



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

METROLINK

Luas Green Line

Peak hour capacity requirements south of Charlemont



QUALITY
I.S. EN ISO 9001:2008
NSAI Certified



Document Control Information

Document Title	Luas Green Line					
Filename	Peak hour capacity requirements south of Charlemont					
Date	Description	Doc. No.	Rev.	Prepared	Checked	Approved
19-03-2019	For Issue		01	DB	EG	AF



Table of Contents

1	Overview	1
2	Calculating Capacity of a light rail service.....	1
3	Existing capacity on the Luas Green Line	1
4	Options for increasing capacity on the Luas Green Line.....	1
4.1	Green Line Capacity Enhancement Project.....	1
4.2	Further Upgrade of Green Line.....	2
4.3	Metro Service.....	2
5	Transport Model Projections	3
6	Summary	4

List of Figures

Figure 1: Green Line AM northbound max line flow projections and capacities to 2057	4
---	---

List of Tables

Table 1: Potential Green Line capacity for different levels of upgrade	3
--	---



Glossary of Acronyms

Acronym	Definition
ERM	East Regional Model (ERM)
GLCE	Green Line Capacity Enhancement
LCC	Luas Cross City
NTA	National Transport Authority
PHF	Peak Hour Factor
PPHPD	Passengers per hour, per direction
TII	Transport Infrastructure Ireland



1 Overview

This note outlines a review of the available Luas Green Line passenger demand projections undertaken as part of the Green Line Capacity Enhancement (GLCE) and MetroLink projects. These projections are reviewed in the context of the required service capacity to accommodate the future projected demand on the existing Luas Green Line, south of Charlemont.

2 Calculating capacity of a light rail service

The capacity of a light rail service is a function of the vehicle sizes / length and the service frequency. Ultimately a peak vehicle requirement and service type is determined through an analysis of projected maximum line flows during peak periods. Given that line flow projections are generally expressed as passenger demand per direction per hour (ppdph), a peak hour factor (PHF) is applied to allow for loading diversity within the hour. An hourly service capacity can then be calculated as:

$$\text{Vehicle capacity} \times \text{service frequency} \times \text{PHF}$$

It is good practice to design a new system with a PHF of 0.8. Due to the unique character of the Green Line between Sandyford and St. Stephen's Green i.e. high level of segregation with very high journey time reliability, PHF in excess of 0.9 have been recorded¹. In this regard TII generally applies a PHF of 0.9 to this section of the Luas Green Line.

3 Existing capacity on the Luas Green Line

At present, with the full Luas Cross City (LCC) service plan in place, there are 20 northbound trams per hour leaving Sandyford Depot at 08:00. At present a mix of Citadis 402 Trams (43m long) and Citadis 502 trams (55m long) operate during the AM peak. The capacity of 402 and 502 vehicles is 319 passengers and 408 passengers, respectively. Typically the capacity currently provided in the AM peak hour is 6,408 ppdph.

4 Options for increasing capacity on the Luas Green Line

4.1 Green Line Capacity Enhancement Project

In November 2017 funding for the Green Line Capacity Enhancement (GLCE) project was approved by Government. The primary objective of the GLCE project is to optimise the public transport network along Dublin's southeast corridor and cater for the future demand for services, ensuring optimal use of existing infrastructure in advance of other major public transport investments.

The project involves increasing the capacity of Luas Green Line through extension of existing tram fleet (lengthening existing 43m trams to 55m trams) and the purchase of eight new trams to facilitate a peak hour frequency northbound of 24 trams per hour.

The GLCE project is currently being implemented by TII in stages and the fleet will incrementally be upgraded with all existing trams and delivery of new trams expected to be complete in early 2021. Ultimately the GLCE project will provide for all 502 type trams (55m in length) with 24 trams per hour in

¹ The actual peak hour factor (PHF) of an existing system can be calculated empirically using the formula $PHF = \frac{V_h}{4 \times V_{max15}}$ where V_h is the recorded hourly volume and V_{15max} is the highest 15 minute count.



the peak hour between Sandyford and St. Stephen's Green. Using a 0.9 PHF, a peak hour capacity of 8,813 ppdph will be provided on the Green Line.

It should be noted that initially within the appraisal of the GLCE project, based on the manufacturer's specification, the capacity of 55m vehicles was assumed to be 379 passengers. The 55m trams have subsequently come into operation on the Luas Green Line and the actual capacity of the vehicles is 408 passengers.

Based on the modelling undertaken for GLCE and the assumptions around capacity it was projected that the Green Line would return to 2015 levels of crowding and passenger comfort and operate over capacity by 2030.

4.2 Further Upgrade of Green Line

In the appraisal of GLCE it was acknowledged that further capacity enhancement of the Green Line would be required by 2030. However, it was also acknowledged that planned investment in transport up to 2027 which includes MetroLink and BusConnects would influence the pattern and level of passenger demand on the Luas Green Line. It was therefore determined that the timing, nature and scale of any future upgrade should not be considered until further detail of the design and implementation of these schemes was known.

Further upgrade of the Luas Green Line to increase capacity in the peak hour would require both infrastructural improvements and acquisition of additional trams. Based on an assessment of the Luas Green Line it has been determined that the maximum ultimate capacity possible for Luas operations would be 55m trams, operating a frequency of 30 trams per hour between Sandyford and Charlemont.

Achieving a frequency of 30 trams per hour while maintaining operational reliability and efficiency would require, at a minimum, additional tram turn back facilities at St. Stephen's Green and Charlemont, adjustment of signal priority at Dunville Avenue / Beechwood Road and grade separation of the Luas crossing at St Raphaela's Road. An increase to 30 trams per hour on the Green Line in the morning peak would provide a capacity of 11,016 ppdph.

It should be noted that the frequency of trams in the AM peak hour could be incrementally increased to 26 trams per hour without the implementation of all infrastructure measures identified.

4.3 Metro Service

As identified in the *Greater Dublin Area Transport Strategy 2016-2035* it is necessary to upgrade the Luas Green Line to metro standard to service the expected future demand.

Based on an analysis of Green Line capacity undertaken by Jacobs / Idom for the MetroLink project, a Metro service would have a carrying capacity of 500 passengers per vehicle. With a frequency of 40 trains per hour and a design PHF of 0.9, this would provide a capacity of 18,000 ppdph.

The potential capacity of the Green Line upgrades are summarised in Table 1.



Table 1: Potential Green Line capacity for different levels of upgrade

Service	Vehicle Capacity (passengers)	Peak hour frequency (trams per hour)	Peak Hour Factor	Capacity (passenger per direction per hour)
Current Green Line services	319 / 408	20	0.9	6,407
Green Line Capacity Enhancement	408	24	0.9	8,813
Further Upgrade of Green Line	408	30	0.9	11,016
Metro Upgrade	500	40	0.9	18,000

5 Transport Model Projections

A number of transport modelling scenarios for the Green Line have been run in the NTA East Regional Model (ERM) as part of the GLCE Business Case and the selection of an Emerging Preferred Route for New Metro North (now MetroLink).

These scenarios can assist in projecting the required capacity on the existing Green Line south of Charlemont. It should be noted that these runs are preliminary, in the context of the MetroLink project. As with any projections of future demand, the longer the term of the projection the greater the uncertainty around the accuracy. For this reason it is appropriate to consider a range of potential demand. Two scenarios have been used for the projection that provide a low and a high estimate of future demand on the Green Line:

- **Low Projection:** GLCE Business Case demand, adjusted to account for the impacts of Metro from Swords to Charlemont; and
- **High Projection:** Full MetroLink from Swords to Sandyford.

Both scenarios were run in the NTA ERM for horizon years of 2028 and 2035 with projections beyond 2035 based on extrapolation of the linear interpolation of growth in demand between 2028 and 2035.

An analysis of maximum line flow projections on the Green Line south of Charlemont between 2028 and 2057 has been undertaken, using the results of the 2028 and 2035 model runs. A plot of the projected maximum line flows, including the service capacities discussed in Section 4 is presented in Figure 1.

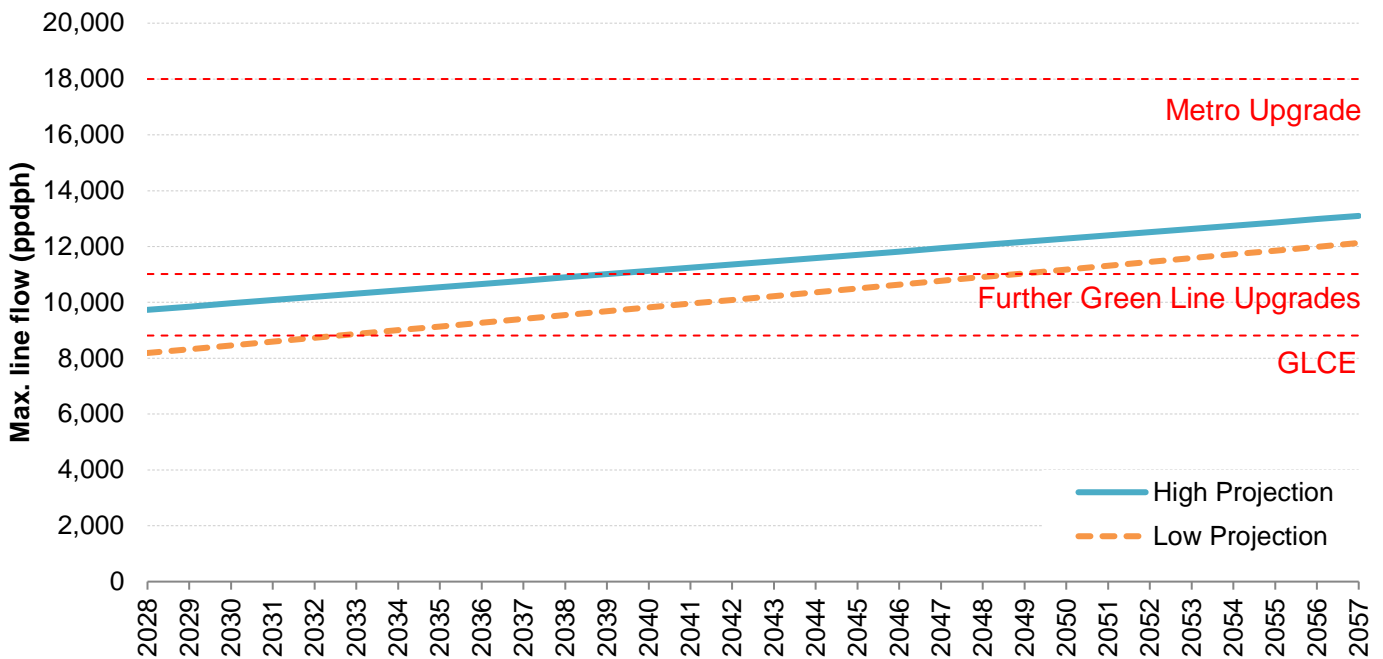


Figure 1: Green Line AM northbound max line flow projections and capacities to 2057

The analysis indicates that the existing GLCE project may cater for the projected demand on the Luas Green Line up to 2033 in the low demand scenario. However in the high demand scenario capacity is likely to be exceeded in 2028. Increased capacity is therefore required on the Luas Green to accommodate projected demand within 0-5 years of the opening of Metrolink.

The ERM projections suggest that the further upgrades to the Luas Green Line, to achieve a 30 trams per hour Luas service between Sandyford and St. Stephen’s Green, would accommodate Luas demand to approximately 2039 in the high projection or to approximately 2049 in the low projection. A metro upgrade of the Luas Green Line south of Charlemont would ultimately be required in the long term however the timing of this is dependent on the rate of growth in demand.

6 Summary

The results of the analysis suggest that an upgrade to Green Line services south of Charlemont is required to accommodate growth in peak period demand beyond 2028. Projections using the NTA East Regional Model indicate that upgrades to the Green Line infrastructure and additional fleet, to provide a 30 tram per hour service in the morning peak, could accommodate passenger demand on the corridor for up to 20 years following the opening of a MetroLink service between Swords and Charlemont. The timing of this upgrade requirement is dependent on the rate of growth in demand.

Further analysis will be undertaken by TII to determine the nature and scale of upgrade required to the Luas Green Line. TII will continue to monitor passenger demand on the Luas Green Line and the impact of the on-going GLCE project on passenger demand. As part of the development of the MetroLink project more detailed transport modelling and analysis of future scenarios will be undertaken which will inform the timing of further upgrades to the Green Line.



This page is left intentionally blank



Ionad Ghnó Gheata na Páirce,
Stráid Gheata na Páirce
Baile Átha Cliath 8, Éire



Parkgate Business Centre,
Parkgate Street,
Dublín 8, Ireland



www.tii.ie



info@tii.ie



+353 (01) 646 3600



+353 (01) 646 3601