8.4.15 Junctions

The design and modelling of junctions is an iterative process to optimise the number of people (rather than vehicles) that can pass through each junction, with priority given to pedestrian, cyclists, Luas and bus movements over general vehicular traffic in accordance with DMURS.

The design for each junction was developed to meet the underlying objectives of the proposed Scheme.

Junctions have been designed to ensure a high level of comfort and priority for sustainable modes of travel e.g., walking, cycling and public transport, by prioritising the space and time allocated to these modes within the operation of a junction, and subsequently to accommodate the forecasted future year traffic volumes as safely and efficiently as possible within the remaining space and time. Thus, the design maximises the number of people moving through each junction and to prioritise these sustainable modes of transport.

The layout of proposed junctions is illustrated on the Landscaping Drawings provided in the RO Drawing Pack

5.8.4.16 Roads Interface with the Luas

Where roads and alignment meet, 5m length minimum deterrent paving is proposed followed by a wheel-stop that permits errant drivers to reverse out and off the track. The deterrent paving could consist of raised profile cobbles or a proprietary system. The form of the wheel-stop will comprise a 1.5m long feature with ramp down preceded by a vertical upstand of 170mm; and

Where the alignment crosses obliquely to the road and on shared surfaces, track inserts will be used to protect two-wheeled vehicle users.

5.8.4.17 Traffic Signalling

- Layout of all traffic signals is based on the requirements of the Traffic Signs Manual;
- The layout of signalised junctions with protected cycle tracks are based on other similar protected junctions constructed by DCC;

- Where feasible, radar detection is proposed for segregated cycle tracks integrated into traffic signals. Push buttons will be used as a second choice; and
- Initial design of signalised junctions was based on an overview assessment of existing traffic flow data and an appropriate level of lane provision provided based on a preliminary assessment and taking into account the principles of DMURS in providing junctions that are more compact, thereby offering a better and safer experience for vulnerable road users. Subsequent traffic modelling of key junctions confirmed the suitability of the proposed junction layouts and lane allocation.

5.8.4.18 NMU Facilities (Active Travel, Mobility, Accessibility & Permeability)

Core to the proposed Scheme is the delivery of infrastructure to facilitate multimodal "cycle - LRT trips", through the delivery of integrated Luas and safe cycling infrastructure, segregated from general traffic and pedestrians, wherever practicable. Physical segregation ensures that cyclists are protected from motorised traffic and can bypass vehicular congestion, thus improving cyclist safety and reliability of journey times. The design also offers physical separation between pedestrians and cyclists which has generally been achieved throughout the proposed Scheme except for a shared surface on the proposed Tolka Valley Park bridge. Physical segregation of traffic will be provided in the form of vertical segregation, (e.g. raised kerbs), horizontal segregation (e.g. verge), or both.

Where enhanced protection or visibility of a kerb-separator is required, flexible bollards will be placed along the kerb line at a spacing of no greater than 10m. It is proposed to bevel the kerb at 30-degrees to provide a forgiving kerb thereby allowing for smooth redirection of bicycle wheels on the cycle track. Motorists will be presented with a conventional kerb upstand on the roadside of the cycle track protection kerb; however, it is proposed to bevel this kerb at 45-degrees at high pedestrian activity locations to limit the potential trip-hazard.

There are no on-road cycle lanes proposed for the proposed Scheme, except for small lengths at tie-ins or at bus stops where there is insufficient space to take the cycle lane to the rear of the bus stop. Bike racks will generally be provided at Stops, where practicable and at key additional locations as illustrated in the Architectural and Landscaping Drawings provided in the RO Drawing Pack.

The 'preferred cross-section template' developed for the proposed Scheme includes protected cycle lanes, providing vertical segregation from the carriageway to the cycle lane and vertical segregation from the cycle lane to the footpath.

The principal source of guidance on the design of cycle facilities is the National Cycle Manual (NCM) (NTA, 2023). The Design Manual for Bicycle Traffic, 2016, *'CROW-Fietsberaad',* a Dutch national standard for cycle track design, was used for areas of design not covered by the National Cycle Manual. The Cycle Design Manual (NTA, 2023) (CDM) was published after completion of the Reference Design. Any updates to the cycle design to comply with the CDM will be incorporated into the detail design stage.

The desirable minimum width for a single-direction, with-flow, cycle lane is two metres. This arrangement allows for two-abreast cycling and is based on the NCM Width Calculator. This also allows for overtaking within the cycle lane. The minimum width is 1.5m, which is based on the NCM Width Calculator, and allows for single file cycling. No single-direction cycle lane is proposed with less than 1.7m width.

The desirable minimum width for a two-way cycle lane is 3.25m. In addition to this, a buffer of 0.5m should be provided between the two-way cycle lane and the carriageway. Using the NCM Width Calculator, reduction of these desirable minimum widths can be considered on a case-by-case basis, with due cognisance of the volume of cyclists anticipated to use the route as well as the level of service required.

The proposed Scheme is 3.9km long and includes 1.2km of segregated (off-road) two-way cycle lanes and 1.8km of segregated and protected one-way cycle lane on both sides of the road, compared with the existing non-provision of cycle lane throughout this area. Details of the proposed cycle provision throughout the extent of the proposed Scheme are provided in the following sections.

Cycle Provision

A segregated cycle lane is a lane dedicated to cycling which is physically separated from the adjacent traffic lane and / or bus lane horizontally and / or vertically, as shown in Figure 5-14.

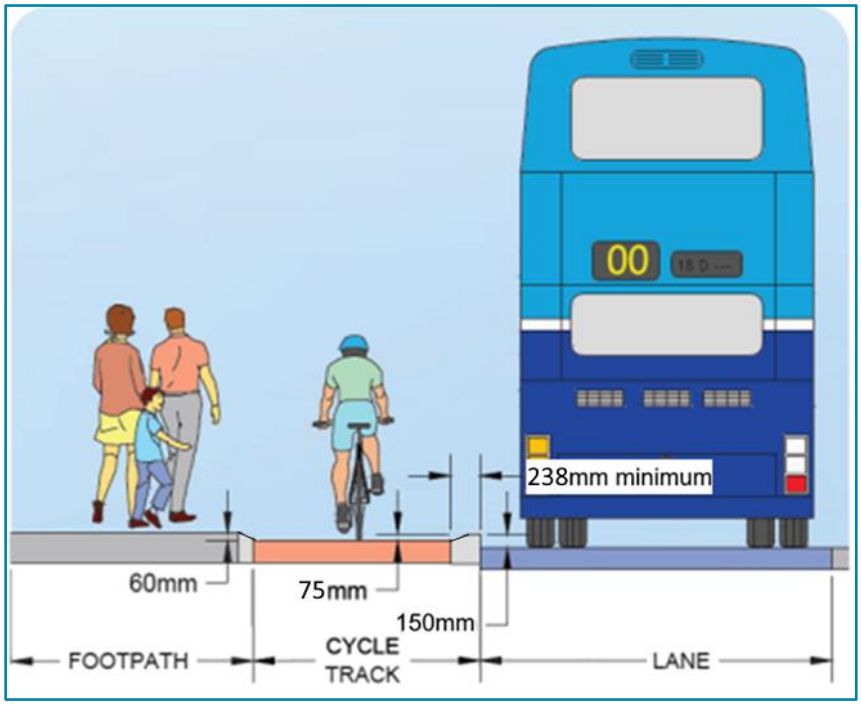

Figure 5-14: Fully Segregated Cycle Lane

- The provision of cycle lanes throughout the proposed Scheme is based on the GDA cycling strategy and consultation with the NTA. Therefore, some streets are provided with cycle lanes and some are not, depending on the NTA's intentions for provision of future cycling networks in the area;
- The layout of cycle lanes within parklands falls under the remit of the landscape architect's responsibility. Such facilities are geared more towards leisure and recreational cycling and will have a different "look and feel" to the more infrastructural role and nature of cycle lanes being provided on streetscapes;
- The principle of '*designing for all ages and abilities'* of cyclist has been incorporated. This is reflected in the provision of a high degree of segregation between cyclists and motorists and pedestrians, including the use of protected cycle lanes throughout. The protected nature of the cycle lane will be achieved by use of a high-kerb to traffic / low-kerb to cycle lane separator that will be landscaped if wide enough. This is a feature of St Margaret's Road where it is anticipated that the cycle lane pavement is likely to come under threat from motorists, particularly near the Stops. Similarly, for Mellowes Road at the Stop, closely-spaced bollards will be used in conjunction with the cycle lane protection kerb to ensure that proper use of the roadway is self-enforcing. There is also an emphasis on segregation between cyclists and pedestrians, to discourage pedestrians from walking on cycle lanes and the avoidance of use of shared surfaces where possible, as recommended in the National Cycle Manual;
- In the context of designing for all ages and abilities, the cyclists' need to retain momentum has been respected with smooth flowing horizontal geometry provided throughout with R=20, 30, 40m typically used for horizontal curvature. Tighter radii (R<10m) are used within signalised junctions as per specific constraints at each junction. Furthermore, the vertical profile of the cycle lane will be smooth with avoidance of any sudden changes in profile, consistent with best international practice. These measures are aimed at increasing the attractiveness of the cycle facility and limiting any "reasons not to use" the facility by more confident and faster moving cyclists;
- Restricted use of road markings for off-road cycle lanes is consistent with the proposed Scheme objective of creating and enhancing parkland settings and making the areas appear softer and less engineered, consistent with the landscape architect's ambitions. Thermoplastic road marking material can lead to loss of traction and potential falls in adverse weather conditions, so their use on cycle lanes have been restrained throughout; and

- Similarly, use of buff-coloured surfacing on cycle lanes throughout for aesthetics and use only of red surfacing at signalised junctions to provide a higher degree of warning to motorists when needing to cross the path of the cycle lane for left or right turns.

Accessibility for Mobility Impaired Users

The proposed Scheme must integrate into a townscape which meets the needs of all users, including less able users. This should promote an environment which encourages the use of the LRT network for all potential users. As a general principle, the proposals should not worsen the existing environment, and wherever possible it should seek to improve it.

Reference to best practice and relevant standards in relation to access for all including Luas user groups / organisations are as follows:

- Building For Everyone: A Universal Design Approach; National Disability Authority Centre for Excellence in Universal Design 2020, (NDA, 2020);
- Part M of the Irish Building Regulations Access and Use (for buildings only), (Department of Housing, Local Government and Heritage, 2022);
- DMURS, (GII, n.d.);
- Department of the Environment Transport and the Regions UK (DETR) Guidance on the Use of Tactile Paving Surfaces, (UK Dft, 2021);
- Twelve Quality Criteria for public urban spaces; Gehl Institute 2018;
- Healthy Streets; Transport for London 2017, (UK TfL, 2017);
- Travelling in a Woman's Shoes; Transport Infrastructure Ireland 2021, (TII, 2020); and
- Luas User Group, (TII, 2023).

TII supports the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), ratified by Ireland in 2018, the purpose of which is to promote, protect and ensure full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities.

TII continues to support key government programmes such as National Disability Inclusion Strategy (NDIS), a whole-of-government approach whose aim is to make transport progressively more integrated and accessible in both urban and rural areas.

TII also supports the Comprehensive Employment Strategy 2015 – 2024 (Government of Ireland, 2015), which seeks ensure that people with disabilities who wish to work are supported and enabled to do so.

Similarly, TII supports associated Department of Transport policy such as Transport Access for All, which places Universal Design at the heart of transport, as well as that of the recent Sustainable Mobility Policy.

In consideration of the above, TII continues to consult as widely as possible on matters of disability, to adhere to best practice in sustainable and accessible public transport and to seek innovative ways of progressing the goals set out in both international and national policy.

The Luas User Group advises TII in relation to the accessibility of its transport services and facilities with a view to improving public transport services for everybody in accordance with "Transport Access for All", the Department's Sectoral Plan under the Disability Act 2005 and the National Disability Strategy Implementation Plan.

As a forum, the Luas User Group (LUG) has proved effective in achieving consensus with marginalised groups, in hearing their needs and in applying these, where feasible, at the earliest stages of design. As a result, the Luas network is fully accessible to people with mobility, sight, hearing and cognitive impairment and to the wider public, including those with buggies, luggage or temporary mobility issues and to older people.

Members of the LUG comprise representatives from the National Council for the Blind of Ireland, Fighting Blindness, Irish Guide Dogs Association, Chime (formerly Deaf Hear), the Irish Wheelchair Association,

Enable Ireland and social inclusion groups such as National Adult Literacy Agency (NALA) and Irish Senior Citizens Parliament. Transdev, the Luas Operator, also participates at meetings with LUG.

A key element of the United Nations Convention on the Rights of Persons with Disabilities centres on a Social Model of disability, as opposed to a Medical Model, and as such, TII has broadened its consultation to include the Coalition of Disabled Persons Organisations (DPOs), a grouping of rights-focused organisations led, directed and governed by persons with disabilities.

TII also sit on the Department of Transport (formerly DTTAS) Accessibility Consultancy Committee (ACC), which reports directly to the Minister on matters relating to disability and public transport, including key issues arising from LUG meetings.

5.8.4.19 Bus Stops and Shelters

Bus stop bays of 21m are typically provided. Where space permits, this is increased to 24m or 26m to better accommodate a second bus. In constrained locations, an 18m length bus bay is proposed.

The space requirements for bus shelters were based on the NTA standard J C Decaux Full Width Roof Cantilever with half end panels or the J C Decaux Narrow Roof Cantilever with no half-end panels where space is restricted.

5.8.5 Integration

5.8.5.1 Integration with Existing and Proposed Public Transport Network

One of the objectives of the proposed Scheme is to enhance interchange between the various modes of public transport operating in the city and wider metropolitan area. The proposed Scheme facilitates improved existing and new interchange opportunities with other transport services including:

- DART Station at Broombridge;
- Existing Luas Green Line;
- Existing and proposed bus services at numerous locations along the route, including Routes 7, 8, 196, 262, E2, F1, F2, F3, N2 and N8;
- BusConnects from Finglas to Phibsborough; and
- Greater Dublin Area Cycle Network Plan (GDACNP).

5.8.5.2 Integration with Other Road Users

General traffic flow and local access will be maintained along the proposed Scheme. There will be impacts on vehicle capacity along the route due to the reallocation of road space to Luas priority and cycle lanes and the introduction of turning movement restrictions. There will be some locations where restricted or alternative vehicular access establishment will be unavoidable. The provision of Luas priority and segregated cycling facilities will result in more efficient movement of increased numbers of people overall along the route, without removing the option for general traffic to use the road system. It is recognised that there is dependence by some on cars or business vehicles. Through the provision of public transport priority and improved cycling and pedestrian facilities, all road users obtain better equitable choices and an associated more efficient use of the road space for people movement. The improvement provided for more reliable sustainable travel options is being balanced against the general traffic flow impacts.

5.8.5.3 Integration with Other Infrastructure Projects

Several infrastructure projects are planned within the vicinity of the proposed Scheme which will interface with the proposals. Refer to Chapter 24 (Cumulative Impacts) for further details on projects in the vicinity of the scheme. These include among others:

- Implementation of the NTA's Greater Dublin Area Cycle Network Plan;
- Infrastructure associated with the Jamestown area redevelopment;
- DART+ West; and
- Royal Canal Greenway Phase 4.

5.8.6 Park & Ride

The proposed P&R facility is located in the north-eastern corner of the existing North Road, Finglas Road, St Margaret's Road roundabout. The site currently contains operational businesses in the form of a DIY store (Discount DIY builder's providers) – refer to Figure 5-15. The adjoining site is a supermarket (Lidl) and Lidl Ireland GmbH are the registered owners of both sites.

Figure 5-15: Approximate P&R Site Extents

The Luas Team have engaged with the landowner (Lidl) and explored a number of options to develop this site, with a view to maximising the P&R benefits, while facilitating also the re-development of the lands by Lidl for their own future needs.

5.8.6.1 Proposed Location and Layout

The proposal is to provide a multi-storey car park on the site currently occupied by Discount DIY to the north of the Lidl site. The building is six storeys high including the ground floor. The roof is proposed to be a green or blue roof with PV panels. The eastern side of the ground floor is assigned to Lidl. The current proposed ground floor area is approximately 3,500m^2 and the gross floor area is approximately 19,250m^2.

Approximately 350 car parking spaces will be provided. The facility is designed to facilitate 100% EV parking, with approximately 20% of EV spaces provided from opening year. There will be pedestrian access to the North Road.

Figure 5-16 below shows the current proposals for the ground floor layout of the P&R, along with the existing Lidl supermarket location.

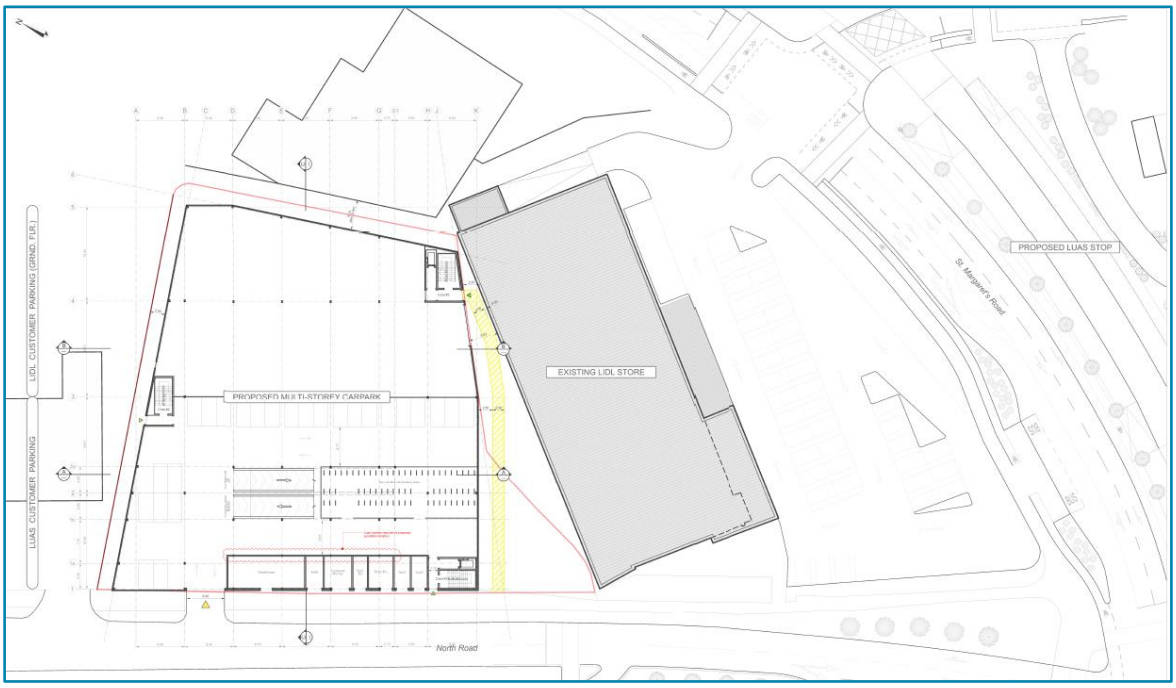

Figure 5-16: Proposed P&R Ground Floor Layout with existing Lidl building location

Lidl have proposals to re-develop their site. Figure 5-17 below shows the current proposals for the ground floor layout of the P&R with the proposed future re-developed Lidl site, with approximately 40 parking spaces reserved for Lidl.

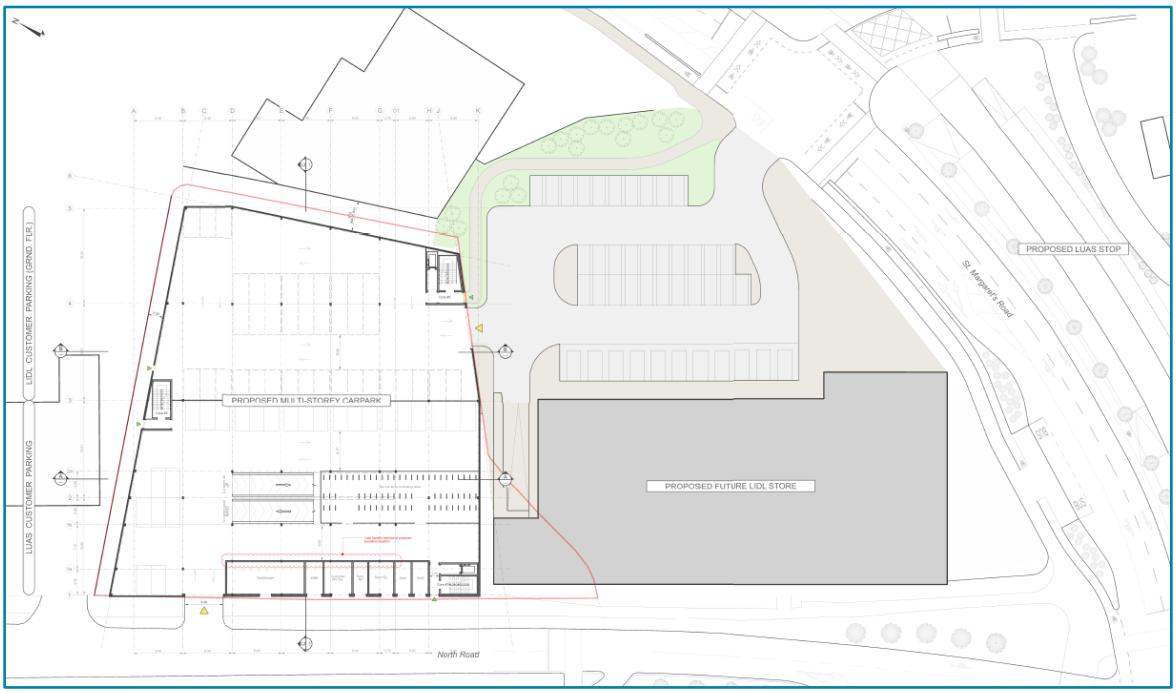

Figure 5-17: Proposed P&R ground floor layout with future proposed Lidl building location

Figure 5-18 below details a typical section through the multi-storey car park.

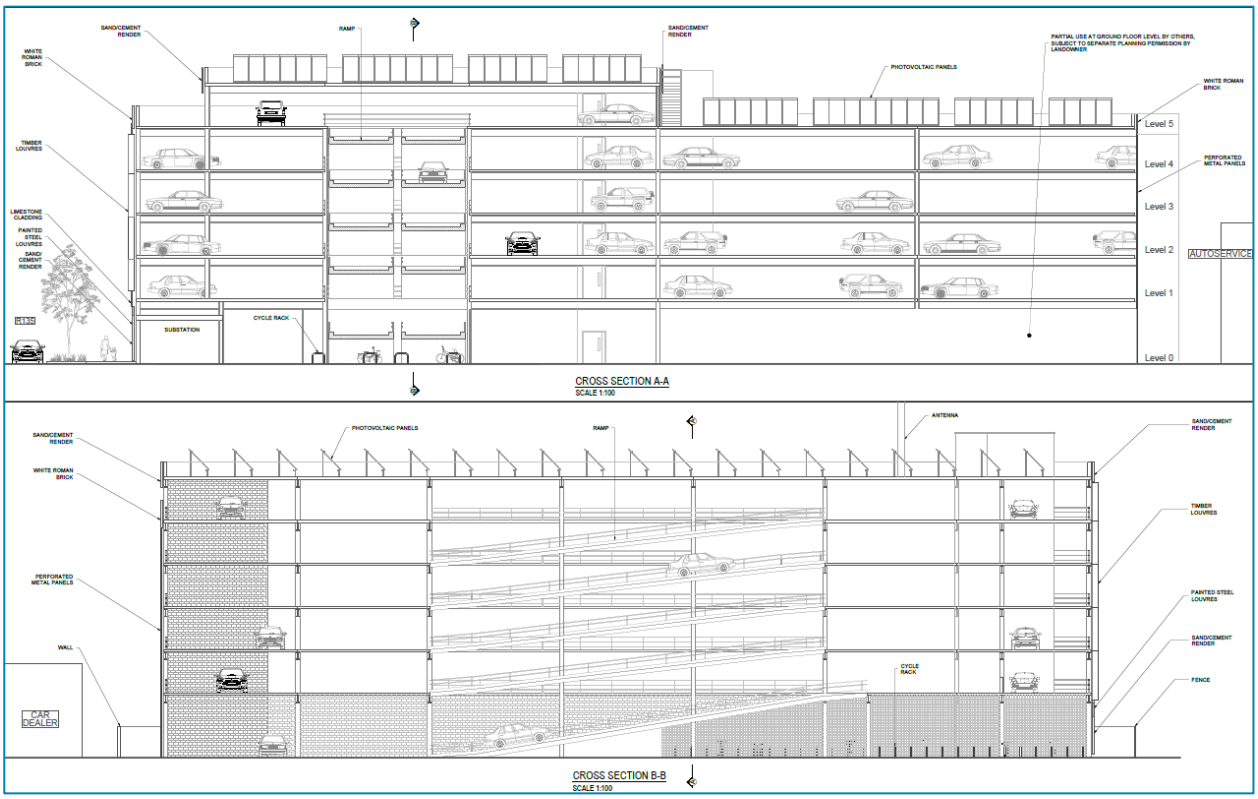

Figure 5-18: Typical Cross-section through the Multi-Storey Car Park

5.8.6.2 Park & Ride Access

A new vehicular access will be provided from North Road into the proposed P&R facility as indicated in Figure 5-19 below.

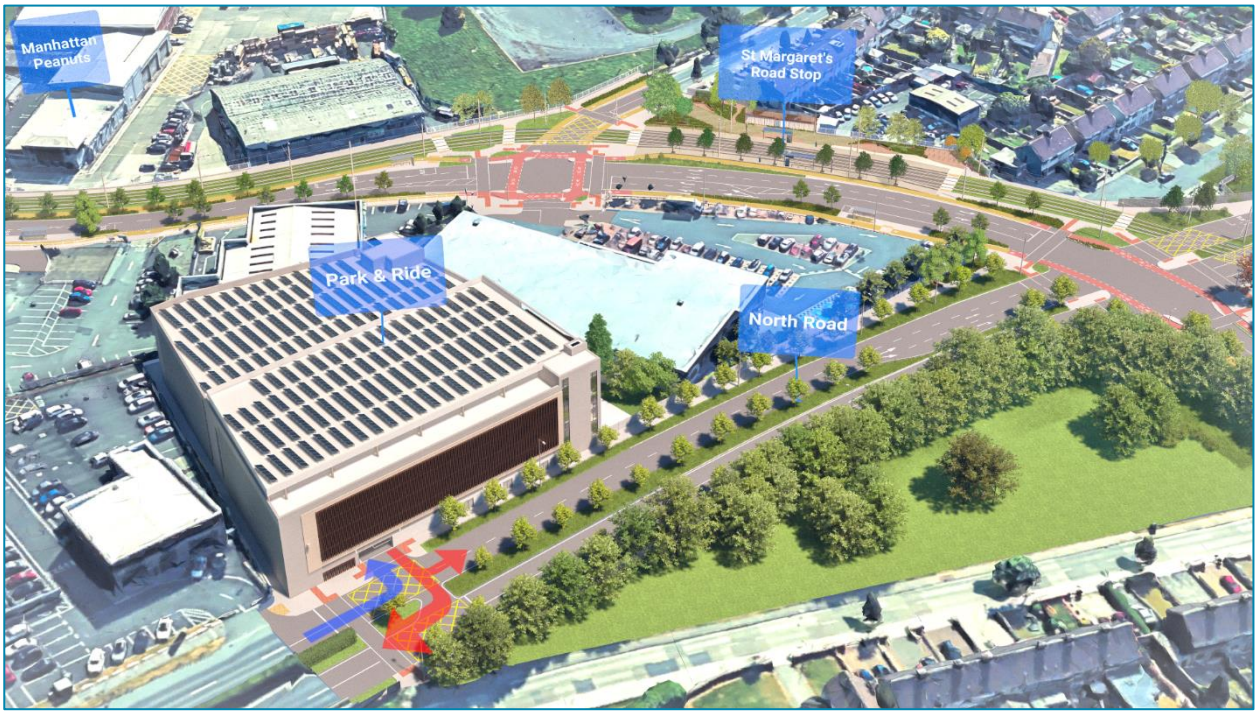

Figure 5-19: Access / Egress Arrangements via North Road

This new access for the P&R has been proposed from North Road for the following reasons:

- Avoids mixing P&R and Lidl retail traffic, which will be segregated and with Lidl access / egress via the existing entrance from St Margaret's Road;
- Provides the most direct access to the P&R facility from the M50, via a left turn from the N2;
- A new signalised junction provides ease of egress from the P&R facility back to the M50, via a right turn; and
- Avoids sending this traffic onto the St Margaret's Road / Finglas Road / North Road junction.

5.8.7 Depot

5.8.7.1 Existing Depot

The existing depot is located close to the Broombridge Stop, along the Luas Green line. It is connected to the existing line by two switches and crossings (S&C) at both ends.

The depot will comprise technical buildings for maintenance, a washing area and stabling lines. There is also a substation for traction power and a radio antenna to be located within the curtilage of the existing depot building.

5.8.7.2 Proposed Depot stabling

The proposed extension of the depot stabling is located south of the existing stabling area on disused brownfield land. It was first proposed to create five new stabling lanes but due to constraints with land acquisition and a housing project being developed by DCC on the site, this has been reduced to four stabling lanes, allowing two LRVs to be parked on each lane. In order to connect the four new lines to the existing network, four new sets of S&C will be installed.

The stabling lane will be a minimum of 120m from the white line to the end of the buffer area to accommodate:

- 2 x 55m long LRVs;
- 2 x 2m between rolling stock and between rolling stock and buffer stop; and
- A 6m buffer area.

In addition, a footpath east of the buffer stop will have to be installed to permit circulation of the driver and depot staff.

The proposed Scheme will be ballasted track except for the southern line and the S&C which will be in embedded track. The southern line embedded track will allow for road vehicle and staff access.

Other infrastructure to be provided includes extended OCS, new lighting, PA and CCTV systems. The boundary will be protected by a new boundary fence line along the southern perimeter.

5.8.8 Earthworks

5.8.8.1 General

The proposed Scheme is sub-divided into four designated project areas as listed below:

- Area 30 – Broombridge Stabling Site;
- Area 31 – Broombridge Station to Tolka Valley Road;
- Area 32 – Tolka Valley Road to Mellowes Park; and
- Area 33 – Mellowes Park to St Margaret's Road.

For the purposes of earthworks design, the proposed Scheme is further sub-divided into a series of earthworks sections, with the dividing lines between sections being either a physical boundary, such as a road junction, or an engineering boundary, such as a proposed bridge. In total, there are eight designated earthwork sections listed below and they are illustrated in Figure 5-20.

- Area 30 – Broombridge Stabling Site;
- Area 31 Section 1 – Broombridge Station;
- Area 31 Section 2 – Broombridge Road;
- Area 31 Section 3 – Tolka Valley Park;
- Area 32 Section 1 – The Valley (St Helena's Road);
- Area 32 Section 2 – Erin's Isle to An Garda Síochána Finglas;
- Area 33 Section 1 – DCC Civic Centre and Mellowes Park; and
- Area 33 Section 2 – St Margaret's Road.

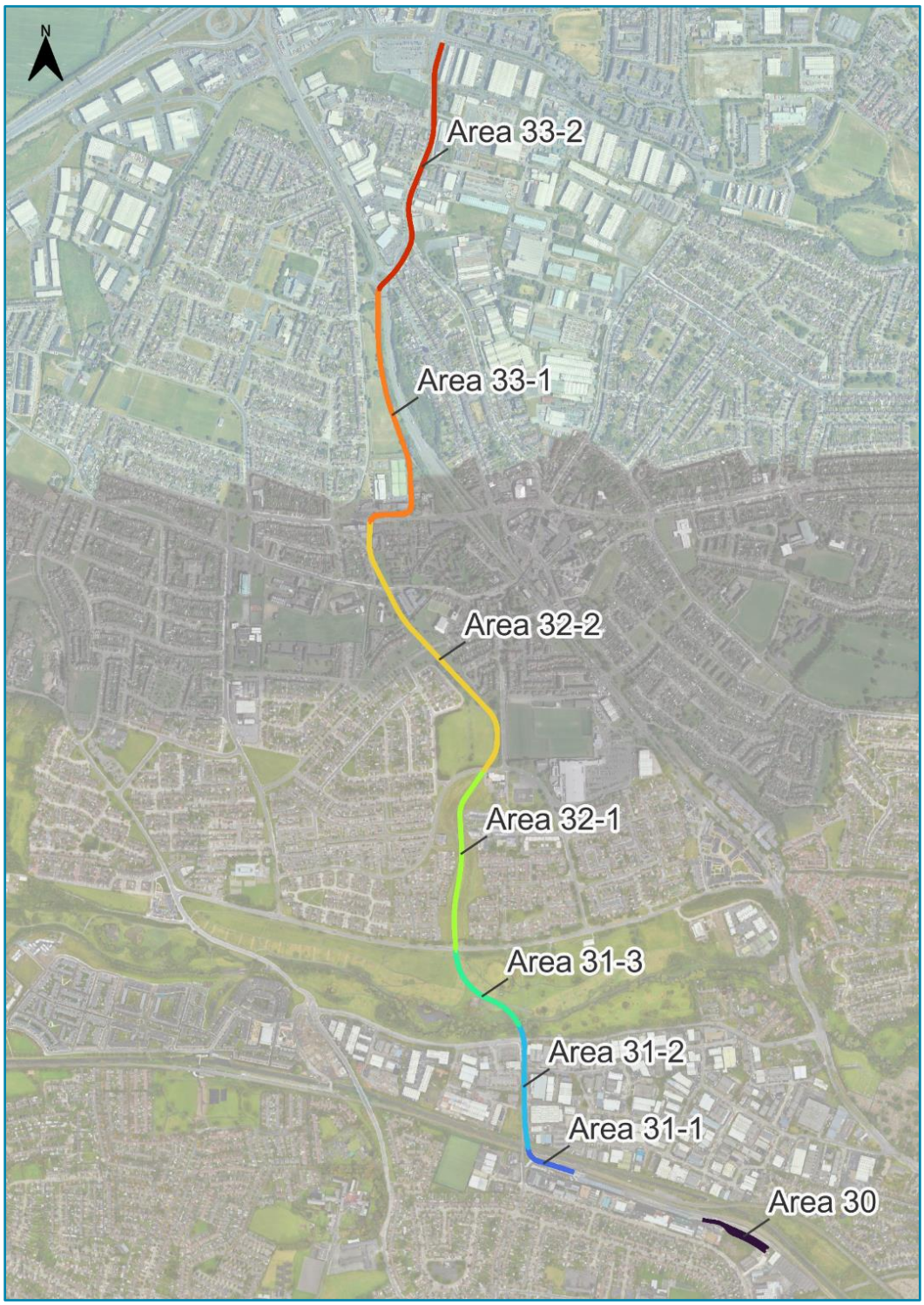

Figure 5-20: Earthwork Sections

5.8.8.2 Cut and Fill Depths

As the proposed vertical alignment is designed to remain at, or close to, existing grade, the anticipated earthworks volumes are relatively low. The average and maximum cut and fill heights across each of the earthwork sections are summarised in Table 5-23 below. The depths shown refer to the differential between existing ground surface and proposed design rail level. The proposed track form options will require temporary excavation to approximately 0.75m below rail level to facilitate the construction of subsurface track elements and the placement of a capping layer.

Table 5-23: Summary of Preliminary Earthwork

Earthworks Section	Average Cut Depth (m)	Maximum Cut Depth (m)	Average Fill Height (m)	Maximum Fill Height (m)
A30	-	-	0.4	2.0
A31.1	0.1	0.2	0.3	0.7
A31.2	0.4	1.0	0.5	1.3
A31.3	0.3	0.8	1.3	4.1
A32.1	0.3	1.0	0.2	0.4
A32.2	0.3	0.9	0.4	1.0
A33.1	0.2	0.9	0.1	0.4
A33.2	0.2	0.8	0.2	0.5

The proposed cut and fills are generally quite small (<1m) along the proposed Scheme. The more significant fill depths are confined to the approaches to new bridge structures or in the case of Area 30, the infilling of an existing localised surface depression.

5.8.8.3 Ground Conditions and Earthwork Materials

Ground conditions along the proposed Scheme were assessed using various sources of information including historic mapping data, aerial photographs, observations from site walkovers, intrusive ground investigations, laboratory testing and post-fieldwork monitoring.

The stratigraphic profile across the site is generally consistent, comprising an initial layer of topsoil or hard surfacing (bitumen or concrete pavement), followed by a variable thickness of made ground, underlain by natural strata comprising cohesive glacial till (known locally as Dublin boulder clay) and bedrock occasionally interbedded with mudstone (known locally as Calp). Cohesive Glacial Tills were found generally to vary in thickness between 0.70m and 19.40m, Cohesive deposits were described typically as grey/brown sandy gravelly Clay with occasional cobbles and boulders. Materials described as Granular Glacial Tills were found generally to vary in thickness between 0.30m and 9.00m, with an average thickness of 1.60m, and were typically described as grey very clayey gravelly fine to coarse Sand.

Bedrock encountered during the ground investigation included variably weathered medium strong to very strong grey/dark grey fine to medium grained laminated Limestone interbedded with weak to medium strong black fine grained laminated Mudstone. Rare visible pyrite veins were noted during logging, which are typically present within the Calp Limestone. The depth to weathered rock ranged from 1.30m bgl to 17.20m bgl with an average depth of 9.00m bgl, with a thickness of between 3.10m and 7.80m. The weathered rock encountered was typically diggable with the large excavator to a depth of up to 0.70m below the top of the stratum.

The made ground can be generally described as reworked cohesive glacial deposits (described generally as grey/brown sandy slightly gravelly clay with frequent cobbles and boulders) containing a variable fraction of construction and demolition waste materials, such as brick, metal, and plastic. Environmental screening tests indicate the made ground material encountered are generally inert and non-hazardous.

As illustrated in Figure 5-21, the most significant deposit of made ground is within Tolka Valley Park. Historic landfill waste was confirmed within Tolka Valley Park with deposits ranging in thicknesses from 0.75m to 5.55m. Materials varied, predominantly comprising gravel and clay derived from various lithologies together with brick, concrete, slag, metal, plastic, glass, ceramic, tile, fabric, topsoil, wood, shells, charcoal, and tar.

The proposed Scheme within Tolka Valley Park seeks to minimise interaction with existing historic waste deposits by following the existing path between the mounded historic waste bodies (See Figure 5-22). Some localised excavation and grading along the eastern edge of the western mound is anticipated. Any historic waste materials excavated will require disposal to a suitably licenced landfill facility.

Refer to Chapter 11 (Land and Soils: Soils, Geology and Hydrogeology) of this EIAR for further detailed discussion of subsurface materials.

Figure 5-21: Made Ground Deposit Heat Map

Figure 5-22: Historic Landfill Deposits Tolka Valley Park

5.8.9 Drainage

The proposed Scheme has extensive sections of off-road alignment running through parks, green strips of land and grass verges, where it is proposed to adopt SuDS for visual aesthetic and environmental reasons. SuDS are designed to manage stormwater locally (and as close to source as possible) in order to mimic natural drainage and encourage its infiltration, attenuation and passive treatment.

The proposed Scheme approach to SuDS aligns with Nature-based Solutions as detailed in DCC's Climate Change Action Plan 2019-2024 (Dublin City Council, 2019) and also recent IFI Guidelines Planning for Watercourses in the Urban Environment (Inland Fisheries Ireland, 2020). SuDS principles typically adopt vegetated open systems such as swales and attenuation ponds which facilitate filtration of surface water runoff from paved areas. SuDS features not only allow surface water to infiltrate to ground but also facilitate storm water attenuation and improvements in water quality.

Whilst SuDS systems offer environmental benefits, they also require less maintenance over traditional closed surface water collection and attenuation systems (for example, piped collection systems and buried attenuation structures). A reduced maintenance regime over the lifetime of the project is one of the drainage design objectives. Where sensitive aquifers or contaminated subsoils exist, additional care will be taken when using SuDS systems.

Outlined below are a number of principles incorporated into the design.

- SuDS-based systems will be incorporated to dispose of surface water runoff generated by the proposed Scheme;
- Vegetative-based SuDS systems will be used;
- Where SuDS-based systems are used, an assessment of the receptor was conducted including;
  - Permeability of the receiving subsoils;
  - Winter groundwater levels / historical flooding;
  - The sensitivity and suitability of the receiving aquifer;
  - The type of runoff the SuDS system will treat and whether from trafficked surfaces, rail surfaces or pedestrian areas; and
  - Water quality of watercourses in the vicinity which any SuDS-based systems have the potential to affect.
- Where connections to any existing surface water networks are proposed, consent will be sought from the relevant parties (it should be noted that the proposed Scheme crosses both DCC and FCC functional areas) that the proposed connections will not increase the likelihood of flooding in the existing system;
- Notwithstanding the above, where connections to watercourses and existing drainage systems are proposed, attenuation will be provided as required. Surface water runoff from new drainage networks shall be attenuated to the critical 1 in 100-Year Storm Event, including 20% for climate change;
- Outfall rates from attenuation areas will be based on greenfield and brownfield assessments that will determine an allowable outfall rate which does not exceed the pre-development condition;
- The system will be designed with the aim of keeping future maintenance requirements to a minimum;
- The Health and Safety of construction and maintenance personnel will be considered at all stages of the design, and it will be a design objective to minimise risk wherever possible in accordance with the Principles of Prevention;
- As the maintenance of the system will likely be carried out by two different parties; one carrying out the maintenance of the rail drainage (TII), and a second separate party carrying out the maintenance of the roads, footpaths and cycle ways (Local Authority), both systems will be kept separate where possible. This objective will be balanced against the degree of complexity and the cost requirements of keeping both systems separate; and
- It is an objective of the design to minimise the environmental impact on the receiving environment.

Refer also to Chapter 10 (Water) for assessment of the impact of the proposed Scheme on the surface water environment during both the Construction and Operational Phases.

5.8.9.1 Existing Watercourses and Culverts

The location of existing watercourses and culverts has been identified from survey. Table 5-24 shows where the proposed Scheme crosses the existing watercourses and culverts. Refer to Chapter 10 (Water) for further details.

Table 5-24: Existing Watercourses and Culverts

Watercourse	Distance from the proposed Scheme
Finglaswood Stream	Traverses the proposed Scheme along its entire length from Tolka Valley Park to St Helena's Road. The stream is culverted in this region and discharges into the Tolka Valley, upstream of Finglaswood Bridge. A number of surface water drainage networks within the region connect into the Finglas wood Stream.
River Tolka	Traverses the proposed Scheme in the Tolka Valley Park close to Ballyboggan Road.
Bachelors Stream	Passes within 25m of the proposed Scheme.
River Finglas	Passes within 765m of Area 30 and 780m of Area 31
Integrated Constructed Wetland	Proposed Scheme is crossed by the ICW.
Royal Canal	Crossed by the proposed Scheme adjacent to Broombridge Station.

5.8.9.2 Existing Drainage Description

The proposed Scheme route crosses a number of existing drainage network systems. The systems encountered drain foul water, surface water or a combination of both. The Finglaswood Stream is a culverted stream which outfalls to an ICW adjacent to the River Tolka. The ICW provides treatment to the waters within the Finglaswood Stream, which are thought to be polluted by mis-connections from domestic properties. Flows from pavements are typically collected in standard gullies and routed via a gravity network to outfall points. Apart from the ICW referenced above, there are no SuDS units on the existing drainage networks to treat or attenuate runoff from the existing roads. At Broombridge Depot in Area 30, there is a subsurface attenuation tank, which controls surface water. The River Tolka and the Royal Canal are the main water bodies along the route. The River Tolka has a number of outfalls draining to it, but outfalls to the Royal Canal are generally not permitted by Waterways Ireland, due to their potential to disturb the functioning of the canal.

5.8.9.3 SuDS

In keeping with the principles of the circular economy, where possible, SuDS will be used to dispose of surface water generated by the proposed Scheme. All of the systems described below can be sealed by providing an impermeable membrane around the filter material. When these systems are sealed their capacity to accept rainwater flows is reduced, as the infiltration element of their design is removed. Once sealed, they perform in a similar fashion to an attenuation tank, but have less capacity, as water can only be stored between the voids in the filter material. Typically, the voids take up only 20-30% of the volume occupied by the filter material. For Luas Finglas, the following types of SuDS systems are proposed.

Rain Gardens

These are vegetated infiltration areas where surface water from the adjacent footpaths or roads drain onto the vegetated surface and then filter into subsurface material. Rain Gardens can accept rainwater from footpaths or from roadways. Where Rain Gardens are accepting runoff from a road surface which could contain pollutants in the form of de-icing salts or hydrocarbons, a mechanism has to be provided which will allow rapid draining of the subsurface material when required. Rapid drawdown is at times required, to prevent pollutants sitting in waterlogged conditions, and which could lead to damage to any plants or tree roots located within the Rain Garden subsurface material. The rapid drawdown feature typically takes the form of a perforated drainage pipe along the base of the filter material, which connects to an outfall or drainage network. The drawdown pipe has a valve which is typically closed during normal operation. Refer

to Figure 5-23, Figure 5-24 and Figure 5-25. Figure 5-25 demonstrates one method of how surface water from a road pavement can be directed into the Rain Garden.

In cases where there are trees provided in the rain garden, a specific detail is required to ensure the tree roots are suitably dealt with, and that the tree is not susceptible to waterlogged conditions. An aeration pipe has to be provided to the rootball, and consideration has to be given to the nature in which the rootball will develop. Please refer to Figure 5-26, for a typical detail of how this will work.

Infiltration Trenches

These are similar to rain gardens in that they are designed to allow collected surface water to disperse to the surrounding subsoils but typically do not include a landscaped surface which may incorporate trees and plants. Infiltration trenches are typically grassed surfaces and the majority of their flow is received through a pipe which is below ground level. This pipe is typically the end point of a drainage network and its invert is usually about 1m below the ground surface. Infiltration trenches are generally used as the end points of drainage networks and typically treat larger volumes of surface water than rain gardens. A rapid drawdown mechanism is generally not required in an infiltration trench as it does not have networks of tree or plant roots which could be damaged by pollutants. Whilst pipes can be provided within infiltration trenches, these are mainly to allow more even dispersion of surface water into the surrounding subsoils and are not always required. A section through an infiltration trench would be similar to Figure 5-24. Infiltration trenches are to be designed in accordance with the BRE Digest 365 or the CIRIA R156 design manual.

Filter Strips

This consists of a gravel trench which can incorporate a perforated pipe to allow better dispersal of surface water through the medium. Filter strips are similar to the filter drains as detailed in the TII SCD's for road projects, (Standard Detail CC-SCD-00521). However, they are slightly different as filter strips are not designed to convey collected surface water, but to disperse it to the surrounding subsoils. Refer to Figure 5-28 and Figure 5-29.

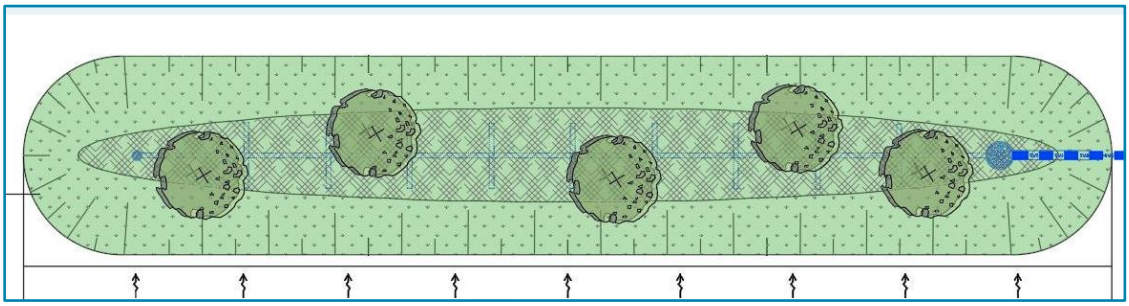

Figure 5-23: Plan of Rain Garden

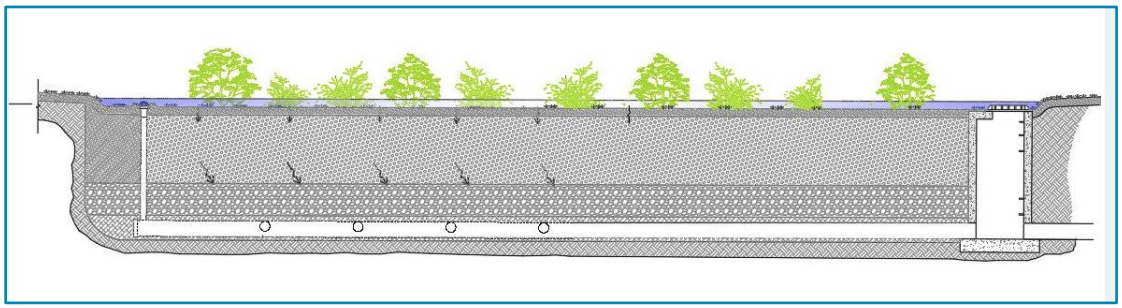

Figure 5-24: Longitudinal Section of Rain Garden

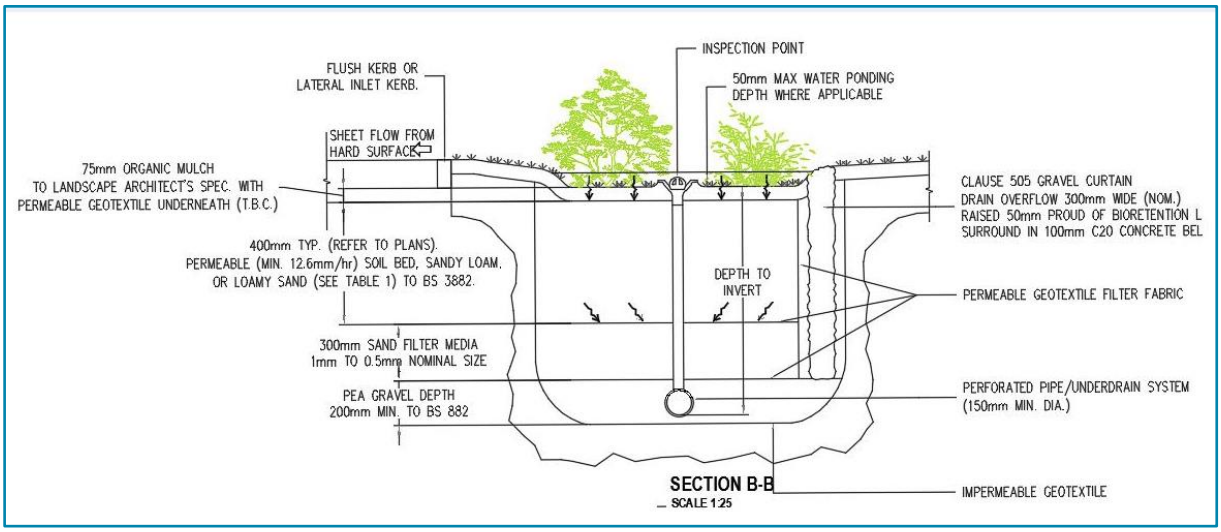

Figure 5-25: Cross-Section through Rain Garden

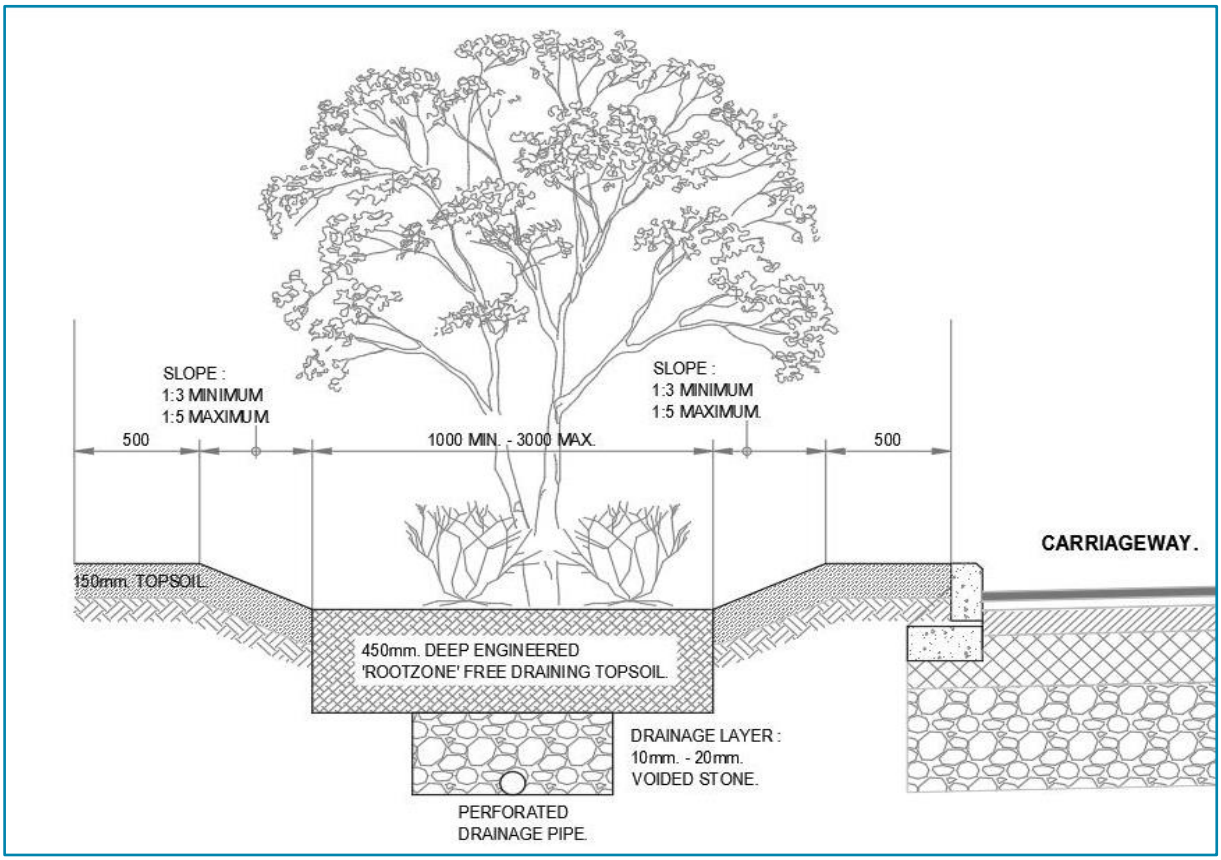

Figure 5-26: Cross-Section through Rain Garden incorporating 'Rootzone'.

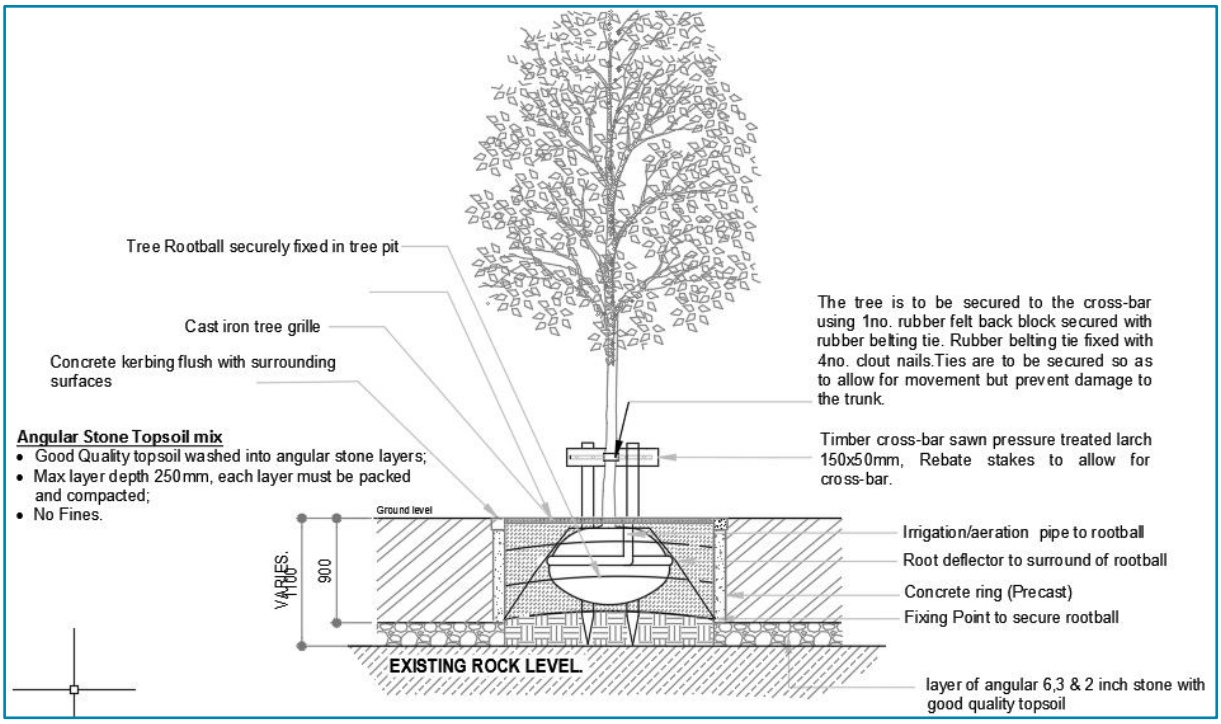

Figure 5-27: Treatment of tree located in rain garden.

This detail also applies where trees are provided on their own and separate to a rain garden.

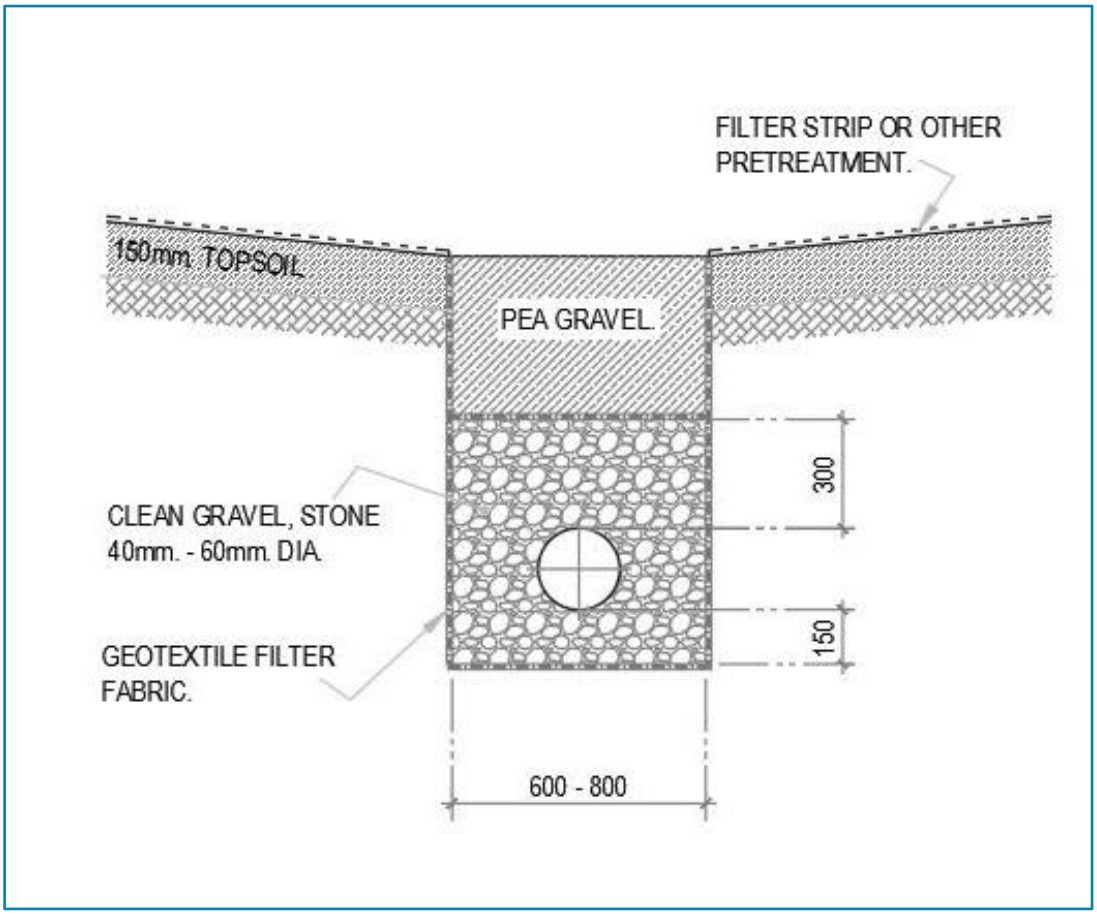

Figure 5-28: Filter Strip

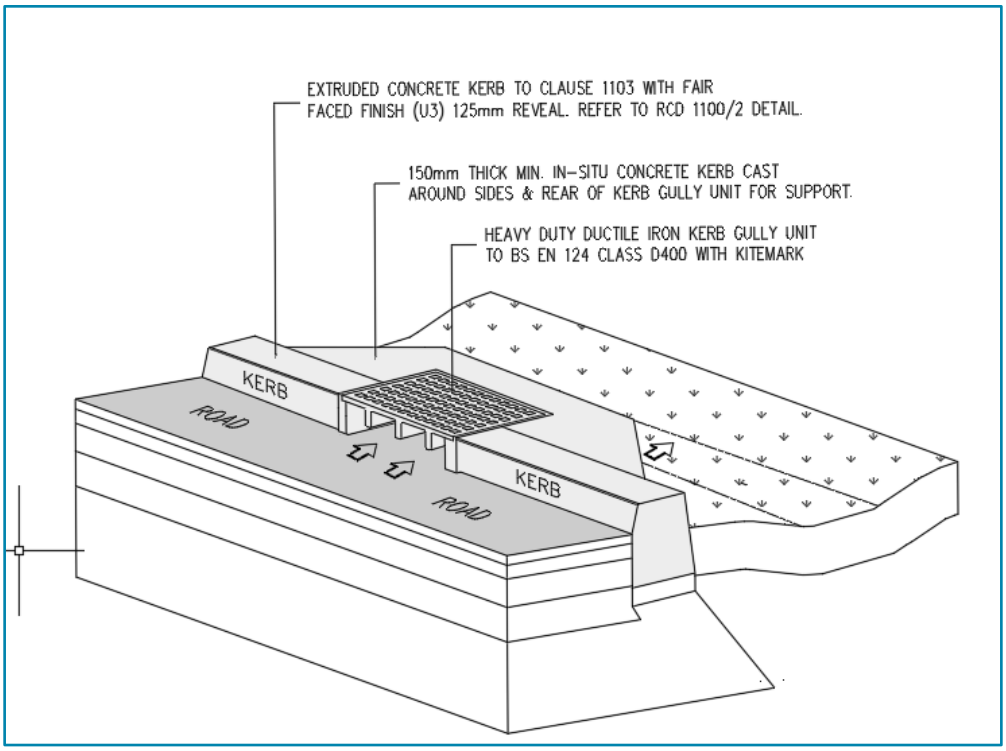

Figure 5-29: Detail showing method of transferring pavement surface water to Rain Garden.

5.8.9.4 Area 30: Drainage-Network 1 -- Track Stabling Area.

Area 30 is located adjacent to the Broombridge Stop and facilitates a stabling area. The track form shall be ballasted track / embedded track. The drainage of the embedded track is via the rail grove drainage as described previously in the document. The outlets form the rail grove drainage are collected by infiltration trenches beneath each of the tracks. The ballasted track will drain directly via infiltration trenches. A high-level overflow is proposed at the eastern end of the infiltration trenches which will be connected to the adjacent existing Luas drainage infrastructure A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

5.8.9.5 Area 31: Drainage Network 1 - Broombridge Stop to High Point of Grand Canal Bridge.

As the majority of this drainage network relates to the envelope of the Royal Canal Bridge and that of the Broombridge Stop, it will be a sealed system. The potential for SuDS is limited, but some silt trapping measures in the form of catchpit chambers will be provided. The track type in this network is embedded trackform. Drainage of the rails and the adjacent pavement will be achieved by slot drain systems whereby there is a drainage system within the rails themselves.

The slot drainage system involves providing a rail grooved drain at intervals of 50m and a cross track drain (slot drain collection channel) every 150m, at low points, and before each pedestrian crossing or road junction at which the rail alignment intersects. While these are guide dimensions for the provision of the slot drain collection channel, spacings can be adapted to consider local weather, provision for climate change and return period.

When the slot drains reach capacity, they will outfall to a separate piped system which will act as the collection mechanism. Refer to Figure 5-30 where a detail of the collection system from the slot rail is indicated. A channel detail which runs perpendicular to the line of the rails, such as this, is provided at locations where the rail system outfalls to a piped collection system. The covers on these channels are removable which allows for desilting and maintenance. In the vicinity of the Broombridge Stop there is an existing 1,148m^3 geocellular attenuation tank system (82m x 7.0m x 2.0m). Water collected in the piped collection system will discharge to this existing geocellular attenuation tank.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5.

Figure 5-30: Detail of Slot Drain Collection Channel

5.8.9.6 Area 31: Drainage Network 2 - Royal Canal River Bridge to Tolka Valley Road

This network commences at the high point of the proposed Royal Canal Bridge and finishes at the River Tolka. This drainage network will accommodate the drainage system from the rails and will also drain Broombridge Road and the proposed footpaths and cycle tracks. As this network starts and ends at new bridge structures, the portions of the rails within the extents of these bridge decks will be drained using slot drain systems within the rails itself, similar to what will be used in Network 1 above (See Figure 5-30).

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

For the cycle tracks and footpaths, where possible the surface will be sloped to allow the surface water drain to a SuDS-based system in the form of a rain garden**.** This will allow the collection and management of reasonably clean rainwater from the surface of low pollution risk areas, such as footpaths and cycle tracks. The rain gardens facilitate the infiltration of surface water to ground as the rain garden consists of clean granular stone overlain with a planted soil top layer wrapped in a geo-textile as shown in Figure 5-32 and Figure 5-33. The shallow layer of topsoil with a stone filtration bed below breaks down pollutants through a process of anaerobic digestion. The topsoil (Item 3 in Figure 5-34) will be improved with up to 20% coarse compost and extend to a minimum of 450mm deep. An overflow will also be provided (Item 5) in the event of heavy rain or impeded drainage.

The rain gardens shall be planted with species that can tolerate a regime of both flooding and drought. These native and naturalised species will enhance biodiversity in the region. Planting within the rain garden will be selected to withstand any saline water which may be present as a result of road gritting during periods of frost.

In the case of road drainage, bioretention rain gardens are used instead of kerb and gullies as a means of drainage. The water flowing along the kerb can access the rain garden through a recess in the kerbing that provides an inlet as shown in Figure 5-31.

As with normal rain gardens, they contribute to the biodiversity of the area but bioretention rain gardens also play a significant role in pollution control. The structure differs from a rain garden in that it employs an engineered topsoil and is used to manage polluted urban rainfall runoff in locations such as streets and car parks. The rain gardens facilitate the infiltration of surface water to ground as the rain garden consists of clean granular stone overlain with a planted soil top layer wrapped in a geo-textile.

Given the surface water which the bioretention rain garden will receive contains silt and pollution from vehicles and urban street use, a maintenance program will be required to remove the build-up of inorganic silt. The free draining nature of the engineered soils will lead to washing of nutrients from the soil. These will need to be replenished on an annual basis through application of a mulch layer or composted green waste.

In locations where a rain garden is not available for the footpaths / cycle lanes to discharge to, the surface water will be collected by a filter strip located between the road and the cycle lane. Essentially these consist of a trench filled with permeable material which will allow surface water to permeate to the subsoil. It is proposed that these longitudinal filter strips will connect with a rain garden The rain gardens will provide additional capacity and reduce the likelihood of surface water ponding along the lengths of the filter strips during severe flooding events. As an additional measure, cross drains will connect the filter longitudinal strips and the rain gardens with the network's main collector drain. These cross drains will only come into operation when the rain gardens and longitudinal filter strips become inundated during significant storm events. For less intense storm events these cross drains will not come into operation.

To coordinate the proposed new rail with the existing road, it is necessary to realign the existing Broombridge Road in Area 31. As a result, some of the existing stormwater sewer on Broombridge Road will require relocation. A dedicated main collector for the rail track and both the footpaths and cycle lanes will be provided and located beneath the footpath on the eastern side of Broombridge Road. This system allows a certain degree of separation between the rail, footpath, cycle lane drainage system and the road drainage system. For the trafficked area of the realigned Broombridge Road, a sealed drainage system will be provided in the form of kerb and gullies. These gullies will connect to the relocated stormwater sewer.

Figure 5-31: Sample Bio-retention Rain Garden Kerbing Inlet Layout

Figure 5-32: Sample Rain Garden Kerbing Inlet Layout

Figure 5-33: Rain Garden Construction

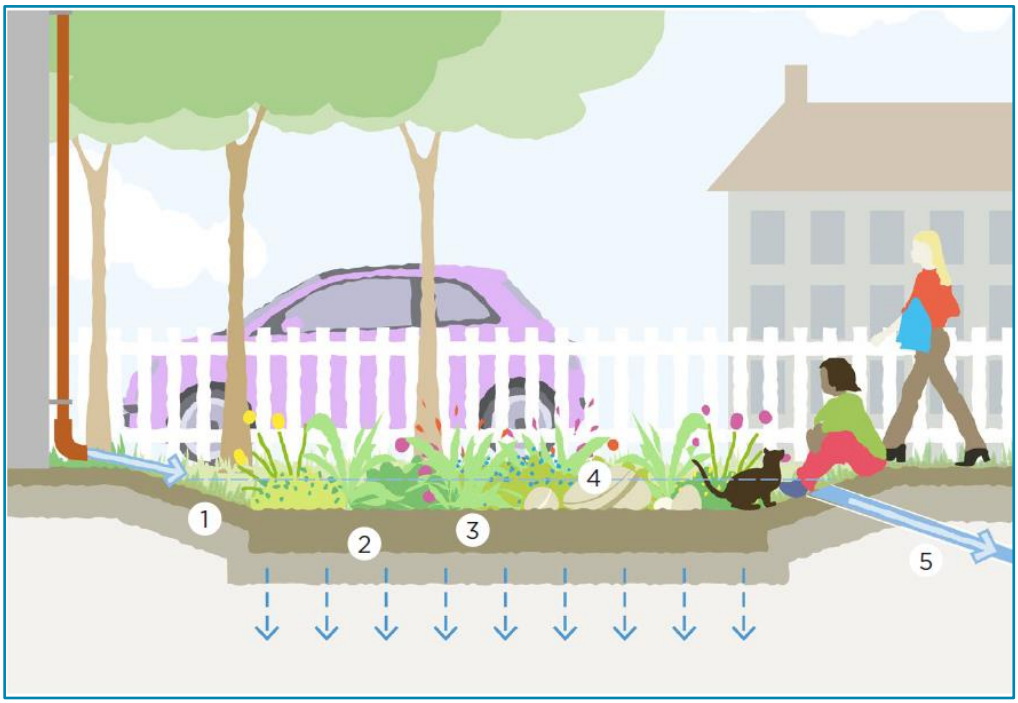

Figure 5-34: Sample Rain Garden

The gradient on this network falls towards the Ballyboggan Road and the River Tolka. Upstream of Drainage Network 2, outfall to the River Tolka attenuation will be provided. Due to the space constraints, the optimal solution will be an attenuation tank or geo-cellular type system. It is also intended to provide a bypass fuel / oil interceptor and control measures in the event of a pollution spillage event on the contributing carriageway. A flow control device will be provided downstream of the attenuation facility to limit the surface water discharge from the network to the receiving waters (River Tolka).

5.8.9.7 Area 31: Drainage Network 3 - Tolka Valley Park Bridge to St Helena's Road.

This network runs from St Helena's Road (the high point) to the River Tolka (the low point).

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

St Helena's Road runs perpendicular to the alignment of the proposed Scheme. Road drainage from St Helena's will be gathered and transferred to the main collector which will then outfall into the ICW adjacent to the River Tolka. Similar to Network 2, runoff from cycle lane and footpaths will be collected via longitudinal filter strips which will end at suitably-sized soakaways. There will be an overflow from the soakaway areas into the main collector, which will come into use during extreme rainfall events.

The track system in this network runs through the open green space of Tolka Valley Park and is proposed to be grass track. This will allow the stormwater from the track area drain to ground and any stormwater which exceeds the infiltration capacity of the ground beneath will be collected and conveyed through a SuDS feature, in this case soakaways, which are sized according to the requirements of the BRE Digest 365. Additional SuDS features such as a tree pit, rain garden or bioretention rain garden, located adjacent to the track to provide SuDS treatment are also proposed. The track system will be drained via a system as per Figure 5-35. Any surface water which does not infiltrate to ground will be collected via the perforated pipes located in the grass trackform sub-base. The grass trackform is provided with a perforated pipe at each side of the track to allow for collection of any surface-water from the trackform build-up materials.

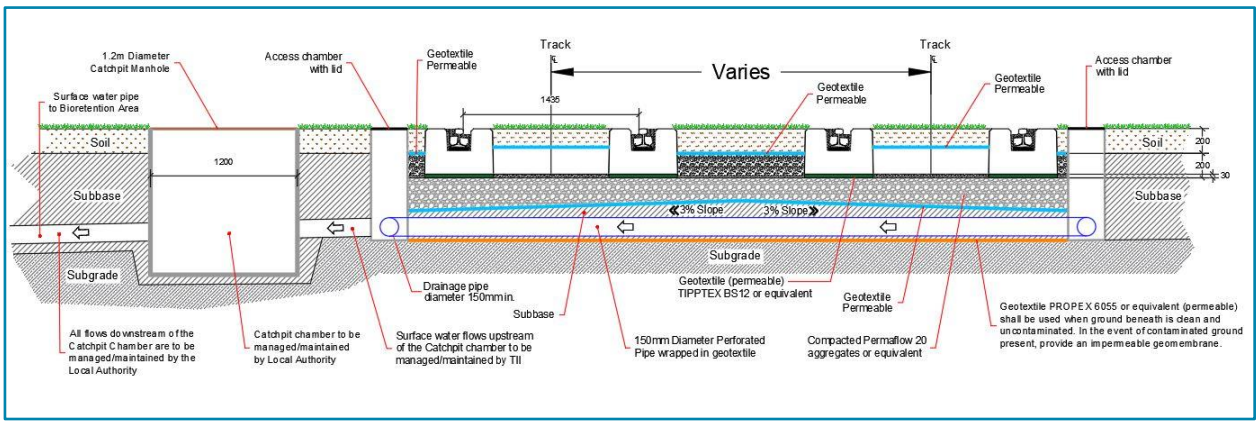

Figure 5-35: Grass Track Typical Drainage Detail

The collected surface water shall be drained Figure 5-35 from the track at intervals of 20m approximately and will be routed to a second SuDS treatment element as outlined above.

A cross pipe will connect this soakaway area with the main collector. The intention of the drainage design within Tolka Valley Park is that during minor and medium intensity storm events the track drainage and cycle lanes and footpaths will be drained at source, with the main collector only coming into operation during the more extreme flood events, or if one of the SuDS systems becomes silted up or blocked.

It is proposed to connect Network 3 to a new attenuation pond which will treat and attenuate flows to greenfield run off rates. The outflow from this attenuation pond will be directed through the existing wetlands and into the River Tolka. As the Finglaswood Stream and the existing vegetated wetland (ICW) will have an

impact on the drainage design for Network 3, a short description of both of these elements has been provided below.

Finglaswood Stream

The approximate route of Finglaswood Stream is indicated on the Drainage Layout Drawings. At present, the Finglaswood Stream is culverted and it is understood that there are a number of foul sewer connections into it from residential properties. The potential of 'daylighting' this stream has been raised previously. There are likely to be complications due to water quality issues and the depth of the culverted stream. It is not proposed to daylight the stream as part of the proposed Scheme. Due to the proximity of the proposed Scheme to the stream, it is proposed to divert the Finglaswood Stream culvert where it crosses the Luas alignment. Refer to Chapter 17 (Material Assets: Infrastructure and Utilities) for more information.

Tolka Wetland

In order to provide treatment to the surface waters emerging from the Finglaswood Stream, prior to outfall to the River Tolka, an ICW was constructed (See Figure 5-36) in 2000. The wetland consists of three treatment cells (1, 2a, 2b) in sequence which drain into an open water pond. The waters discharge through the open water pond to the River Tolka. In accordance with data on the EPA website, The River Tolka (Tolka_05) is currently "at-Risk". The treatment flow through the wetland cells and lake, is in the opposite direction to the River Tolka, which flows west to east. The drainage layout drawings indicate the Wetland Cells, and the extents to which it is currently affected by the proposed Tolka Valley Park Bridge. Drainage Network 3 is currently indicated draining to the ICW.

The proposed Scheme will result in the loss of approximately 260m^2 of treatment area (~10% of total area) within the first cell of the ICW. Areas have been identified within Cell 1, Cell 2a and Cell 2b to cater for the loss of treatment area, as well as to provide refurbishment opportunities for the ICW. The proposed works within the ICW will offset the lost treatment area, ensuring that the ICW is capable of providing improved passive treatment of through-flowing waters. These works will also improve access across the ICW for operations, maintenance and sampling works. The Tolka Valley Park ICW is an important element of the park itself, providing surface water protection to the River Tolka, public amenity areas for those visiting a park, and a range of ecosystem benefits for the area. The proposed Scheme provides a much-needed opportunity to refurbish the ICW after over 20 years of passive treatment.

Figure 5-36: Aerial View of Integrated Constructed Wetland

The primary cell is on the extreme right of Figure 5-36. The secondary cell, to the right of centre. The culvert carrying Finglaswood Stream connects into the primary cell.

Figure 5-37: 3D Render Visualisation of the proposed Scheme at the ICW

5.8.9.8 Area 32: Drainage Network 1 - St Helena's Road to Wellmount Road

This network commences at St Helena's Road and extends to Wellmount Road. The proposed horizontal alignment for the track runs through existing green space which currently hosts local amenities in the form of footpaths and both a soccer and GAA playing pitch at the southern end of this network.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

The proposed rail track in this area shall be predominantly grass track and drained as previously described. Prior to discharging to the adjacent existing surface water sewer, the track surface water will be routed through a second SuDS feature in the form of a soakaway in advance of discharging to the stormwater sewer in the area.

The Farnham playing pitches will be realigned and provided with a SuDS compliant drainage solution. This involves the extension / replacement of the existing pitch drainage to connect to a new carrier pipe located between the realigned pitches. A soakaway is provided for the stormwater discharge from each pitch. This soakaway is positively drained to the adjacent Finglaswood Stream.

The footpaths currently in this green space have been redesigned to allow for the relocation of the playing pitches. Drainage to these relocated footpaths is provided in the form of filter strips adjacent to the paved surface. These filter strips discharge to the soakaways as described previously.

The proposed Scheme also includes an updated design for part of St Helena's Road and Farnham Drive. New drainage will be provided to that extent of works in the form of kerbs and gullies which will discharge to the existing stormwater sewer in the area.

Where the rail track alignment crosses Wellmount Road, the trackform reverts to embedded track. A track cross drain is provided on the high side of the rail crossing (northern side) and at the embedded track low point. The water from the embedded track is routed through an adjacent soakaway which is positively drained to an adjacent stormwater sewer.

5.8.9.9 Area 32: Drainage Network 2 - Wellmount Road to Mellowes Road

The trackform type from Wellmount Road to Mellowes Road is mainly grass track which provides drainage and SuDS treatment to the surface water. As with the other networks on the proposed Scheme, the water discharged from the green trackform is routed through a soakaway before discharging to the adjacent existing surface water sewer. The trackform changes to embedded trackform at the northern end of the network adjacent to the Ravens Court residential development and extends to the Mellowes Road Junction.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

This embedded trackform will discharge to a proposed soakaway located in the green space to the east of Cardiff Castle Road. The soakaway will be positively drained to the existing stormwater sewer on the Cardiff Castle Road.

Road realignment works are also proposed for Patrickswell Road to facilitate space for the rail track alignment. Drainage for the new road works on Patrickswell Road will be provided in the form of a kerb and gully system which will discharge to a new stormwater sewer in the proposed road. This pipe will discharge to the existing stormwater sewer at the junction of Wellmount Road and the new Patrickswell Road layout.

Between Wellmount Road and Cappagh Road a footpath is proposed north of the alignment. There is green space proposed between the green track and the footpath in which a filter strip will be located. This will provide both drainage and SuDS treatment to the footpath surface water runoff. Stormwater in the filter strip which does not infiltrate to ground will pass through a second SuDS feature in the form of a soakaway before discharging to the new stormwater sewer on Patrickswell Road.

On the southern side of the Patrickswell Road a footpath is proposed. Between the Wellmount Road junction and the entrance to the Little Sisters of the Assumption property, the footpath slopes away from the road. The surface water is collected by an adjacent filter strip which is to discharge to a soakaway at the Wellmount Road end, and which discharges to the new stormwater sewer on Patrickswell Road.

North of the Little Sisters of the Assumption premises' entrance, the slope on the footpath changes to fall towards the road. This facilitates collection of the surface water in a filter strip between the footpath and Patrickswell Road. Further north the surface water flows towards the road and is collected by the Patrickswell Road drainage system.

The proposed new footpath adjacent to Cardiff Castle Road slopes towards the road and the surface water will be collected by the existing road drainage system. The footpath north of the alignment from the Ravens Court development to the Mellowes Road Junction shall drain towards the track and the surface water shall be collected by the embedded track drainage system.

Cycle lanes are also proposed each side of the new Patrickswell Road. These cycle lanes slope towards the road so any surface water will be collected by the road drainage system.

5.8.9.10 Area 32: Drainage Network 3 - Mellowes Road to Mellowes Park

Embedded track is proposed from Mellowes Road to Mellowes Park. The embedded track is drained via the rail groove drainage, as previously outlined. The water which discharges from the track is collected via a collector drain which runs parallel to the track alignment. This collector drain flows northwards and discharges to a suitably-sized soakaway which collects water from the Mellowes Park drainage system. As with all soakaways proposed, it shall be positively drained to the existing stormwater sewer in the area.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

5.8.9.11 Area 33: Drainage Network 1 - Mellowes Park

Area 33 commences at the southern end of Mellowes Park on the Finglas Road (R135) side of the park and runs directly north for a distance of approximately 520m. Mellowes Park is a medium-sized urban park which provides recreational space in addition to playing pitches and playgrounds.

In keeping with the drainage strategy of the broader scheme, SuDS features will be utilised within Area 33. It is intended to provide stormwater drainage in the Mellowes Park region using three elements to treat surface water runoff.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

Figure 5-38: Image of Existing Grass Track (Dublin) configuration

Initially grass trackform will be used, similar to that indicated in Figure 5-38 which will facilitate infiltration to ground and an element of stormwater attenuation and treatment The collected surface water will be routed to a second SuDS treatment element in the form of an infiltration trench before passing to the third SuDS feature in the form of a soakaway. The soakaways shall be positively drained by means of a connection to the existing surface water drainage infrastructure in the region.

5.8.9.12 Area 33: Drainage Network 2 - St Margaret's Road (Mellowes Park to McKee Avenue).

At the northern end of Mellowes Park the environment of the proposed Scheme changes from urban parkland to that of paved roadway. At the northern end of Mellowes Park, the trackform changes from grass to embedded trackform and terminates at the current McKee Avenue Roundabout.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

The drainage is provided using the slot drainage system. As infiltration of the surface water to ground is not possible where the embedded trackform is used, SuDS treatment of the surface water is provided by routing

the collected surface water through the adjacent SuDS features such as infiltration trenches, bioretention rain gardens or tree-pits. Where possible SuDS features have an outfall to the existing drainage infrastructure in the area.

In certain locations, the flow path of the surface water towards the kerbing inlet is obstructed, for example by the presence of a cycle lane, or there not being a rain garden available for SuDS treatment. In such a case, the surface water is collected using road gullies and piped to the nearest bioretention rain garden. None of the proposed surface water gullies have a contributing catchment larger than 200 square metres, which is in accordance with DCC recommendations. Gullies are also provided at pedestrian crossings and at local low points. Double gullies are proposed at low points.

The footpaths in this area are sloped towards the rain gardens.

A Stop is located on St Margaret's Road, adjacent to McKee Avenue. The Stop platform is sloped away from the tracks. The adjacent cycle lane in this area slopes towards the Stop platform forming a shallow grade v-channel between the two pavements. At the low point in this region the surface water is collected via a gully and piped to the adjacent rain garden.

5.8.9.13 Area 33: Drainage Network 3 - McKee Avenue.

The McKee Avenue surface is superelevated, directing the surface water in the north-eastern direction towards the kerb where it enters the proposed bioretention rain garden through kerb inlets. The footpath and cycle lane to the southwest drain onto the road. On the north-eastern side of McKee Avenue, the footpath and cycle lane drain 'over the edge' to the adjacent bioretention rain gardens. In one location, a small pocket rain garden is situated between the proposed footpath and cycle lane. In this case the small, isolated rain garden is linked to the larger adjacent rain garden which discharges to the existing storm water drainage infrastructure on McKee Avenue.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

5.8.9.14 Area 33: Drainage Network 4 - St Margaret's Road (McKee Avenue to McKelvey Celtic AFC).

Track drainage from McKee Avenue to McKelvey Celtic AFC reverts to grass track and the storm water is routed through the tree pit / rain garden located adjacent to the track. These SuDS features are also positively drained to the existing stormwater sewer in the area. In two locations, the trackform changes from grass to embedded: firstly, at the entrance to the Jamestown Business Park opposite McKelvey Road and also at the more northern entrance to ESB Networks. This is to facilitate vehicle crossing points and drainage is provided as outlined previously for embedded track. In keeping with the SuDS strategy, the collected surface water will pass through an adjacent bioretention rain garden before discharging to the existing surface water infrastructure in the vicinity.

A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

The road surface water drains to the adjacent bioretention rain gardens mostly via the kerb inlets provided. There are tree pits proposed north of McKelvey Road which will provide treatment to the St Margaret's Road surface water. The tree pit design shall be co-ordinated with the landscaping design and the choice of tree species proposed shall be selected for salinity tolerance where the tree pit may receive surface water from gritted roads. A drain down pipe shall be provided to ensure there is no prolonged waterlogging of roots and no build-up of road salt within the SuDS tree pit. The SuDS Tree Pit proposed differ from traditional tree pits as they have a free drainage soil and a way of draining down entirely within a reasonably short timeframe. This will allow the melt water after snow or ice, along with rain to flush the soluble salt through the soil and to the drain.

On the western side of St Margaret's Road, the footpath and cycle lane is sloped towards the road which allows over-the-edge drainage to the rain gardens, where available, and onto the road elsewhere. The surface water on the footpath to the east of St Margaret's Road flows towards the tracks and is collected by the rail drainage. The surface water from the cycle lane located between the alignment and St Margaret's Road will flow 'over the edge' to the adjacent rain garden. Where a rain garden is not available surface water will be collected by the road drainage system.

Occasionally road gullies are provided, such as at the McKelvey Avenue junction to facilitates surface water removal.

5.8.9.15 Area 33: Drainage Network 5 - St Margaret's Road (McKelvey Celtic AFC to Melville Road Junction).

The trackform in this section is predominantly grass track with a segment of embedded track at the Charlestown Stop, adjacent to the Century Business Park. A preliminary drainage layout detailing the proposed drainage collection systems, bioretention areas, rain gardens / tree pits, etc is shown in Volume 5 - Appendix A10.5 of this EIAR.

As per the drainage design strategy, SuDS treatment is provided to the embedded track region by routing the collected surface water through the adjacent rain gardens before discharging to the existing stormwater infrastructure.

This section of St Margaret's Road is drained in the same manner as previous sections. The surface water enters the bioretention rain garden through the kerb inlet except occasionally where the biotretention rain garden is remote from the road edge, a road gully will be provided and the surface water is piped to the rain garden.

The footpath and cycle lanes on the western side of St Margaret's Road fall in the direction of the main road and drains 'over the edge' to the adjacent rain garden before discharging to the existing sewer. Where a rain garden is not available for surface water to access, the footpath flows onto St Margaret's Road and is collected by the road drainage.

Similar to the St Margaret's Stop further south, the Stop platform drains away from the rail line towards the adjacent footpath. The footpath also falls towards the platform creating a shallow V-dish. Tree pits are provided to collect the surface water and provide SuDS treatment. These tree pits are linked via a drainage pipe to optimise volume available to each tree and are positively drained, initially to the adjacent rain garden which then drains to the stormwater sewer.

The updates proposed for the St Margaret's Road / Melville Road junction follow a similar design philosophy to that on St Margaret's. Surface water enters the proposed rain gardens via a recess in the kerbing. The rain gardens shall discharge to the existing stormwater drainage network on Melville Road. Gullies are provided at low points or where the area of surface water collected approaches 200m^2. Proposed footpaths and cycle lanes slope towards the road which allow 'over the edge' drainage into the rain gardens where available. If no rain garden is present, this surface water flows on the road, to be collected via the Melville Road drainage system.

5.8.10 Structures

5.8.10.1 Principal Structures

There are two principal bridge structures and a Park & Ride facility as part of the proposed Scheme. The bridges are located at the southern end of the proposed Scheme. The bridges are the Royal Canal and Rail Bridge and the Tolka Valley Park Bridge. The Park & Ride is located near the northern end of the scheme at St Margaret's Stop. Refer to Section 5.8.6 above for details of the Park & Ride. Structures Options Reports (SORs) and Preliminary Design Reports (PDRs) have been prepared as part of the design process for the EIAR. The SORs record the preferred bridge option for each structure and alternative options considered.

They describe the main structural elements and discuss the options in terms of economy, aesthetics, hydraulics, environment, H&S, buildability, ground conditions etc.

Sections 5.8.10.2, 5.8.10.3, 5.8.10.4 and below summarise the principal structures proposed and provide justification where necessary.

The bridge forms recommended for each structure should not be considered as overly binding or prescriptive. Refinements and value engineering proposals may be possible in subsequent design stages.

5.8.10.2 Minor Structures

The following Minor Structures are proposed along the length of the proposed Scheme:

- Trackform;
- Retaining Walls;
- Stop Platforms; and
- Substations.

Below is an overview of Minor Structures proposed on the scheme.

Trackform

The trackforms proposed are detailed in section 5.8.2 above.

Retaining Walls

Two types of retaining walls are proposed along the proposed Scheme: for retained height less than 1m and away from LRT or road traffic, blockwork retaining wall shall be constructed. This type of retaining wall will also serve as a boundary wall separating the Luas corridor from adjacent properties.

For retained height over 1m and within the zone of influence of the rail or road traffic, reinforced concrete walling shall be constructed.

Refer to the Structural Drawings provided in the RO Drawing Pack for details of proposed structures:

- Broombridge Road retaining walls;
- Farnham Pitches retaining wall; and
- Finglas Village / Cardiff Castle Road retaining walls.

Stop Platforms, Substations

These structures consist of small, ground bearing concrete elements, such as beams and slabs. Precast concrete shall be used wherever practicable.

The structure locations and references are illustrated in the Structural and Landscaping Drawings provided in the RO Drawing Pack.

5.8.10.3 Royal Canal and Rail Bridge

The proposed bridge carries the LRT over the Maynooth Rail line and Royal Canal. It is an eight-span structure consisting of two main parts: a variable depth weathering steel composite box girder followed by a constant depth solid concrete slab. The bridge has the following span arrangement: 35m + 47.5m + 30m + 17m + 3x22m + 17m. Steel composite superstructure extends over the first three spans. The bridge deck is continuous over the full length of 212.5m. It is also articulated on all supports.

The proposed structure has seven intermediate piers, all of them are well clear of the railway and canal. The first south pier (P1) is positioned beyond the perimeter of the railway platform, the second pier (P2) approximately 7m north of the canal bank, behind the towpath and the Royal Canal Greenway, which will be slightly realigned locally. Remaining piers (P3 to P7) are situated further north, on the east side of the

Broombridge Road. All piers have a unified bespoke form – an elliptical cross-section which tapers out near the top to accommodate bridge bearings and temporary jacking points.

There are pair of bearings at both abutments as well as piers P3 to P7, while piers P1 and P2 have only a single, guided bearing each. Bridge abutments include an internal gallery to facilitate access for bearing and expansion joint inspection.

There are solid approach ramps / embankments at each end of the bridge. The southern approach ramp is 33.9m long, the northern approach ramp is 43.8m long. To minimize the land take and for aesthetic reasons, the ramps have reinforced concrete, bespoke cantilever side retaining walls with a granular fill material in between.

Refer to the Structural Drawings provided in the RO Drawing Pack for the Royal Canal and Rail bridge sections and elevation. The visualisation of the bridge is shown on Figure 5-39.

Figure 5-39: Visualisation of the proposed bridge over the railway and Royal Canal

5.8.10.4 Tolka Valley Park Bridge

The proposed bridge carries the LRT over the Tolka River. It is a fully integral structure, with three spans 10m, 45m and 10m long; the overall length is 65m (measured along the centreline), the width is 11.62m and with variable depths between 1.5m at midspan and 2.5m at piers. The bridge has a zero degrees skew angle and consists of a composite steel and concrete girder with integral piers and abutments.

The main span consists of two parts: 25m long weathering steel box section with composite concrete slab, connected to 10m long concrete girder section at each end. The rigid connection (for full moment and shear transfer) between the steel and concrete girder will ensure continuous structural behaviour of the bridge deck along its full length. Additionally, the steel composite box girder section will significantly reduce the required extent of temporary works.

The bridge has two 4m wide wall type piers with adjoining side walls (wing walls in effect) which block the space underneath the end buried spans. Piers (as well as abutments) are set perpendicular to the bridge deck axis. The south pier is approximately 5m from the riverbank; there is no major restriction in the support location at the right (south) bank; whereas the north pier is set back approximately 22m from the riverbank to minimize the impact on the wetlands area.

Abutments will be of reinforced concrete construction. Refer to the Structural Drawings provided in the RO Drawing Pack for general arrangement and elevations. The bridge visualisation is indicated on Figure 5-40.

Figure 5-40: Visualisation of the proposed bridge in Tolka Valley Park

5.8.11 Landscape and Urban Realm Integration

The landscape and public realm design are derived from analysis of the existing public realm, including existing character, any heritage features, existing boundaries, vegetation and tree planting, and materials. For each section of the route, the design took a broad overview of typical dwelling age and style, extents of vegetation and tree cover. The predominant mixes of paving types, appearance of lighting features, fencing, walls, and street furniture was considered. The purpose of this analysis was to assess the existing character of the area and how the proposed Scheme might alter this. The outcome of the analysis allowed the designers to consider appropriate enhancement opportunities along the route. The enhancement opportunities include key nodal locations which focus on locally upgrading the quality of the paving materials, extending planting, decluttering of streetscape and general placemaking along the route. Where possible, a SuDS approach has been taken to assist with drainage along the route.

The following subsection descriptions include the principal urban realm and landscape design elements for each of the four sections of the proposed Scheme, sub-divided into the each of the areas' sections where necessary. For the technical elements of the proposed Scheme design, e.g. track, lighting, drainage, etc.,this description should be referenced along with the chapters for other disciplines in this EIAR.

Refer to Chapter 21 (Landscape and Visual Impact) for Landscape assessment and mitigation and to Volume 5 – Appendix 21.4 and Volume 5 – Appendix 21.5 for the landscape and urban realm design integration strategy and also the Landscaping Drawings provided in the Railway Order (RO) Drawing Pack.

5.8.11.1 Area 30: Broombridge Depot

The depot stabling area is within a publicly non-accessible area and due to both its functional nature and restricted space, limited opportunities exist for landscape treatment apart from the boundary treatment. A retaining wall with a chain link fence is proposed and which can be used for climber planting, together with adjacent hedge planting. This is in order to act as an effective visual barrier for the proposed adjacent future DCC housing development.

Within the stabling area there is a mixture of ballasted and embedded track for vehicular access and the existing type of track bed treatment will be continued for the extension stabling area. A recently constructed concrete boundary wall exists to the east of the alignment. The current boundary fence to the existing stabling will be removed to unify the entire stabling area within one curtilage. It is to be noted that the proposed Scheme requires the removal of some existing trees at the north-eastern end of the stabling area, and which will be compensated by new tree planting within the Broombridge area.

Figure 5-41: Proposed Landscape Scheme at Broombridge Depot stabling

5.8.11.2 Area 31: Broombridge to Tolka Valley Road

Broombridge and Royal Canal

Broombridge is currently a significant interchange location between Luas, Mainline IÉ services and bus routes. Broombridge currently features a bus turnaround, drop off facilities, disabled parking, and cycle storage facilities. The area also features access to/from and car parking facilities for the Hamilton Depot (operated by Transdev). The area functions satisfactorily at present and has an open circulation plaza with modest soft landscaped areas and tree alignments along the existing alignment and set down area.

The introduction of the new ramp and bridge structure will impact circulation patterns in this area and offers the opportunity to rearrange the interchange to give more pedestrian priority, avoid confusing circulation patterns and improve provision for cycle storage and mobility impaired passengers.

The pedestrian access ramp linking Broombridge Road to the IÉ Broombridge Station inbound platform will be removed. Alternative access to the Iarnród Éireann platform is available via the Luas platforms from Broombridge Road and the existing overbridge between the Iarnród Éireann platforms.

Figure 5-42: Aerial View of Existing Broombridge (Source Google Earth)

The proposed new layout provides improved access for bus, pedestrian and mobility-impaired passengers and frees up space for additional soft landscaping and a reduction in the area of hard surfaces. The introduction of the ramp structure creates a significant physical as well as visual barrier to access between the mainline station and Luas. This will be ameliorated by a wide pedestrian link underneath the bridge at the western end of the IÉ platform.

The under-croft area of the bridge is proposed to house a covered cycle storage facility. In order to bring the disabled parking bays closer to the platforms and interchange with IÉ, it is proposed to modify the existing depot parking area to generate the required space.

Materials and finishes are based upon the existing Luas palette for the interchange area to provide visual continuity. Existing tree alignments will be conserved as much as possible with new tree planting extended along the northern interchange platform. The western bank between the Broombridge Road and the interchange will be landscaped using native shrub species as well as along both sides of the Luas ramp structure. SuDS-based drainage proposals will be integrated where possible.

The bridge and viaduct structure will require careful landscape and visual integration with the Royal Canal banks and towpath, ensuring easy pedestrian, bike and maintenance access. Much of the existing canal side vegetation will be conserved, taking into account the ecologist's recommendations for several protected species, with careful replacement planting where necessary to conserve the existing canal greenway. The northern banks between Broombridge and the canal towpath will be landscaped using native species, including tall shrub visual screening along Colorman's industrial boundary.

Figure 5-43: 3D Rendered Image at proposed Broombridge Terminus

Broombridge Road

The integration of Luas Finglas along Broombridge Road creates an opportunity for the complete regeneration of its streetscape and industrial facades with extensive potential landscape development. The design intent is to transform what is currently an unfriendly pedestrian and cycle area into a more appropriate environment to facilitate and encourage walking and cycling. It is also intended to provide enhanced access between the Luas interchange and Tolka Valley Park, as well as linking Broombridge Road to the existing greenway along the Royal Canal towpath.

The development of Broombridge Road includes footpaths on both side of the road with a cycle lane on the western side of the road linking the existing cycle lane on Broombridge to Tolka Valley Park. Pedestrian and cycle circulation has been designed to create safe crossings at entrances and junctions.

New tree alignments are proposed on the western side of the road with soft landscaped areas where space permits, including planted buffers between the highway, cycle lane and footpath. The Luas approach ramp walls will be landscaped with climbing shrubs.

Hard materials and finishes are based upon the Luas palette with exposed aggregate concrete footpath and exposed aggregate bituminous cycle lane finishes, softened with the larger areas of soft landscaping.

The trackbed treatment along the at-grade section and approach ramp of the alignment is green track using a low maintenance sedum-based ground cover.

Figure 5-44: General view of Broombridge Road Looking North

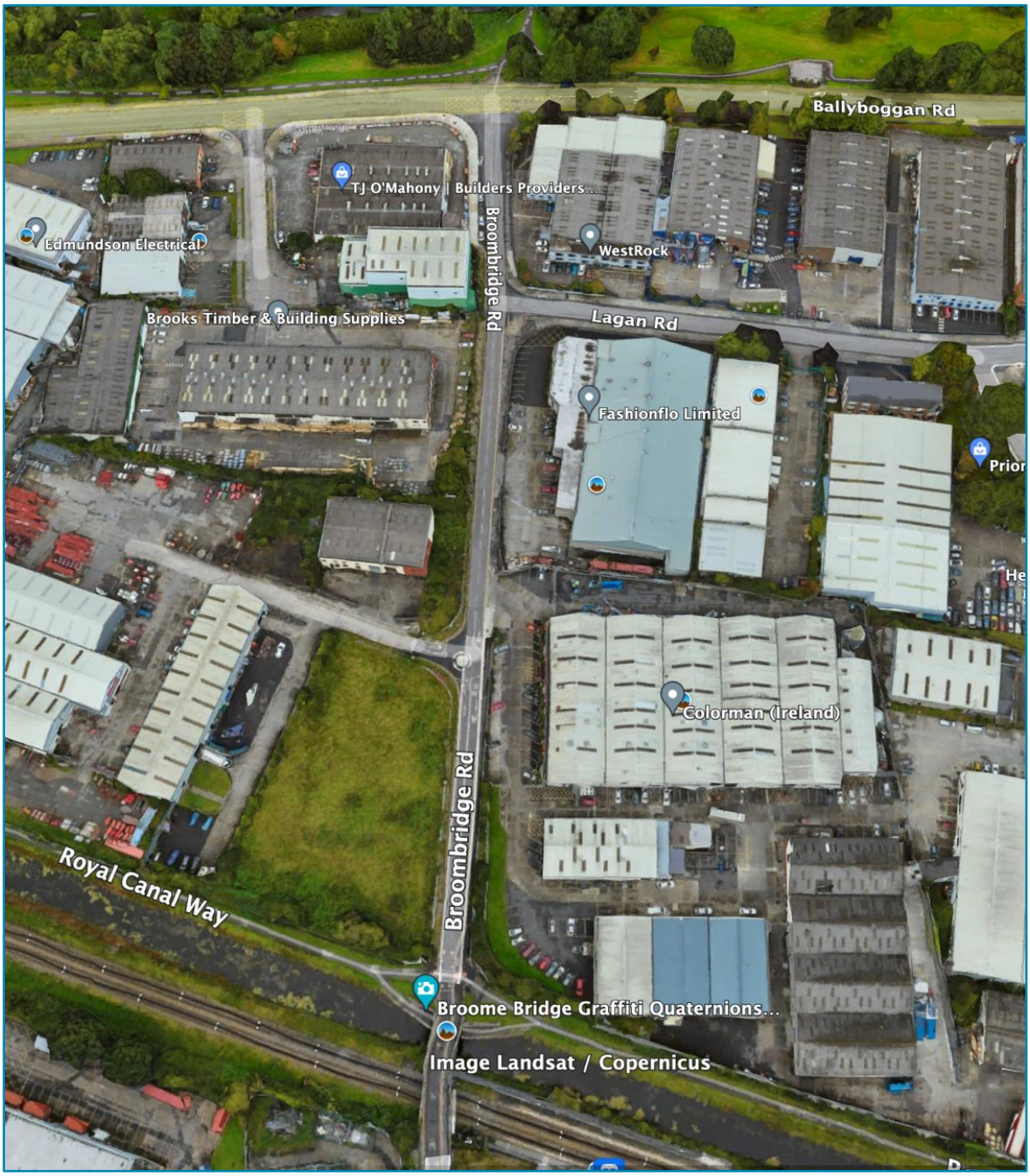

Figure 5-45: Broombridge Road Existing Arrangements (Source Google Earth)

As can be seen in Figure 5-46, there is a significant increase in tree and shrub planting along Broombridge Road as part of the proposals.

Figure 5-46: 3D Rendered Image on proposed Broombridge Road

Tolka Valley Park

Construction in Tolka Valley Park consists of the alignment and trackbed, a new bridge, as well as associated footpaths and cycle lane facilities linking Ballyboggan Road to Tolka Valley Road and St Helena's Park.

The alignment has been carefully designed to follow the existing ground contours as closely as possible in order to minimise construction impacts and avoid any disturbance of the contaminated soil in the vicinity of the proposed Scheme. The cycle lane runs parallel to the track crossing the Tolka Valley river on the new bridge and running through the park separated from the footpath with a green buffer strip. Several seating areas are located along the ramped footpath to provide resting areas and also viewpoints towards the wetland areas and urban skyline.

The existing Park Depot buildings will be demolished and replaced by a landscaped meadow grassland area integrated with a SuDS retention area for the track drainage. This will create an uncluttered visual axis down to the lake and urban skyline.

Two new entrance areas are proposed beside Ballyboggan Road and Tolka Valley Park Road which necessitate new pedestrian and cycle crossings, as well as reorganisation of the existing parking spaces along each road. Cycle parking areas are located beside both entrance areas.

The entrance area beside Ballyboggan Road will conserve pedestrian access to the existing Tolka Valley river footbridge as well as the cycle lane which follows the new Luas Tolka Valley Park bridge. The riverbank wetland areas will be conserved as much as possible taking into account the ecologist's recommendations for several protected species.

The existing trees will be conserved where possible though the Luas alignment will require the removal of several trees at the bridge crossing and entrances. Extensive compensation tree planting is proposed both at the entrances and along the alignment, together with the restoration of the meadow grassland areas. The track will be grassed to integrate it into the park's meadow grassland areas, with a sedum planted green track on the river bridge deck. Refer to Chapter 21 (Landscape and Visual Impact) and Volume 5 – Appendix 21.2 of this EIAR, for further detail on the number of trees to be removed and impact assessment.

The existing park railings and gates to footpaths will be replaced where necessary to match the existing, as well as providing anti-trespass measures and wheel traps at the track entrances to the park. Bollards will be provided on the cycle lane entrances to the park to prevent anti-social wheeled access. Timber bollards to delineate the swept path of the proposed Scheme Alignment in the open parkland are provided on each side of the track perimeter.

In line with DCC policy, only minimal lighting is provided within the park along the cycle lane and where it is necessary to ensure security and safety for the park users. This will include the park entrances, cycle parking and bridge crossings. Refer to Figure 5-47 to Figure 5-49 inclusive, below.

Figure 5-47: Aerial View of Tolka Valley Park (source Google Earth)

Figure 5-48: Proposed Landscape Scheme for Tolka Valley Park

Figure 5-49: 3D Rendered Image at proposed Tolka Valley Park

5.8.11.3 Area 32: Tolka Valley Road to Finglas Village Stop

St Helena's Park and Stop

St Helena's Park is at present a large open windswept grass area with limited tree planting at the southern and northern entrances. The open space's sloping topography provides magnificent views back to both Tolka Valley Park, the urban skyline and the Wicklow mountains. The meadow grass areas have significant importance in terms of the ecological value, and as such will be conserved or reinstated where possible.

The fenced open area also creates a physical and social barrier between the neighbouring residential estates with considerable resistance already expressed by the residents to link the eastern and western sides of the park.

The proposed Scheme will provide a federating element to the regenerated public open space, incorporating community activities and leisure activities e.g. community gardens, as well as developing an ecological corridor by enhancing biodiversity of the park with native shrub and tree planting.

Figure 5-50: Aerial view of St Helena's Park (source Google Earth)

The southern park entrance on Tolka Valley Road will be developed with a small public plaza to provide a meeting space with public seating and integrated cycle parking provision. The existing tree planting will be reinforced to create a visual buffer to the road traffic and create a gateway entrance to the park.

The park entrance will be treated in a similar way to the Tolka Valley park entrances, with replacement of existing park railings and gates to footpaths where necessary to match the existing. Anti-trespass measures and wheel traps will be provided at the track entrances to the park and bollards will be integrated on the cycle lane entrances to the park to prevent anti-social wheeled access.

The cycle lane will run parallel to western side of the track along a north-south axis, with a meandering footpath incorporating seating areas to provide resting areas and also viewpoints towards Tolka Valley Park and the Wicklow mountains. Several east/west footpaths links provide access from Barnamore Grove and St Helena's Road to the park areas and principal footpath.

The park's eastern side of the track will be conserved as meadow grassland with an ecological corridor created by native tree groupings parallel to the track. Several track drainage SuDS wetland features will be integrated into this area to enhance the biodiversity of the park. This area will also provide space for any future community leisure activities to be developed in coordination with Stakeholders and DCC Parks Department. Strategically positioned native woodland planting along the residential eastern perimeter will create visual and acoustic screening for the residential area.

The park's western side of the track will incorporate low shrub planting buffer areas between the track, cycle lane and footpath, as well as reinstated meadow grassland areas and new native tree planting. Tall screen planting will be provided along the western residential boundaries.

Timber bollards to delineate the swept path of the proposed Scheme Alignment in the open parkland are provided on each side of the track perimeter.

Figure 5-51: Proposed Landscape Scheme for a Section of St Helena's Park

The northern entrance to the park is provided by St Helena's Stop area. The Stop platforms will be integrated into the surrounding public open space levels to allow free pedestrian access and circulation, with the bike path turning around the area to meet St Helena's Road.

On the eastern side of the Stop, an informal play area with a terraced seating will provide an informal outdoor teaching facility linked directly to St Helena's Resource Centre. Link footpaths are provided between the Centre's creche play area and car park. Buffer shrub and tree planting will provide a visual screen between the Stop and the Centre.

On the western side of the Stop, two public open space areas are proposed. Firstly, adjacent to St Helena's Road, a large informal plaza area with social seating and tree groupings provides a community and Stop users' meeting place. Community facilities will be developed including a pavilion with stage and food court/truck facility with access from St Helena's Road.

Secondly, an informal community garden will be developed based on the circular economy concept with the re-use of materials from the project, including the Mellowes Park footbridge steelwork as a planted trellis structure.

Bike parking facilities will be located at three separate locations next to the bicycle and pedestrian circulation junctions to provide adequate and comfortable bike parking.

Figure 5-52: 3D Rendered Image at proposed St Helena's Park

All the leisure areas will provide natural surveillance of the Stop area, reinforced by CCTV and Help facilities adjacent to the Stop to minimise anti-social behaviour and integrate gender equity principles.

In the park, and in line with DCC policy, only minimal lighting will be provided within the park along the cycle lane together with pedestrian scale lighting at the park entrances and within the leisure areas to ensure security and safety for the park and LRT users.

The Stop will be equipped its standard lighting and street furniture including the Luas standard shelters.

Hard materials will follow the proposed Luas palette with a resin-bound gravel finish for the park's footpaths, an exposed aggregate bituminous finish for the cycle lanes and a self-binding gravel finish for the leisure areas and bike parking. The stop platforms and ramps will have a granite paving finish.

In St Helena's Park, the track will be grassed to integrate it into the park's meadow grassland areas, with a granite paving sett finish to the Stop track area between the platforms. SuDS drainage principles will be applied for all pedestrian and top areas draining into the soft landscape areas.

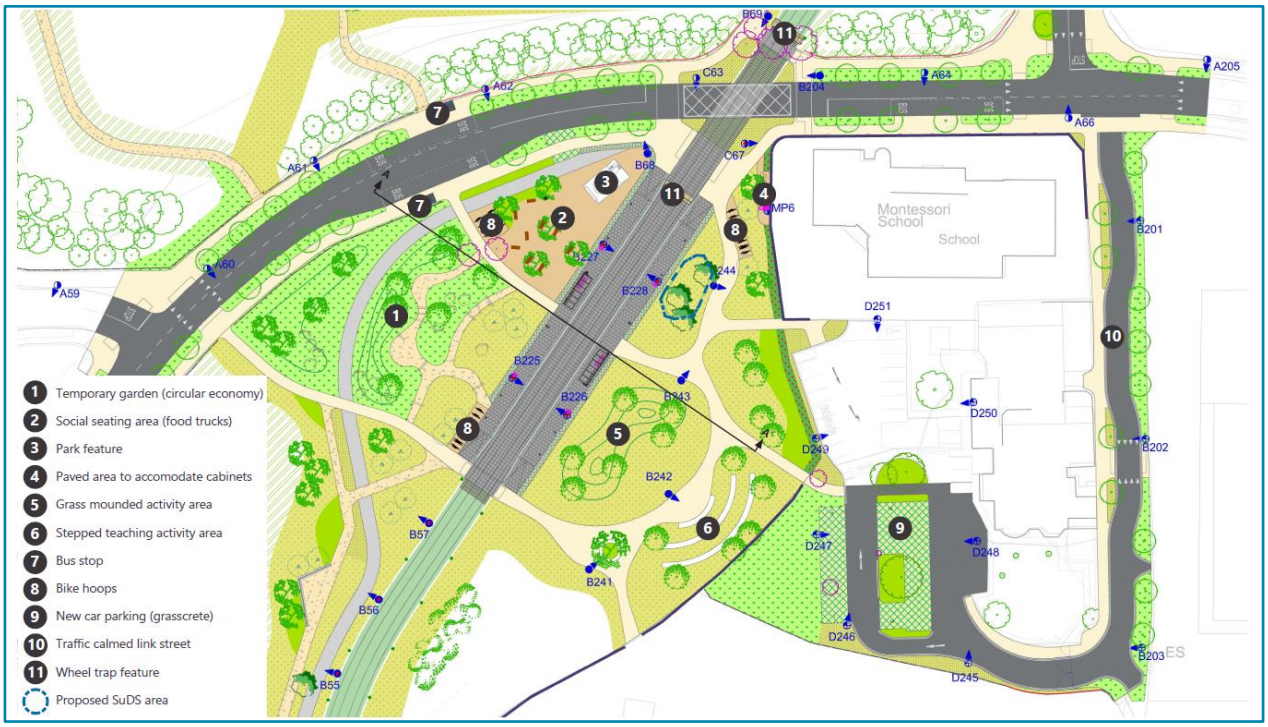

Figure 5-53: Proposed landscape scheme for St Helena's Stop

Figure 5-54: 3D Rendered Image at proposed St Helena's Stop

Refer also to Figure 5-50 to Figure 5-54 inclusive, above.

Farnham Park to Wellmount Road

The proposed Scheme will necessitate the relocation of the two sports pitches further to the west of the area and the removal of a number of trees both between the existing pitches and within the alignment. The proposed Scheme continues parallel to Casement Road within the existing green area. Several footpaths will have to be relocated to ensure the existing pedestrian circulation around the sports pitches and beside the alignment linking Farnham Crescent to Casement Road and Wellmount Road.

The sports pitch area is accessed both from St Helena's Road with three pedestrian crossings as well as Farnham Drive and Casement Road. The principal access from Farnham Drive will cross the alignment with two grassed mounds on either side of the footpath, thereby creating an entrance gateway and providing visual and acoustic screening for the sports pitches. A kiosk, to mitigate the impacts of the proposed Scheme on the GAA club, is proposed at the Farnham Drive park entrance area in order to provide a future storage facility for Erin's Isle GAA Club.

The majority of the existing trees will be conserved, with new native tree planting proposed on the grass mounded areas and in tree groupings along the Casement Road section. The existing grassland will be reinstated where necessary with the introduction of meadow grass areas around the relocated GAA sports pitch and the area east of the Casement Road section of the alignment. Tall native shrub and tree buffer planting is proposed along the Farnham Crescent residential area to provide visual and acoustic screening and together with the meadow grassland planting develop the section's biodiversity and greenway concept.

The trackform will be grassed to ensure its integration within the park area and alignment park bollards will provide track security from vehicles.

The existing park railings and gates to footpaths will be conserved or replaced where necessary to match the existing. Anti-trespass measures and wheel traps will be provided at the track entrances and crossings to the sports area. Ball stop fencing will be provided within the sports pitch area beside the alignment to ensure and protect the alignment passage.

Timber bollards to delineate the swept path of the proposed Scheme alignment in the open parkland are provided on each side of the track perimeter. Refer also to Figure 5-55 to Figure 5-57 inclusive, below.

Figure 5-55: Aerial view of Farnham Park (source Google Earth)

Figure 5-56: Proposed Landscape Scheme for Farnham Park

Figure 5-57: 3D Rendered Image at proposed Farnham Park

Wellmount Road to Finglas Village Stop

This linear section is sub-divided into three distinct landscape subsections: the narrow section beside the relocated Patrickswell Place Road, the predominantly green section between Cardiff Castle Road and Mellowes Court, and the urban section between Ravens Court and Finglas Village Stop.

The section beside the relocated Patrickswell Place Road is extremely narrow and after several alternative options were examined, the road linking Wellmount Road to Cappagh Road has been retained. The result is a narrow section integrating both the roadway and alignment with a relocated footpath on the western side of the road and the removal of a considerable number of existing trees. Cyclist circulation will be provided with roadside cycle lanes. Careful consideration is to be given to the western boundary treatment and levels, given the proximity of the relocated footpath and road. The existing footpath and boundary walls are conserved on the eastern side of the alignment.

The section between Cardiff Castle Road and Mellowes Court traverses the existing green area with existing tree planting, arriving at a narrow pinch point between Ravens Court and the existing Garda Station. Careful consideration is to be given to the treatment of boundary walling to Ravens Court, as well ensuring the pedestrian link between Cardiff Castle Road and Mellowes Road.

The grass track will continue up to Mellowes Road with a meadow grassland surface. Compensation native tree planting is proposed within the wider area of this section and buffer shrub planting between the two Garda Station car parks. Refer to Figure 5-58.

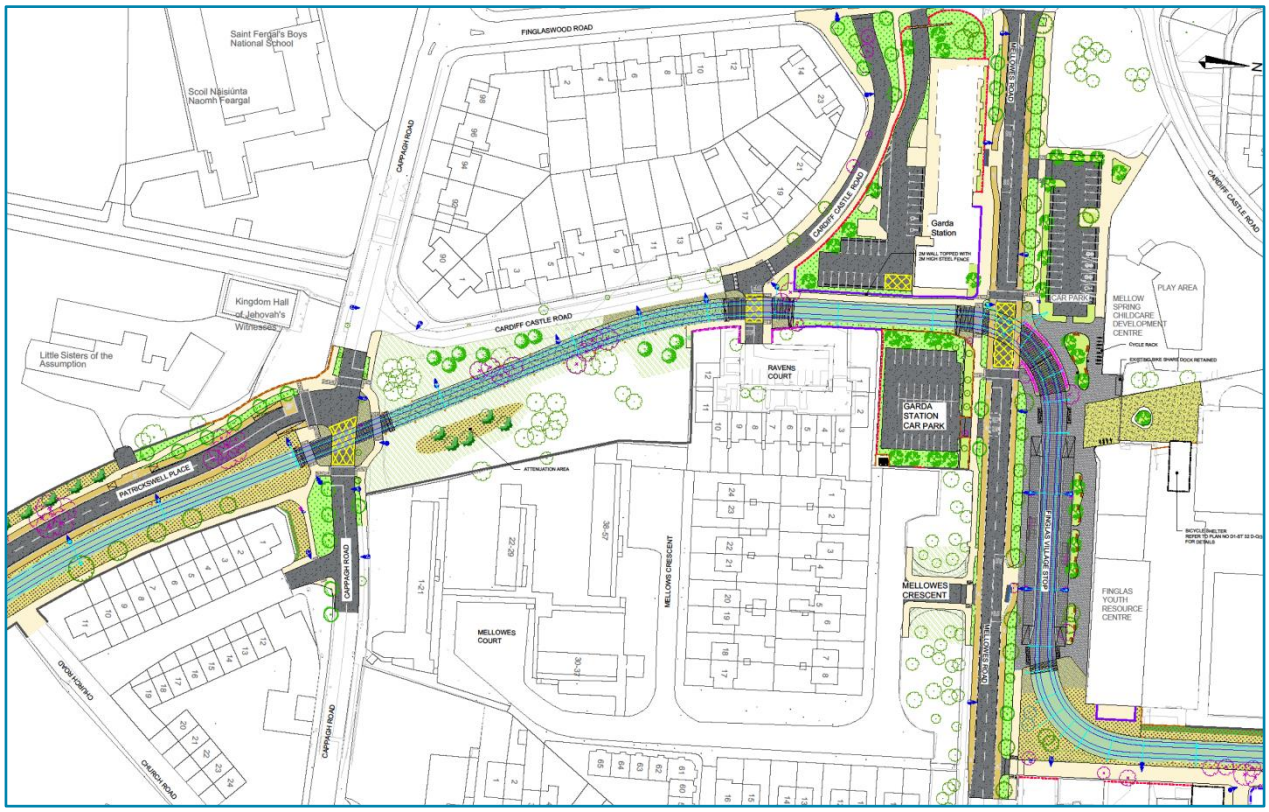

Figure 5-58: Proposed landscape scheme for Wellmount Road to Mellowes Road

Figure 5-59: 3D Rendered image at proposed Cardiff Road

At Mellowes Road, the alignment traverses the main road which has been altered to allow for the LRT passage. Pedestrian crossings adjacent to the alignment link the southern pavement to the Finglas Village Stop plaza, located within the existing car park area in front of the DCC office buildings.

The stop platforms are integrated into the plaza area levels, allowing free pedestrian circulation at the back of platform into the plaza area. The existing car park has been configured with a limited number of places and a single access to Mellowes Road. The plaza is directly linked to the Finglas Sports and Fitness Centre pedestrian area which provides a pedestrian and cycle link to Cardiff Castle Road. A bespoke covered cycle parking facility will be integrated behind the office building.

The plaza area will be landscaped with informal shrub planting and native tree planting areas, with integrated public seating areas to both provide for waiting LRT users and as a meeting place encouraging natural surveillance of the Stop. The planted areas will also provide SuDS drainage for the pedestrian areas.

The roadside footpaths will have an exposed aggregate concrete finish and the plaza area a granite paving finish providing a visual continuity with the stop's platforms and ramps. The stop track between the platforms will be finished with granite setts.

Three lighting levels are proposed – the highway lighting for the roadside footpaths and cycle lanes, Stop standard lighting and low-level lighting for the plaza pedestrian areas.

An anti-trespass wheel trap will be located at the exit of the alignment as it turns up the Mellowes Park between the DCC office and Park Depot buildings, in order to prevent vehicle access to the park area.

Refer also to Figure 5-60 to Figure 5-62 inclusive, below.

Figure 5-60: Aerial View of Finglas Village Area (source Google Earth)

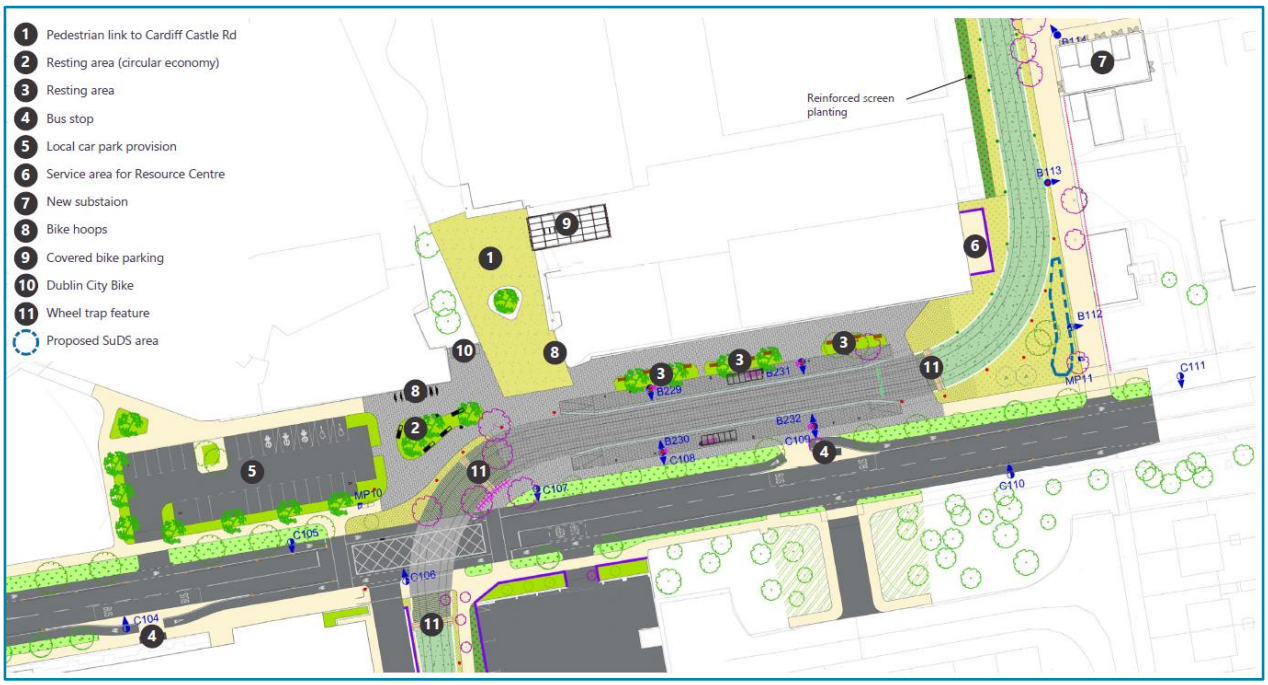

Figure 5-61: Proposed Landscape Scheme for Finglas Village Stop

Figure 5-62: 3D Rendered Image at proposed Finglas Village Stop

5.8.11.4 Area 33: Mellowes Park to Charlestown Terminus

Mellowes Park

The alignment exits the St Margaret's Stop with a steep curve between the existing Park Depot building and the Luas Finglas Sports and Fitness Centre's tennis courts. The Depot access road is conserved to provide access to the new substation location, as well as a future DCC residential development which is presently at feasibility stage. The alignment insertion will necessitate the removal of trees which will be compensated for by new native tree planting both in the tram stop plaza and Mellowes Park.

A pedestrian link is conserved linking the Stop plaza area to Mellowes Park with tall screen shrub planting. This is proposed along the existing tennis court boundary fence to reinforce the existing hedge and provide visual screening between the tennis courts and the alignment.

The footpath enters Mellowes Park crossing the alignment up to Casement Road with a new footpath running parallel to the alignment up to the junction with North Road. The footpath has several links to Casement Road crossing the park.

The principal objective of the alignment insertion within the park is to limit its visual and physical impact on the parkland public open space. This is achieved by the grass track alignment running parallel with the park's southern boundary beside the existing stone wall with meadow grass verges and the park alignment bollards running on the western side of the track. The track will also be grassed from the Stop plaza exit through Mellowes Park up to the junction with North Road to ensure its landscape integration within the parkland.

The alignment within the park will necessitate the removal of the footbridge between the Liam Mellows Memorial and the North Road. This will be replaced by new pedestrian crossings at the reconfigured traffic junction between North Road / Finglas Bypass and St Margaret's Road. This will replace the existing roundabout. The removal of several trees is also required at the eastern end of the park beside the junction with Finglas Bypass and which will be replaced by new tree planting within the area next to the Mellows Memorial.

The Mellows Memorial's existing layout and access from Casement Road will be conserved with a new ramped pedestrian link to the proposed Scheme footpath and traffic junction pedestrian crossings. The

ramped footpath will provide a visual viewpoint from the Memorial area over the parkland with meadow grassed slopes merging into the existing park areas.

Refer also to Figure 5-63 to Figure 5-64 inclusive, below.

Figure 5-63: Aerial View of Mellowes Park (source Google Earth)

The existing park railings and gates to footpaths will be replaced where necessary to match the existing, as well providing anti-trespass measures and wheel traps at the track entrances to the park. Bollards will be provided on the footpath entrances to the park to prevent anti-social wheeled access, in addition to the park alignment bollards along the track's western edge.

In line with DCC policy, only minimal lighting is provided within the park where it is necessary to ensure security and safety for the park users. Specific pedestrian lighting will be provided beside the Mellows Memorial footpath and footpaths adjacent to North Road.

Timber bollards to delineate the swept path of the proposed Scheme alignment in the open parkland are provided on each side of the track perimeter.

Figure 5-64: 3D Rendered Image at proposed Mellowes Park

St Margaret's Road

The new road junction between North Road/Finglas Bypass and St Margaret's Road will transform the area linking Mellowes Park to St Margaret's Road, with extensive new tree alignments and shrub planting. The controlled pedestrian and bike crossings will permit more comfortable pedestrian circulation and linkage between the Casement Road and North Road / St Margaret's Road neighbourhoods.

The new tree alignments and shrub planted areas will provide visual screening of the new road junction from the park areas as well as also providing extensive SUD's drainage capacity for both the footpaths, cycle lanes and highway areas.

A new substation will be located withing the demolished footbridge ramp area between the North Road and the proposed Scheme. The existing trees on this site will be conserved as much as possible, with additional tree and tall shrub planting to screen the substation from the surrounding area.

The LRT's insertion along the southern side of St Margaret's Road creates an opportunity to regenerate the entire length of the road into a tree-lined urban boulevard with separate cycle lanes and footpaths. The new boulevard will provide a strong urban and landscape visual identity as a green spine for the future urban regeneration along the road, including the redevelopment of both the Lidl and Aldi sites and the Kingstown Urban Regeneration masterplan.

Figure 5-65: Aerial View of St Margaret's Road (source Google Earth)

St Margaret's Stop is located between North Road and McKee Avenue, with its platforms and ramps integrated into the footpaths on both side of the alignment. The cycle lane will pass behind the northern platform parallel to the highway. The new tree alignment will continue along the platform integrating the Stop with the boulevard's streetscape.

A small public open space is proposed behind the southern platform with informal native tree and shrub planting integrating both cycling parking facilities, public seating and an access road to residual lands. The boundary treatment and planting will provide both visual and acoustic screening for the neighbouring residential area.

St Margaret's Stop will be linked by pedestrian crossings at the McKee Avenue Road junction to the proposed Park & Ride facility.

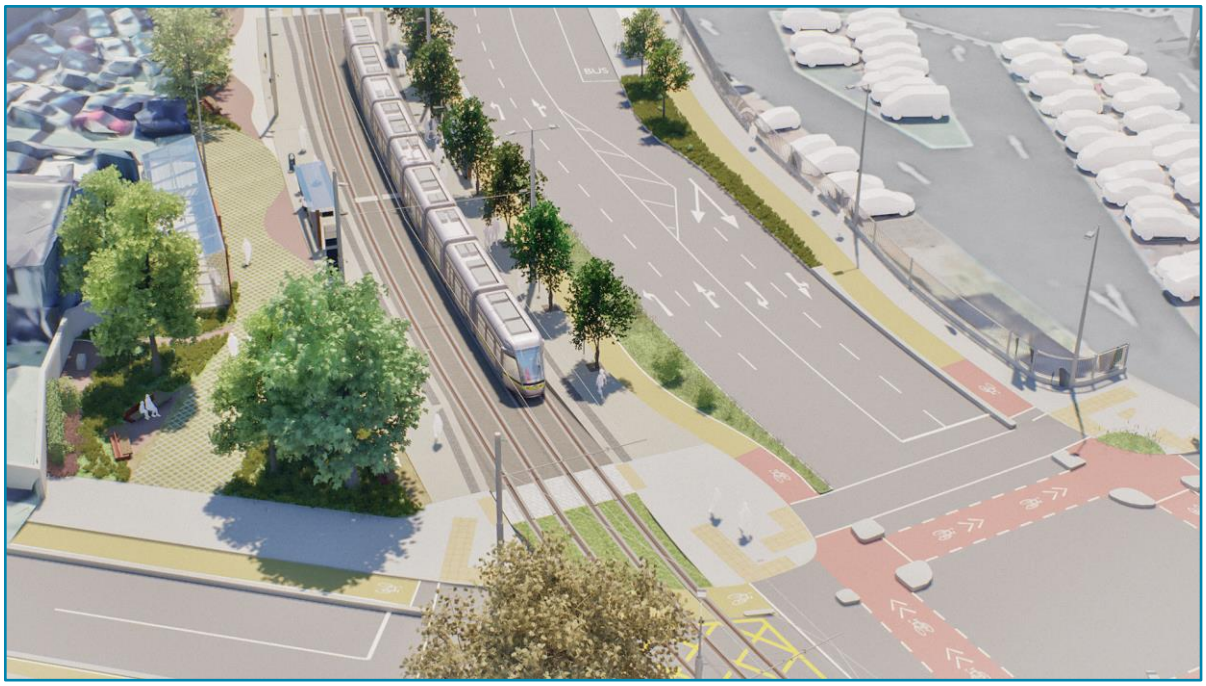

Figure 5-66: 3D Rendered Image at proposed St Margaret's Stop

The LRT's insertion along St Margaret's Road continues with a consistent cross-section up the Charlestown Terminus. The tree alignments and shrub planted areas are relatively narrow but will still provide SuDS capacity for the footpath and cycle lane areas. The LRT tracks will be grassed for nearly all their length along St Margaret's Road, excepting the two Stops and a short length traversing McKee Avenue.

As a result of consultation, St Margaret's Court residential area will be redeveloped with new car parking at the rear of the residences and to be accessed from the Kingstown Industrial Estate Road. This new parking will mitigate and replace on-street car parking impacted by the proposed Scheme. The boundary areas will be planted with native tree and shrub plating to screen the residences from the road.

Twelve residential properties along the west side of St Margarets Road, in the vicinity of McKelvey Road and McKelvey Avenue, will be impacted by the proposed Scheme with both permanent and temporary land take of gardens required, necessitating regrading of gardens / driveways and a new boundary wall / fence.

The existing boundary treatment will be conserved where possible and replaced with "like for like" where necessary. Two existing boundary fencing typologies have been identified – the residential boundaries with low walling and railings and the industrial fencing with 2m high steel fencing. Anti-trespass measures have been proposed beside the alignment pedestrian crossings, with wheel trap deterrents placed adjacent to the alignment road crossings.

The boulevard will be lit generally with highway lighting integrated with the OCS poles. Supplementary lighting will be provided for the footpath and cycle lane areas on the boulevard's wider sections and road junctions.

Figure 5-67: 3D Rendered Image at proposed St Margaret's Road

Refer also to Figure 5-65 to Figure 5-67 inclusive, above.

Charlestown Terminus

The terminus Luas Stop is located beside the complex St Margaret's Road / Charlestown Place / Melville Road junction. The junction has been completely reconfigured integrating both the terminus Stop and bus stops with the footpath and cycle lane crossings.

As with the North Road junction, extensive new tree and shrub planting will separate the highway from the footpath and cycle lanes areas, providing security and visual screening as well extensive SuDS drainage capacity for both the footpath, cycle lanes and Luas Stop platform areas.

The Luas Stop is inserted next to a commercial unit's car park boundary which will require rebuilding with new retaining walls and fencing. The platforms and ramps will be integrated into the surrounding footpath levels, with a proposed open cycle parking facility located on the southern end of the eastern platform and northern end of the western platform.

Several public open spaces with native tree and shrub planting are located around the Charlestown Stop, with integrated cycle parking facilities. The platform's granite paving will be extended into the public open space to ensure the Stop's integration into the public open space. The track area between the platforms will have a granite sett finish with a green ground covered planted area terminating the alignment.

Refer also to Figure 5-68 to Figure 5-70 inclusive, below.

Figure 5-68: Aerial View of Charlestown Area (source Google Earth)

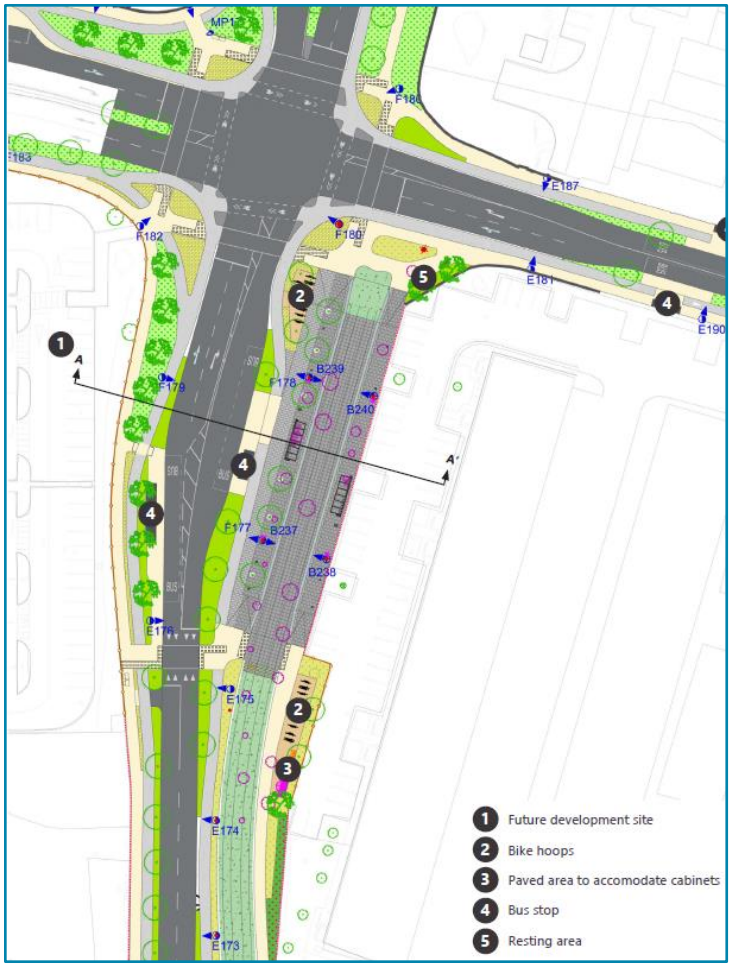

Figure 5-69: Proposed Landscape Scheme for Charlestown Stop

Figure 5-70: 3D Rendered Image at proposed Charlestown Stop

5.8.12 Lighting

A review of the existing lighting provision along the extent of the route has been carried out to understand the impact of the proposed Scheme on lighting columns and associated infrastructure. Several existing columns are proposed to be relocated or replaced to accommodate the proposed Scheme, as illustrated on the Landscaping Drawings provided in the RO Drawing Pack. Light Emitting Diode (LED) lanterns will be the light source for any new or relocated public lighting provided. The lighting design will involve works on functional, heritage and contemporary lighting installations on a broad spectrum of lighting infrastructure along the proposed Scheme. This will include, but not exclusively, luminaires supplied by underground and overhead cable installations and those located on ESBN infrastructure.

In locations where road widening and/or additional space in the road margin is required, it is proposed that the public lighting columns will be replaced and relocated to the rear of the footpath, where practicable, eliminating pedestrian obstruction. Where possible public lighting will be co-located on OCS poles to minimise the number of poles provided as part of the proposed Scheme. For existing columns that have specific aesthetic requirements, the intent for the replacement (where applicable) of such columns will include:

- Replacing the existing heritage columns and brackets with identical replica columns and brackets; and
- Replacing existing luminaires with approved LED heritage luminaires.

The design of the proposed Scheme also includes lighting at Luas Stops.

5.8.12.1 New Lighting

All new public lighting has been designed and must be installed in accordance with the requirements of the relevant National Standards and guides, including but not limited to:

- Local Authority Guidance Specifications;
- EN 13201: 2014 Road Lighting (all sections);
- ET211:2003 ‘Code of Practice for Public Lighting Installations in Residential Areas’;
- BS 5489-1 ‘Code of practice for the design of road lighting’;
- Volume – 1 - TII Specification for Road Works, Series 1300 & 1400;

- Volume – 4 - TII Road Construction Details, Series 1300 & 1400;
- IS EN 40 – Lighting Columns;
- *Institution of Lighting Professionals and Bat Conservation Trust (2018) Guidance Note 08/18 Bats and Artificial Lighting in the UK Bats and the Built Environment Series;*
- Institution of Lighting Professionals "GN01 Guidance Notes for Reduction of Obtrusive Light";
- National Parks and Wildlife Services, Bat Mitigation Guidelines for Ireland V2 (2022); and
- 'Guidance notes for the Reduction of Light Pollution' issued by the Institution of Lighting Professionals (ILP)

5.8.12.2 Bridges and Parks Lighting

Lighting design was developed in conjunction with the Luas Team ecologist to limit the impact on bats. The decision made was to avoid lighting on the bridges (Royal Canal and rail bridge and Tolka Valley Park bridge) and in the Parks, allowing only for lighting at the track crossings.

At these locations, where lighting is required, direction lighting (which only shines on access roads and not nearby countryside) will be used to prevent overspill. LED lanterns, which is a more bat-friendly light source as it contains very little/no UV frequency lighting will be used. Luminaires will emit zero upward light, in compliance with the Institute of Lighting Profession GN01 Guidance Notes for the Reduction of Obtrusive Light. This is particularly important near to Dublin Airport and at specific locations identified in Chapter 9 (Biodiversity) of this EIAR.

In addition, lighting control systems based on motion sensors will be installed, as per consultations with DCC Parks Department.

Any potential impacts arising due to the lighting design on biodiversity has been assessed in Chapter 9 (Biodiversity) of this EIAR.

5.8.13 Utilities

When considering the scope of diversions for a new LRT project, the parameters of the design follow particular requirements. Utilities beneath the proposed Scheme have been assessed for diversion, as this facilitates both the construction of the new trackbed and also the accessibility to the utilities post construction and uninterrupted operation of the LRT system. This is primarily due to the fact that a rail system and its rolling-stock is fixed with no ability to divert from the track. Therefore, to avoid operation disruption, to facilitate repairs and maintenance to utility infrastructure, the utility infrastructure is diverted to a new position where utility providers maintenance crews can carry out their works safely without interfering with the running of the system as far as practicable.

The design of the utility diversions takes consideration of future operations and maintenance from the beginning of the process, whilst also taking account of constructability and sequencing of the works taking account of existing utility infrastructure, allowing for minimum interruption to existing services.

Refer to Chapter 17 (Material Assets: Infrastructure and Utilities) for further information.

5.8.13.1 Existing Services

Requests were made to the following service providers for their latest records, namely:

- Uisce Éireann (Irish Water): asset owners for potable water, foul drainage and combined drainage;
- Local authorities: DCC and FCC;
  - Asset owners of: Public Lighting, Traffic, Local CCTV Fibre, and surface water drainage;
- ESBN: High voltage and Medium/Low voltage overhead and undergrounded network. Also including ESBN Telecoms: Communications network;
- Gas Networks Ireland: High pressure and low-pressure mains - including also Aurora communications ducting and cables;

- Eir: Communications network;
- Virgin Media Ireland: Communications network;
- BT Ireland: Communications network; and
- Alt Comms Companies: Colt, ENET(Verizon), Smart, Vodafone, and EU Networks.

Service information was gathered and combined into a single-model file and standardised, to evaluate where conflicts are present and what proposed diversions will be required for a like-for-like design.

Verification of the existing services was undertaken. This was to ensure that the design that is being developed is in line with the existing services as verified are correct.

The following surveys were undertaken:

- Ground penetrating Radar (GPR), to accurately map the underground services;
- CCTV – to verify the condition and inverts of the existing drainage systems; and
- Slit-trenching to further verify services not captured in the GPR and to validate GPR findings.

Below is a comparison table outlining these three survey methods employed.

Table 5-25: Comparison of the Survey Methods Employed

Method	PROs	CONs
Utility Record Information	▪ With certain utilities (e.g. ESBN) additional information may be present highlighting depths, distance to kerbs/buildings and configuration of the cabling/ducting. ▪ Records also give an indication to the historical abandonment of ducting and pipework. ▪ Having the latest record information from each of the relevant service providers should give an accurate account and quantity of the ducts and pipework that they have present underground.	▪ Record information is rarely point accurate and should be used as a guide only as to the position of the ducting and pipework present. It has been found that the quantities are usually quite accurate. ▪ Chambers and manholes are not usually detailed on records, so size and special dimensioning is not available without a comprehensive survey being undertaken. ▪ The latest as-laid records have not always been up-dated to reflect the most recent services laid.
GPR (Ground Penetrating Radar) [Mapping]	▪ Comprehensive view of interactions of utilities in congested areas. Providing designers with a very good understanding of constraints and requirements. ▪ Overall, approximately 80% Accurate ▪ 3-Dimensional information available ▪ Non-invasive process ▪ Minimal Traffic and/or associated pedestrian management ▪ Suitable for all surfaces except overgrown, rough terrain ▪ No permits required, liaison with the local authorities on method of work and agreement to hours of presence on site is usually all that is required	▪ Some utilities can evade capture by radar (particularly Gas/Water). ▪ Some difficulties encountered in interpretation of data collected in the survey during the post-processing process. Therefore, can be quite iterative when liaising with the utility companies for confirmation. ▪ Quality of the interpretation during the post processing: the accuracies or otherwise is dependent on which mapping company completes the task, The last contracts received went to two different contractors and it was found that one was more accurate than the other.

Method	PROs	CONs
Slit Trenching	▪ Accurate and exact: however, this is limited to within the excavated focus area only. ▪ Suitable for all terrains and surfaces, very few exceptions ▪ Ability to send survey team to survey precise GPS (XYZ) coordinates of exposed utilities within the excavated trench ▪ Invasive process requiring traffic Local Authority permits and agreement ▪ Relatively quick to complete once permits and agreement is in place	▪ Comprehensive traffic and pedestrian management required to be agreed in advance of works with local authorities. ▪ Invasive excavations. Noise, vibration, and dust/debris being present during the process. ▪ No ability to recheck received data queries, except through photographs taken while the trench is open. ▪ Strict time restrictions placed upon the contractor with regard to hours of work.

5.8.13.2 Utility Diversions

Due to the extensive nature of the proposed Scheme, there are certain areas along the route which will require utility diversions, due to localised conflicts. Identified service conflicts and recommended diversions are described and assessed in Chapter 17 (Material Assets: Infrastructure and Utilities) of this EIAR.

5.8.14 Operations

5.8.14.1 Operating principles for normal operations

Normal operations cover operating modes for which the LRT system is designed, and for which its performances are optimal.

The new LRVs will be driven manually using line-of-sight. During normal operations, LRVs will normally run on the left-hand side. The LRV driver will be responsible for:

- Driving at a safe speed, according to the urban and environmental conditions (visibility, pedestrians, road traffic and other LRV movements, etc.);
- Respecting speed restriction signs and other operating instructions;
- Respecting signalling colour aspects between:
  - Cars, buses and LRV (stop, proceed, caution); and
  - LRV and LRV (stop, proceed, points position confirmed);
- Keeping a safe distance between cars, buses and other LRVs;
- Being capable of stopping safely at any moment, before a reasonably visible stationary obstruction ahead, from the intended speed of operation using the service brake; and
- Keeping to the scheduled timetable (note : Luas does not operate on a published scheduled timetable, only operating times and frequencies/headways).

Normal line operation is managed by the Network Management Centre (NMC). The Red Cow control room is currently used for the operation of both lines (Green Line and Red Line). The Broombridge Hamilton depot is only used for minor maintenance operations. A mini-control room with one desk (and no permanent staff) is also set up at this depot, as per Figure 5-71. This room is due to be expanded as part of the Luas resilience project with an additional desk and workstations to be added.

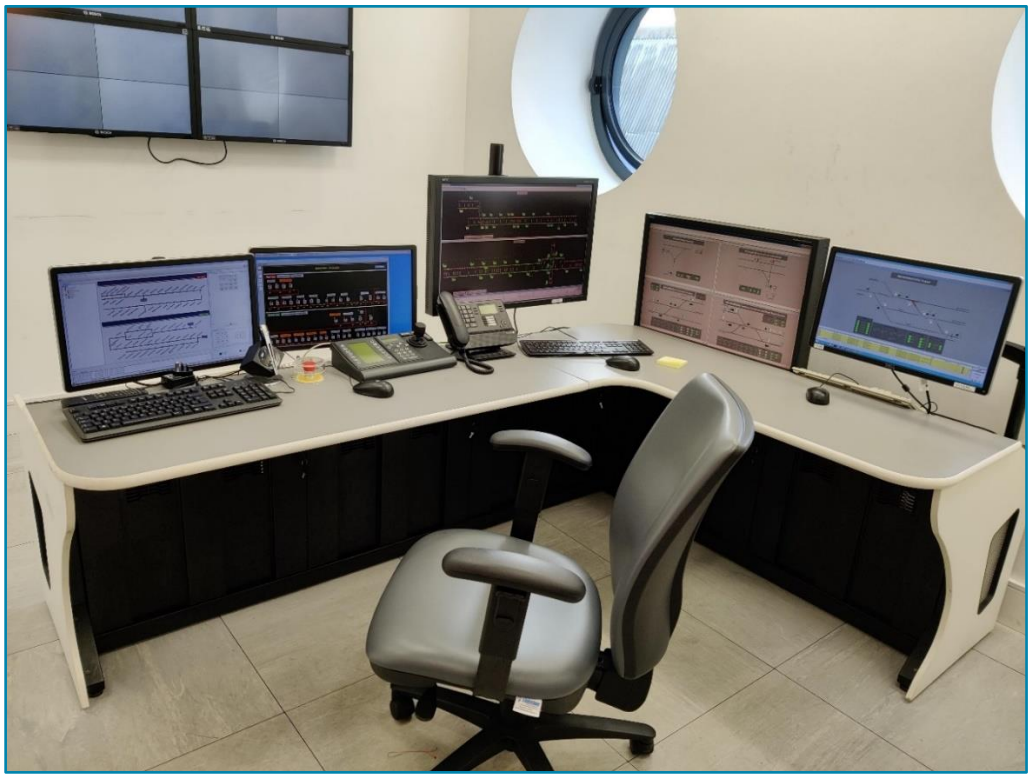

Figure 5-71: Current control room at Broombridge Hamilton depot

The normal line operation managed by the NMC includes:

- LRT insertion and withdrawal (depot ↔ mainline);
- LRT regulation;
- Management of operating personnel (including drivers);
- Management of passenger boarding and alighting at stops;
- Passenger information and announcements; and
- All background activities managed by the NMC.

During normal operations, the O&M Entity shall ensure that only authorised persons who have been properly trained and certified are allowed to access the LRVs, Stops, infrastructure, track, fixed installations, systems and equipment. This includes their personnel, third party suppliers and Subcontractors. Before staff are given access to the LRT line facilities, the O&M Entity shall ensure that the relevant section is safe to access and, if required, no longer in train operation (with the traction power switched off, if required).

During the access period, the O&M Entity will (via the NMC) continually monitor and coordinate developments. Before returning the LRT line to revenue operations, the O&M Entity will ensure that it is back to a safe and proper state (e.g. that everyone has left the track and infrastructure, and not forgotten any tools or left any objects creating obstacles, etc.). If this is not the case, then the O&M Entity will manage the situation locally and aim to resolve the delay to revenue services as quickly as possible.

Regarding the cleaning of the grooved track, a special vehicle is currently used on the Luas network.

Before opening to service, the proposed Scheme will follow a period of testing and commissioning, to test the correct functioning of the systems and guarantee safety for optimal use. This is then followed by a shadow running period to simulate the final operation of the system without passengers and to facilitate driver training and familiarity.

5.8.14.2 Commercial services

There are currently four services operating on the Luas Green Line:

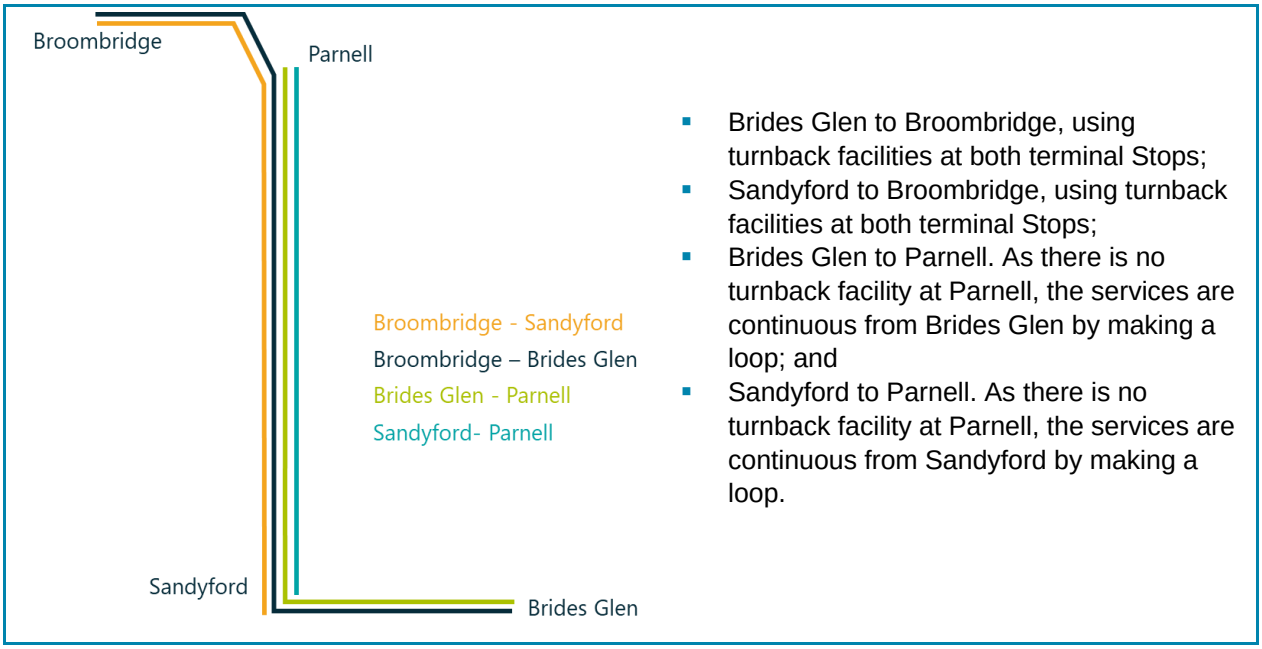

Figure 5-72: Luas Green Line current commercial services

At the opening of the proposed Scheme, it is planned that the same services will be operated on the Green Line, with the exception that the services currently terminating in Broombridge will proceed to Charlestown, as shown below.

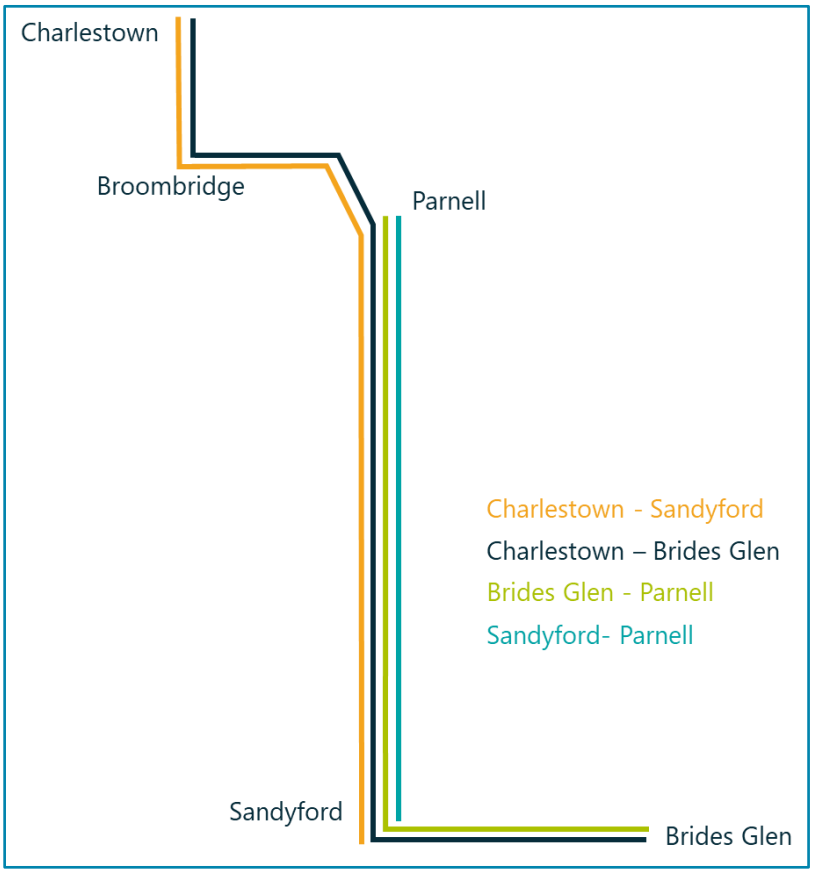

Figure 5-73: Luas Green Line planned services at the opening of the Finglas section

5.8.14.3 Timetables

Luas currently operates 364 days per year (no service on Christmas Day). There are three types of operating days in the year:

Table 5-26: Luas operating days

Operating day	Number of operating days per year
Weekdays (Mondays to Fridays)	253
Saturdays	51
Sundays & Bank Holidays	51+9
Total	364

The period of operation is currently as follows:

Table 5-27: Luas operating hours (source: Luas website)

Operating day	First departure from Broombridge terminal station	Last departure from Broombridge terminal station
Weekdays (Mondays to Fridays)	05:30	00:17
Saturdays	06:30	00:17
Sundays & Bank Holidays	07:00	23:17

During the peak periods, the LRT is operated at their shortest headway (or highest frequency). The greatest number of LRVs are out on-line and in revenue operation.

For weekdays, the morning and afternoon peak periods that are considered are based on the Luas Green Line timetable:

- Morning Peak: 07:00 to 10:00; and
- Afternoon Peak: 16:00 to 19:00.

For Saturdays, Sundays and Bank Holidays, there are no morning and afternoon peak periods.

There are also occasional late-night services running during the holiday period around Christmas and New Year and for special events (including occasional 24-hour or extended services).

The current fleet size on the Green Line is 41 *Citadis 502* LRVs. The highest peak vehicle requirement is in the morning when 32 LRVs are needed for the on-line operation.

It is assumed that the proposed Scheme will be operated with a peak hour headway of 7½ minutes at the opening of the extension (year 2035) with 4 additional LRVs on-line. In the long-term horizon, the peak hour headway could be reduced to 5 minutes, with 6 additional LRVs on-line.

5.8.15 Land Use and Accommodation Works

5.8.15.1 Summary of existing land use and affected landowners

This section outlines the design development of the accommodation works for the proposed road development.

The Luas Team, undertook a series of meetings with the directly affected property owners to communicate the status of the project delivery and to further understand how the proprieties will be affected, including access arrangements and continued use of their land. At these meetings, concerns raised and requests

made by landowners were recorded and were then communicated to the design team to be considered as part of the design development.

The design of the accommodation works is subject to ongoing discussions with affected property owners. Given the extent of land impacts and property acquisitions, significant accommodation works elements, and in particular, the design of accesses, parking and re-circulation movements within affected properties have been developed and included in the design.

5.8.15.2 Requirements to Acquire Land

The Property Registration Authority of Ireland (PRAI) mapping shows the extent of ownership of registered lands. During the Preliminary Design, this PRAI mapping was reviewed to assess the current access arrangements for each land parcel, business property and dwelling. This information, together with landowner consultations, has informed the access requirements and the development of accesses, etc.

Impacts on landowners, businesses and farm holdings are inevitable and land acquisition is necessary for the provision of the proposed Scheme. The land acquisition plans are prepared in accordance with the requirements of the RO application.

Land take due to construction will be required for various reasons including:

- Light Rail track construction;
- Light Rail Stops construction;
- Substation construction;
- Ducting, OCS;
- Road construction;
- Active Travel construction;
- Drainage and Environmental works;
- Structures;
- Buffer zones and landscaping;
- Verges, embankments and cuttings;
- Access Roads;
- Accommodation works for entrances and accesses to businesses, houses and properties;
- Maintenance strips and working space;
- Construction staging and traffic management; and
- Fencing, Signage and other ancillary works.

5.8.15.3 Proposed Accommodation Works

Accommodation works are proposed to alleviate the impacts on landowners. Accommodation works will be negotiated further for final agreement with the relevant landowners at the detailed design stage. The accommodation works aim to:

- Ensure property owners are given appropriate access to their property;
- Provide for alternative vehicle movement or car parking where impacted;
- Ensure property owners are given access to the local road network in the area;
- Where existing boundary treatment / walls are impacted provide for replacement on a like for like basis
- Maintain services and water supplies; and
- Provide drainage requirements.

Once the required lands are in possession for the commencement of works, boundary fences / walls will be erected to secure the site and control access. In places where permanent walls or fencing cannot be erected immediately or where none is required, temporary construction fencing, or hoarding will be required to secure the site.

5.8.16 Safety and Risk

This section discusses safety and security considerations of the proposed Scheme from a design perspective. It is sub-divided into two main sections:

- Personal safety on the network, covering criminal and anti-social behaviour; and
- Global security of the network, covering risks such as terrorism.

The designs are intended to integrate design principles to lessen the likelihood of criminal and anti-social behaviour. Due consideration has been given to the design in particular by:

- Providing inward and outward visibility at entrances and exits;
- Providing a defined perimeter to the Stop;
- Maximising opportunities for informal natural surveillance;
- Ensuring waiting areas are visible to others;
- Providing adequate way-finding features at entrances and exits;
- Providing emergency help points, information points within a well-lit and CCTV-covered environment; and
- Where relevant, provide secure facilities (i.e. for cycle parking).

Luas Stops can become crowded places, and as a result become a potential terrorist target. It is recognised that a range of simple measures can help to create the feeling of a controlled environment which can act as a deterrent for hostile actors, and also provides reassurance to customers. These measures include:

- Minimising street clutter, in particular street furniture;
- Ensuring cupboards and equipment boxes are fitted with locks and or tamper proof seals; and
- Providing access controls.

5.9 Difficulties Encountered in Compiling Information

No difficulties were encountered during this phase of the EIAR.

5.10 References

BSI, British Standards Instituition, 2018. *BS 8300-1:2018 Design of an accessible and inclusive built environment,* UK: BSI.

Department for Transport, UK, 2021. *Inclusive Mobility : A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure,* London, UK: Dft, UK.

Department of Environment, Climate and Communications, 2024. *Climate Action Plan,* Ireland: DECC.

Department of Housing, Local Government and Heritage, 2022. *Building Regulations:Technical Guidance Document M,* Dublin: DHLGH.

Dublin City Council, 2019. *Climate Change Action Plan,* Ireland: DCC.

EPA, 2023. *Monitoring Assessment Green House Gas.* [Online] Available at: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/ [Accessed 2023].

Gehl Institute, 2018. *Twelve Quality Criteria for public urban spaces,* Ireland: Gehl Institute.

Government of Ireland, 2015. *Comprehensive Employment Strategy for People with Disabilities,* Dublin, Ireland: Stationery Office.

Government of Ireland, 2023. *Design Manual for Urban Roads and Streets.* Dublin, Ireland: Stationery Office.

Inland Fisheries Ireland, 2020. *Planning for Watercourses in Urban Environment Guidelines,* Dublin: IFI.

Irish Wheelchair Association, 2020. *Best Practice Guidelines,* Dublin: Irish Wheelchair Association.

National Disability Authority, 2012. *Shared Space, Shared Surfaces and Home Zones from a Universal Design Approach for the Urban Environment in Ireland,* Ireland: National Disability Authority.

National Disability Authority, 2015. *How Walkable is Your Town,* Dublin: National Disability Authority.

National Disability Authority, 2020. *Building for Everyone: A Universal Design,* Dublin: NDA.

NTA, 2023. *Cycle Design Manual,* Ireland: National Transport Authority.

South Dublin City Council, 2022. *Sustainable Drainage Explanatory Design & Evalauation Guide,* Ireland: SDCC.

TII, 2011. *Specification for Road Works; Earthworks,* Ireland: Transport Infrastructure Ireland.

TII, 2019. *Ireland's Environmental Strategy,* Ireland: Tranport Infrastructure Ireland.

TII, 2020. *Travelling in A Woman's Shoes,* Dublin, Ireland: Tranport Infrastructure Ireland.

TII, 2021 [Updated 2023]. *Statement of Strategy,* Ireland: Transport Infrastructure Ireland.

TII, 2023. *All Aboard: TII's Accessibility Podcast,* Dublin: Transport Infrastructure Ireland.

TII, 2024. *Sustainability Implementation Plan,* Ireland: Tranport Infrastructure Ireland.

Transport for London, 2017. *Guide to Healthy Streets Indicators,* London,UK: Transport for London.

UK Department of Transport, 2021. *Guidance on the Use of Tactile Paving Surfaces,* London, UK: UK Department of Transport.

USEPA, 2011. *Guide To Sustainable Transportation Performance Measures,* USA: USEPA.

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