Waterford City Cordon Survey Report 2023

Report on Inbound People Movements Across the Waterford City Cordon

List of Abbreviations and Definitions

JTC:

- Junction Turning Counts

LGV:

- Light Goods Vehicle. LGV includes the following vehicle types: Van, Pick-Up, Car Delivery Vans, Minibus, Commercial Vehicles < 3.5 tonnes (single rear tyres)

M/C:

- Motorcycle. M/C includes the following: Motorcycles, Motor Scooters, Mopeds, Three-wheel motorcycles

NTA:

- National Transport Authority

OGV1:

- Ordinary Goods Vehicle 1. OGV1 includes the following vehicle types: 2-Axles Rigid Truck, 3-Axles Rigid Truck and Commercial Vehicles > 3.5 Tonnes (single rear tyres)

OGV2:

- Ordinary Goods Vehicle 2. OGV2 includes the following vehicle types: 4 or more Axles Rigid Truck, 3 Axle or more Articulated Truck, Vehicles in Category OGV1 towing trailer

P/C:

- Pedal Cycle

PED:

- Pedestrian

PSV:

- Public Service Vehicle, excluding private / non-scheduled service vehicle

BUS:

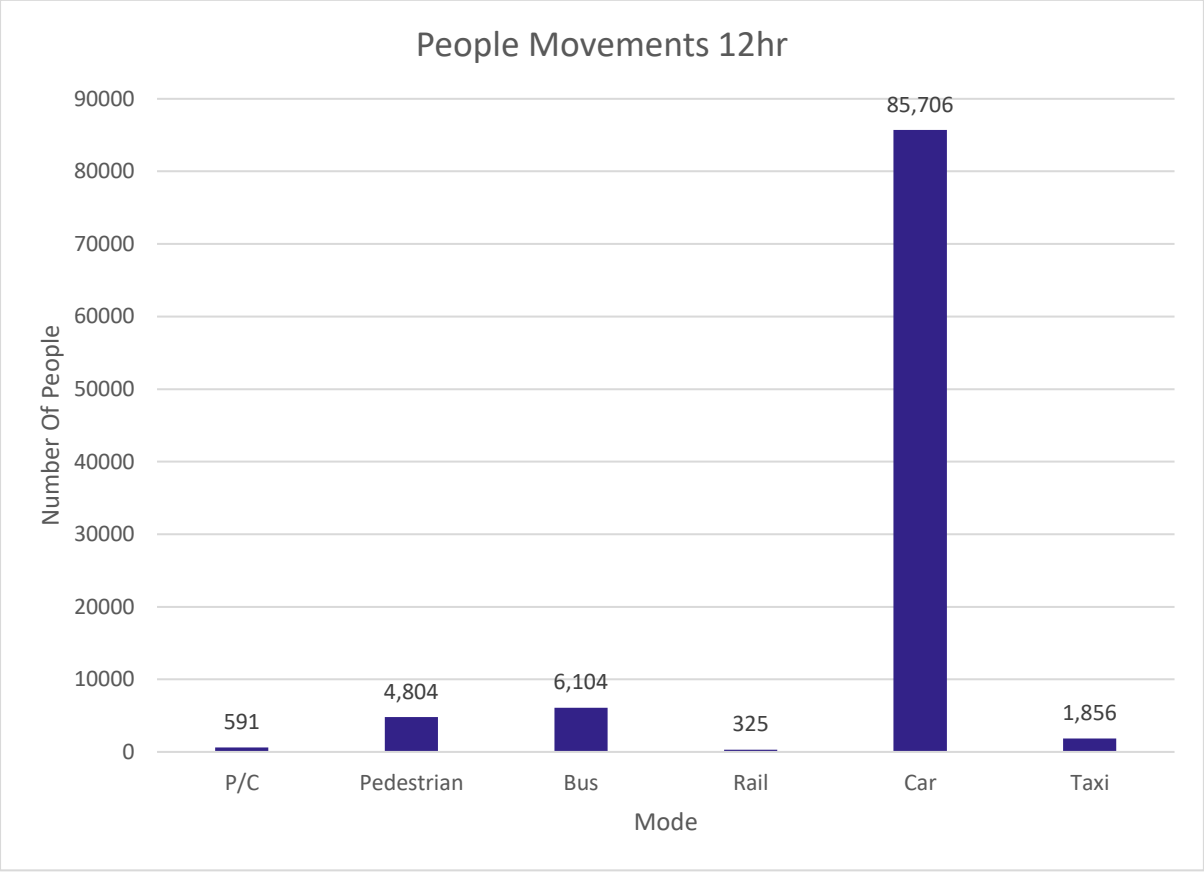
- Includes all public (PSV) / private, single / double deck, scheduled / non-scheduled service vehicles

Executive Summary

The Waterford City Cordon is a cordon of traffic survey locations that encloses Waterford City. Classified Junction Turning Counts and Pedestrian surveys were undertaken at 9 locations to determine the traffic flows crossing the Waterford City Cordon inbound during the key traffic periods for a typical weekday, i.e. AM (07:00 - 10:00), Lunch Time (10:00 - 13:00), School Run (13:00 - 16:00), PM (16:00 - 19:00), OP (19:00 - 07:00) and 24hr (00:00 - 24:00).

In addition to this, Bus Occupancy surveys were undertaken at 8 bus stops to determine the number, occupancy and frequency of bus services crossing the Waterford City Cordon. Passenger numbers from the Annual Rail Census (Iarnród Éireann) were also used to determine the passengers travelling across the Waterford City Cordon inbound. Based on the analysis of the 2023 survey data, the key results are:

- In terms of overall people movements, 11,824 (12%) of a total of 99,386 people travelling inbound towards the City between 07:00 and 19:00 used sustainable modes of travel, i.e. Pedal Cycle, Pedestrian, Bus and Rail (as shown in the figure below).



People Movements by Mode over a 12-hour Period

- The total number of vehicles, pedestrians and cyclists that crossed the Waterford Cordon inbound was 87,046 on the day of the survey.

- The busiest time period for vehicles and cyclists was the AM peak with 17,275 crossing the Waterford City Cordon inbound towards the city. The busiest time period for Pedestrians was the PM peak with 1,423 crossing the Waterford City Cordon inbound.
- Between the hours of 07:00 and 19:00, cars were recorded to have the highest vehicular traffic split, with 80% of the total inbound flows. Light Goods Vehicles (LGVs) recorded 8%, Ordinary Goods Vehicles 1 (OGV1) recorded 1%, Ordinary Goods Vehicles 2 (OGV2) recorded <1% and taxis recorded 2%. The remaining vehicle classifications recorded 2% or less of the total flows.
- Between 07:00 and 19:00, 59% of buses were at 25-49% capacity. Approximately 6% of buses were at 0-24%. 27% were at 50-74% capacity, 7% were at 75-99% capacity and 1% were at 100% capacity.

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1 Introduction

The Waterford City Cordon is a closed cordon of traffic survey locations that encloses Cork City. This report presents the findings of traffic surveys along the cordon, which were undertaken in November 2023 and captured the traffic movements crossing the Waterford City Cordon inbound towards the city.

The structure of this report is set out as follows:

- **Chapter 2** provides a definition of the Waterford City Cordon and sets out the methodology for the data collection;
- **Chapter 3** outlines:
    - The traffic flows crossing the Waterford City Cordon inbound by vehicle classification;
    - The occupancy of the vehicles crossing the Waterford City Cordon in terms of the number of occupants per vehicle. Each vehicle type has been analysed per peak time periods and for the duration of the survey period.
- **Chapter 4** outlines the total number of people movements crossing the Waterford City Cordon inbound towards the city; and
- **Chapter 5** provides a summary of key findings.

2 Definition and Methodology

2.1 Definition of the Waterford City Cordon

A map of the Waterford City Cordon is presented in Figure 2-1, and highlights the locations along the Cordon where JTC and pedestrian data has been collected on the movement of people into the city. It also shows the bus stops where bus occupancy surveys were conducted.

The Waterford City Cordon has been chosen to ensure, as far as possible, that any traffic flow (including cyclists and pedestrians) entering the city must pass through one of the locations where the surveys have been undertaken.

The data, as presented in this report, refers to movements in one direction only (i.e. inbound towards the city) across the various cordon points.

2.2 Data Sources

To establish the movement of people across the Waterford City Cordon, a bespoke data collection exercise was carried out, comprising of the following surveys:

Junction Turning Counts (JTC):

- The JTC surveys were recorded in 15-minute intervals over a 24-hour period at 9 sites between 21/11/2023 and 23/11/2023. They were undertaken using telescopically mounted video cameras and were recorded for Car, LGV, OGV1, OGV2, Motorcycle, Pedal Cycle, Taxi and Bus.

Vehicle Occupancy Surveys

- Vehicle Occupancy counts were also undertaken at survey points along the Waterford City Cordon. Vehicle Occupancy counts were carried out by a manual enumerator between 07:00 and 19:00. All information was recorded in hourly intervals.

Bus Occupancy Surveys

- Bus Occupancy surveys were undertaken at 8 bus stops inside the Waterford City Cordon on the day of the survey in order to record the number of people travelling inbound into the city via bus. Manual enumerators recorded both occupancy of the bus at the bus stop, and the number of passengers boarding and alighting. These surveys also recorded the number of public and private buses passing the bus stop and the type of bus.

Heavy Rail Data:

- Since 2012, Iarnród Éireann has undertaken a census of passengers boarding and alighting on all services passing through all stations on the national rail network. The 2023 survey was undertaken on 09/11/2023. While this rail survey was not commissioned as part of the multi-modal cordon surveys, results from the rail census were used to supplement the surveys.

Additional Two Weekly Vehicle Counts/Speed Surveys:

- Automatic Traffic Counts (ATCs) were carried out over a continuous two-week period (between 18/11/2023 and 12/05/2023) in order to gather longer term data on daily movements at key points on the radial routes leading into the cordon.

Figure 2-2, below, illustrate the locations of the surveys mentioned above.

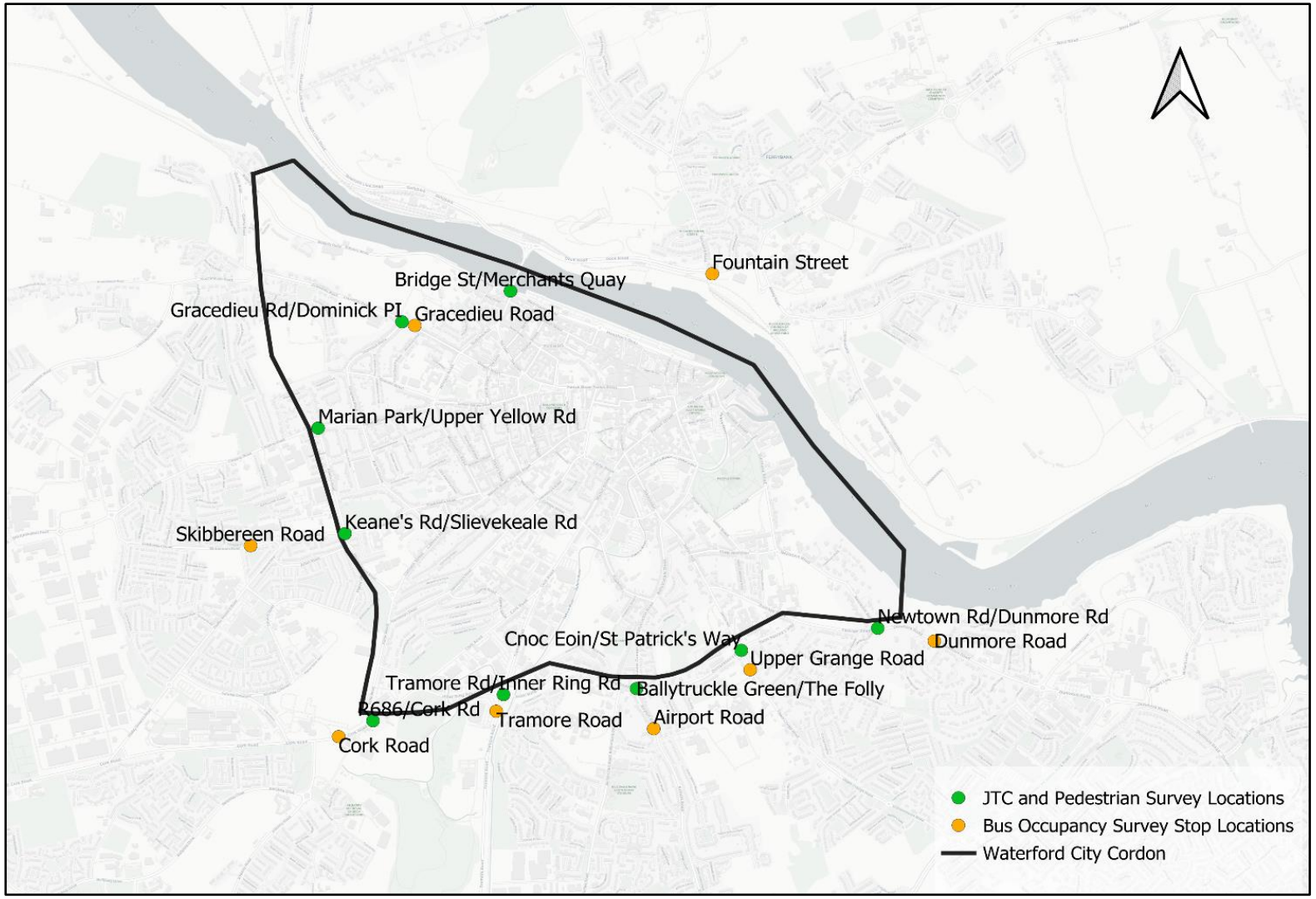

Figure 2-1:JTC, Pedestrian and Bus Occupancy Site Locations

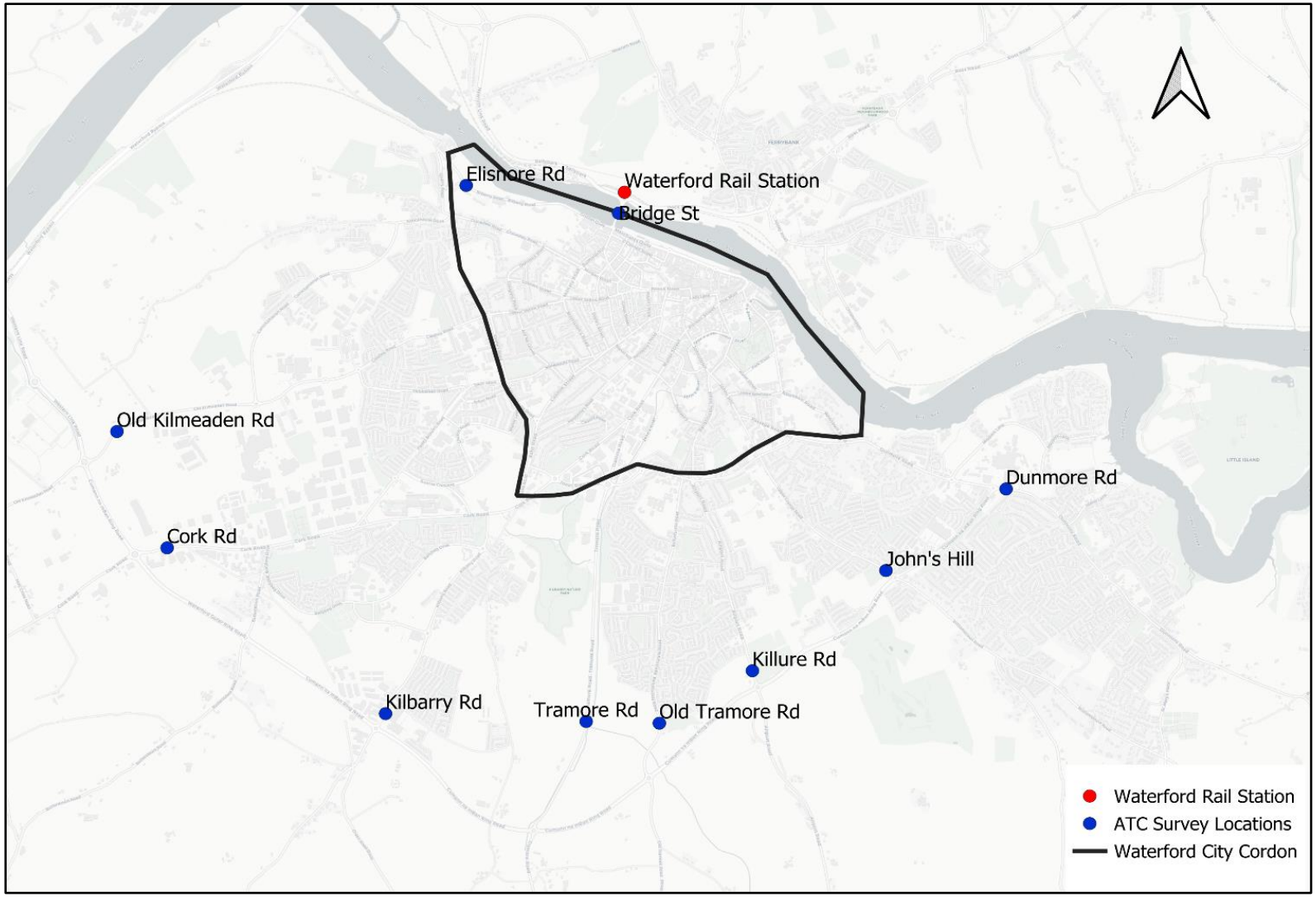

Figure 2-2:ATC Site Locations and Waterford Rail Station

2.3 Time Periods Analysed

Surveys were recorded at either 15-minute or one hour intervals, or, in the case of public transport services, when the bus or train was at a specific stop or station. Therefore, it is possible to understand trends throughout the day from the data. As such, the data has been analysed for the following time periods:

- AM: 07:00 - 10:00
- Lunch Time (LT): 10:00 - 13:00
- School Run (SR): 13:00 - 16:00
- PM: 16:00 - 19:00
- OP: 19:00 - 07:00
- 24hr: 00:00 - 00:00

3 Waterford City Cordon

3.1 Traffic Flow Surveys

3.1.1 Overview

This section outlines the classified vehicle, pedestrian and cycle flows crossing the Waterford City Cordon inbound, towards the city centre. This information was collected from the JTC traffic survey sites for Car, LGV, OGV1, OGV2, Motorcycle, Pedal Cycle, Taxi and Bus, as well as pedestrian survey sites. It should be noted that these surveys count the number of vehicles, cyclists and pedestrians crossing the cordon. However, the figures presented below do not include the number of people in each vehicle (vehicle occupancy). Therefore, these figures are not representative of the mode share. Total passenger flows and mode share are discussed in sections 4.4 and 4.5 of this report.

Table 3-1 presents the observed flows by vehicle classification crossing the Waterford City Cordon inbound during the time periods recorded in the 2023 survey.

Table 3-1:Movements Across the Waterford City Cordon Inbound

Vehicle Classifications	AM 07:00-10:00	LT 10:00-13:00	SR 13:00-16:00	PM 16:00-19:00	OP 19:00-07:00	24hr 00:00-24:00
Car	14,621	13,129	14,808	14,580	12,678	69,816
LGV	1,729	1,530	1,454	1,263	898	6,874
OGV1	256	336	254	106	147	1,099
OGV2	68	79	65	16	34	262
Motorcycle	47	41	60	59	36	243
Pedal Cycle	141	110	134	206	155	746
Taxi	283	380	346	229	368	1,606
Bus	130	131	136	106	171	674
Pedestrian	1,034	1,099	1,248	1,423	922	5,726
Total	18,309	16,835	18,505	17,988	15,409	87,046

Figure 3-1 illustrates the overall flows for all vehicle types across the Waterford City Cordon per key time period. It is evident that the SR time period has the highest volume of traffic movements, with a total of 18,505 travelling inbound.

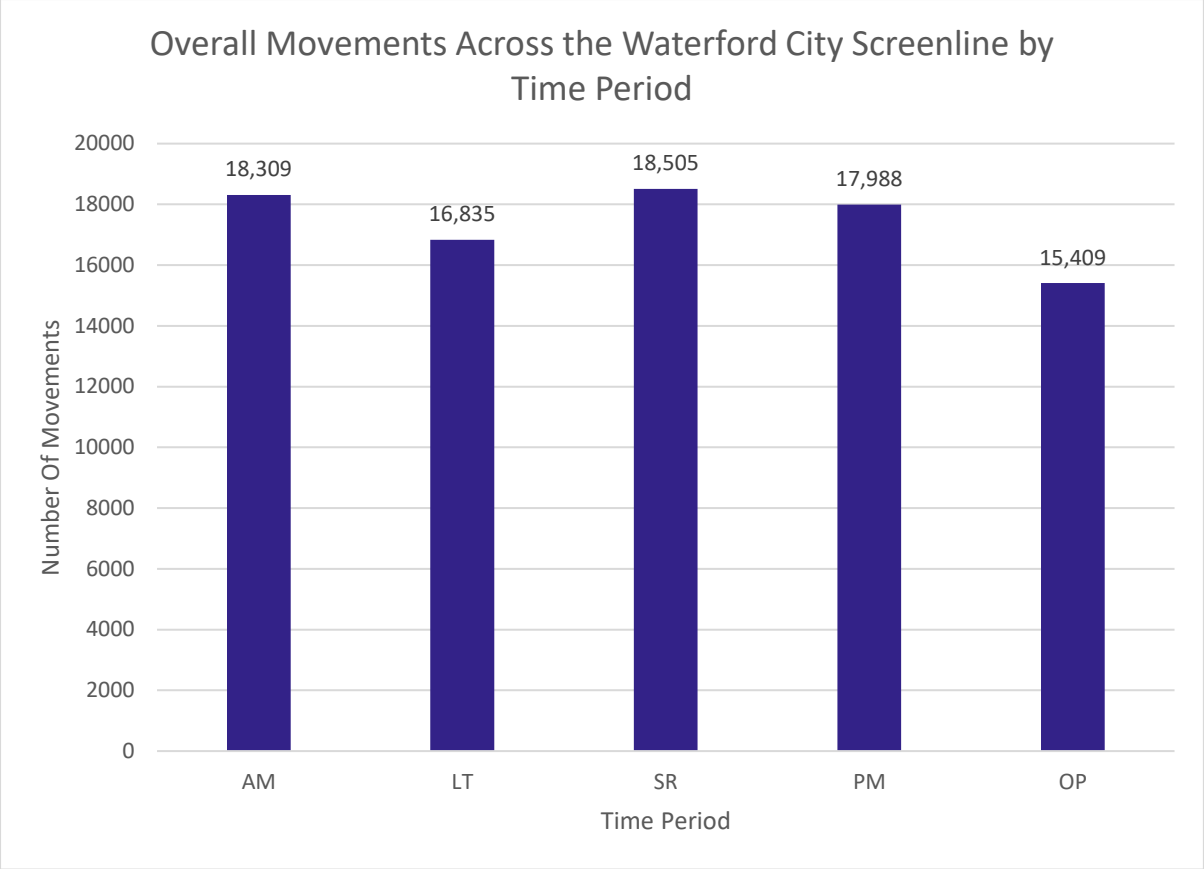

Figure 3-1:Total Movements across the Waterford City Cordon Inbound by Time Period

For further information, please refer to Appendix A, which presents additional graphs separated into the respective time periods and survey site locations.

Figure 3-2 sets out the number of vehicles in each classification as recorded in the JTC surveys, as well as the number of pedestrians, over a 24-hour period. This figure shows that car is the most common vehicle type, with 69,816 inbound movements in the 24-hour period, accounting for 80% of all crossings.

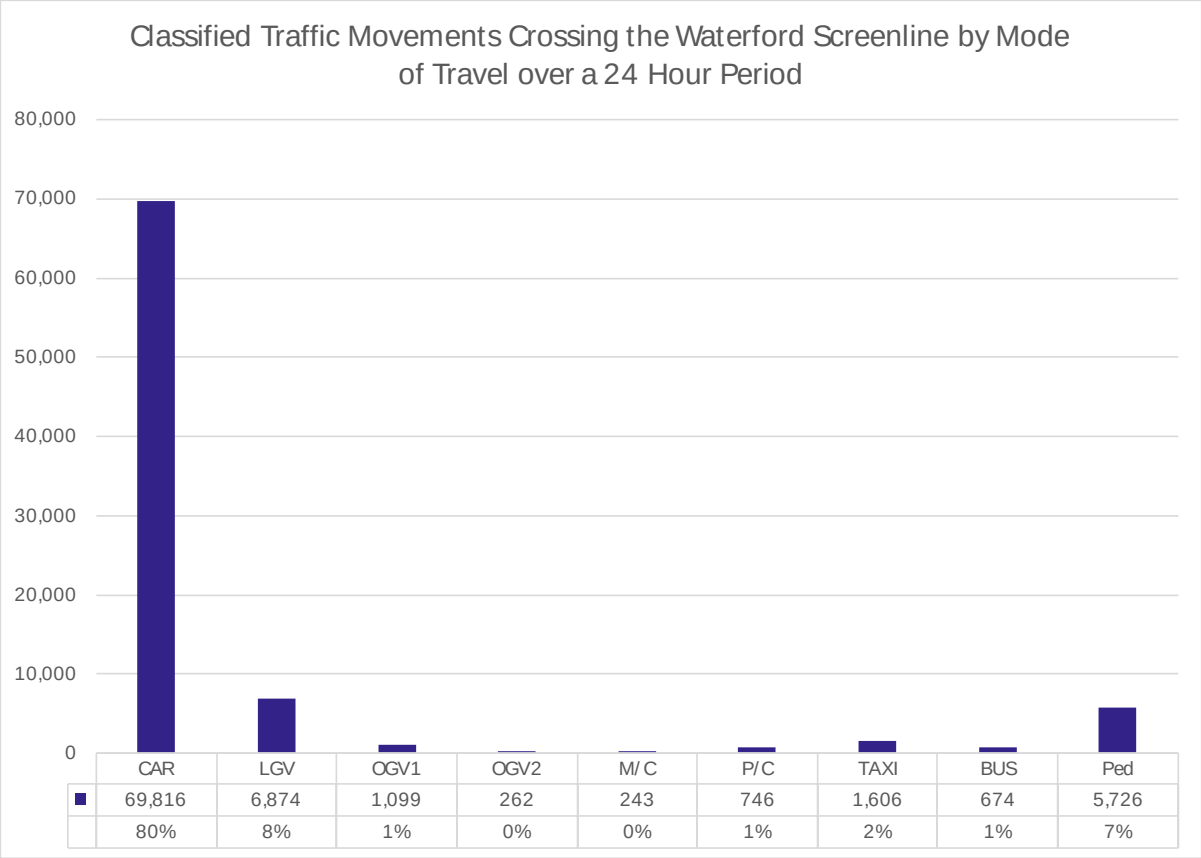

Figure 3-2:Total Number and Percentage of Vehicles crossing the Waterford City Cordon inbound by vehicle classification over a 24 hour period

Figure 3-3 sets out the number of vehicles in each classification as recorded in the JTC surveys, as well as the number of pedestrians, over a 12-hour period (i.e. 07:00 – 19:00). This figure shows that car is the most common vehicle type, with 57,138 inbound movements in the 12-hour period, accounting for 80% of all crossings.

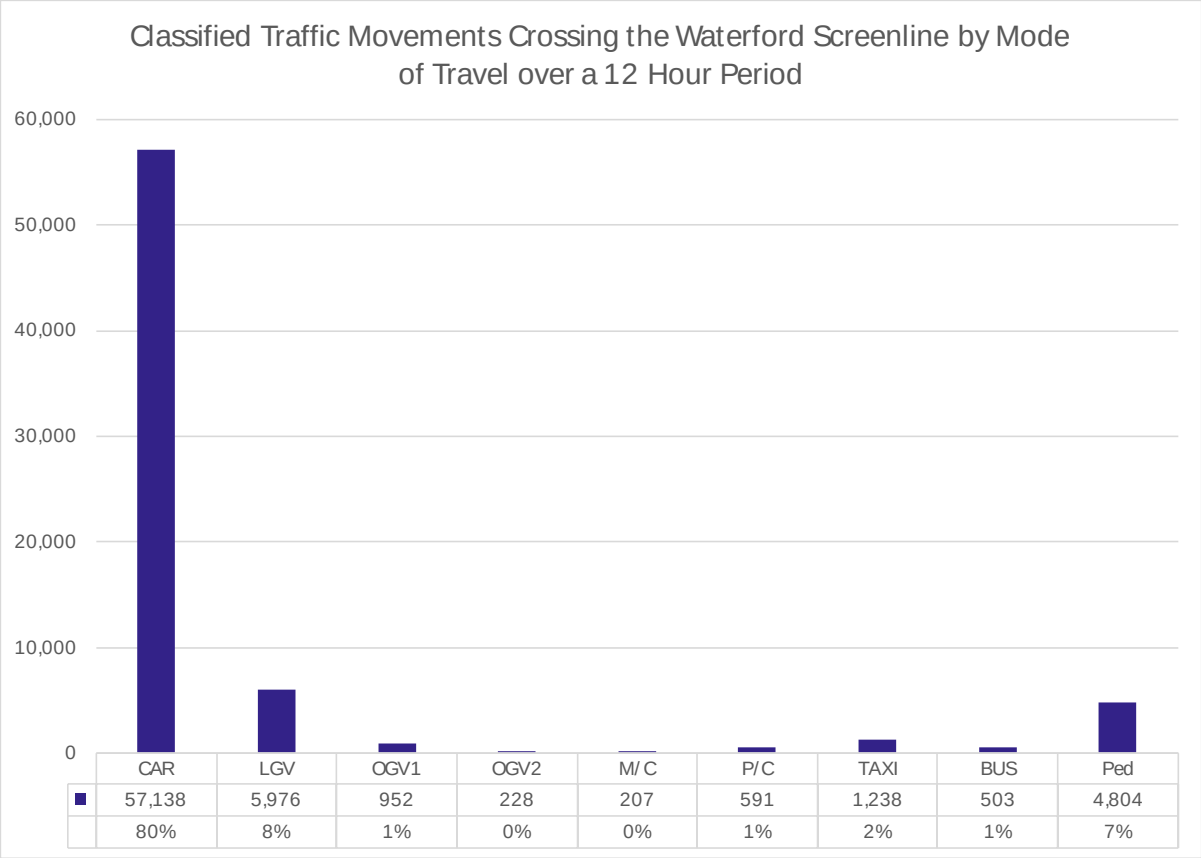

Figure 3-3:Total Number and Percentage of Vehicles crossing the Waterford City Cordon inbound by vehicle classification over a 12 hour period

3.1.2 Vehicle Classified Traffic Flows

The following sections provide a more detailed overview of the JTC survey results by vehicle classification and survey sites. Each vehicle class is analysed in turn providing information on the volume of vehicles per time period and per survey site.

Car

Figure 3-4 below presents the total number of cars crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the SR time period has the highest volume of cars, with a total of 14,808 cars travelling inbound.

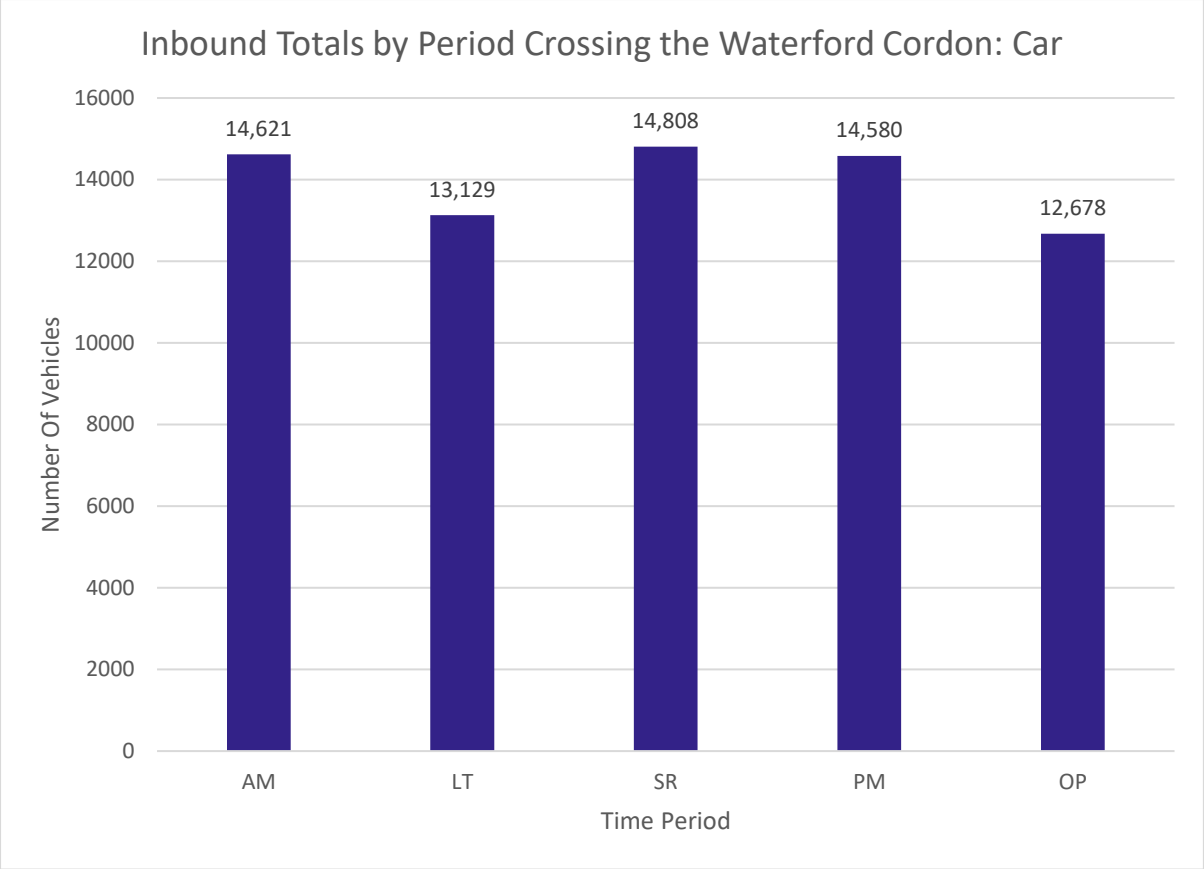

Figure 3-4:Total Number of Car journeys per Time Period

Figure 3-5 presents a further breakdown of the total number of cars, with reference to each site location. The busiest location for cars crossing the Waterford City Cordon was the Bridge St/Merchants Quay junction, with a total of 14,936 cars travelling inbound through this junction over a 24-hour period.

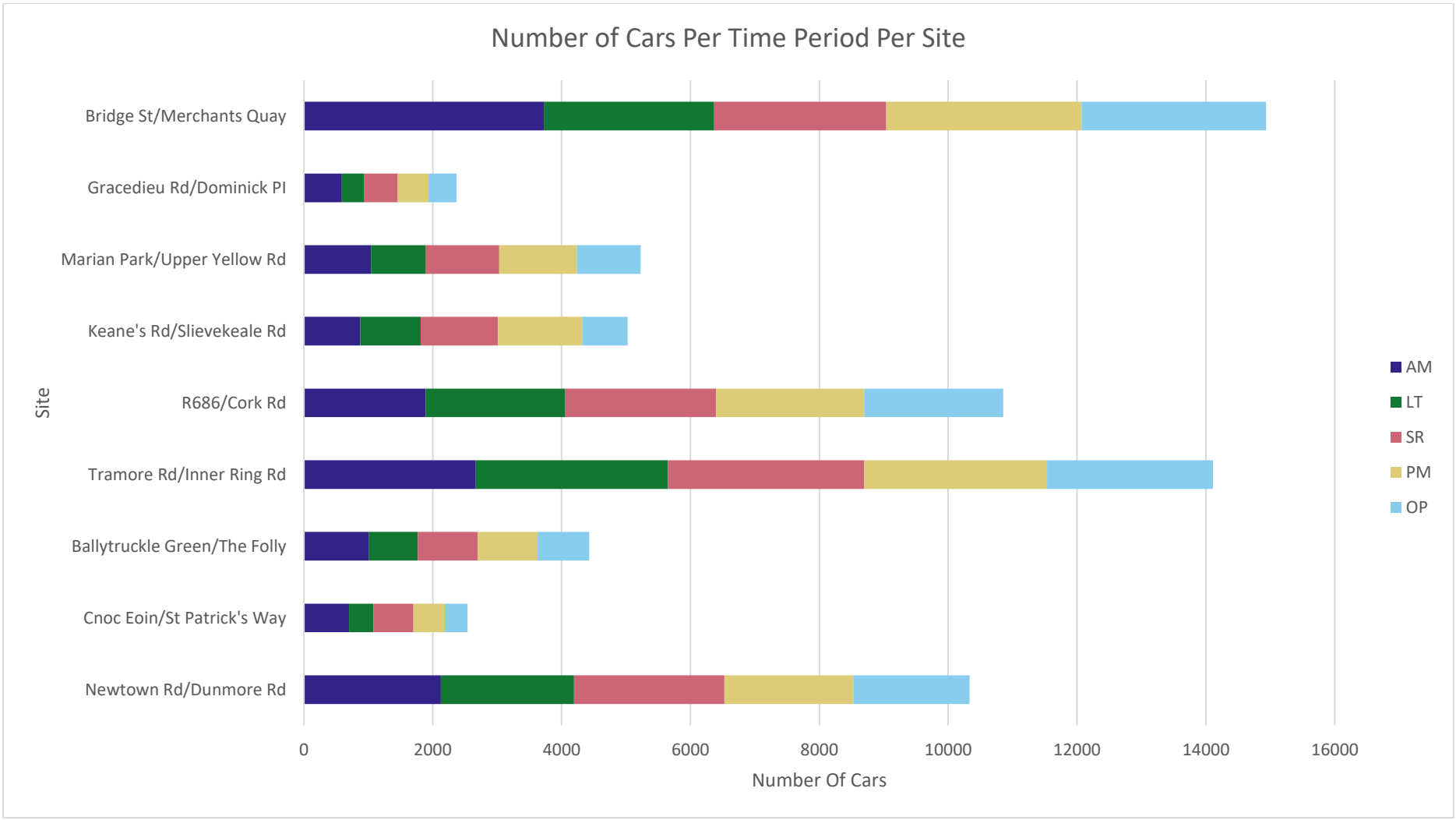

Figure 3-5:Number of Cars Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Please also refer to Appendix A for further information on the total number of cars, with reference to each individual time period.

Light Goods Vehicle

Figure 3-6 below presents the total number of LGVs crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the AM time period has the highest volume of LGVs, with a total of 1,729 LGVs travelling inbound.

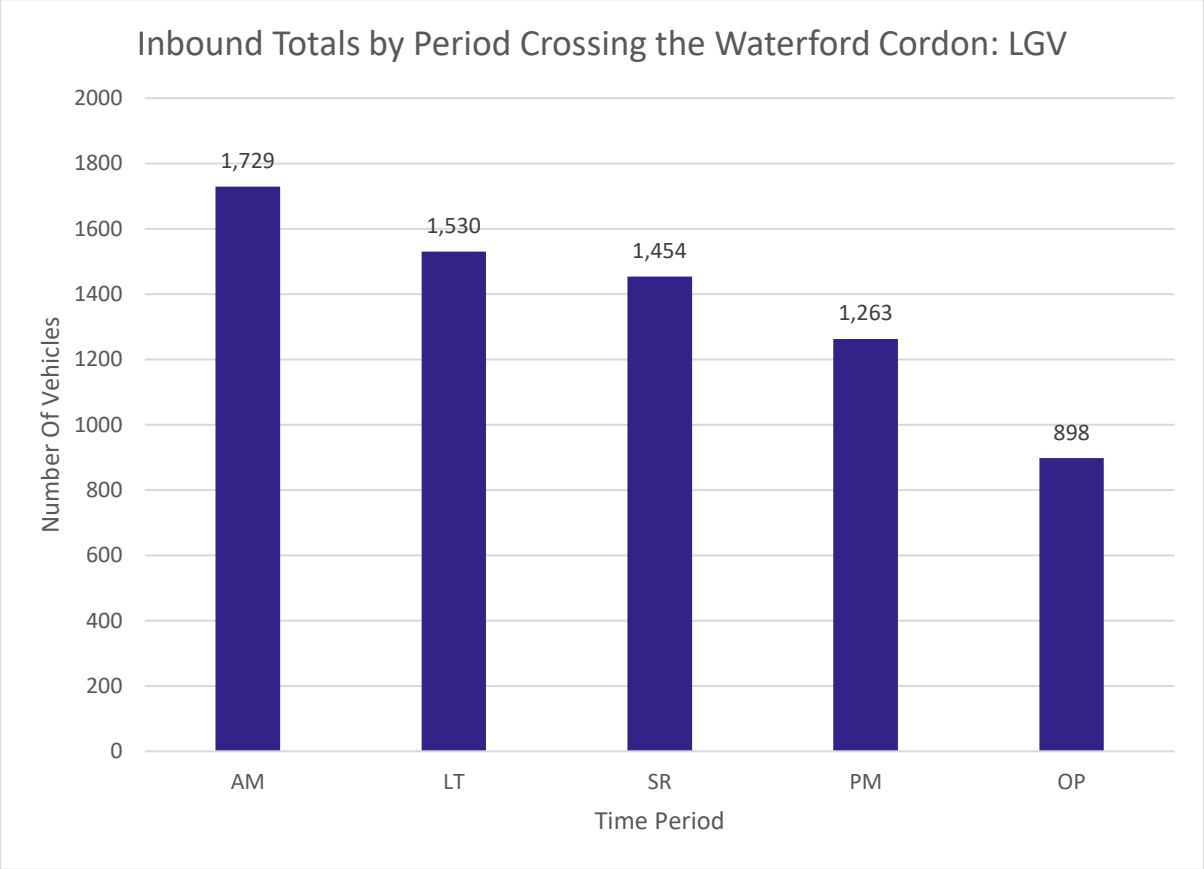

Figure 3-6:Total Number of LGV journeys per Time Period

Figure 3-7 presents a further breakdown of the total number of LGVs, with reference to each site location. The busiest location for LGVs crossing the Waterford City Cordon was the Bridge St/Merchants Quay junction, with a total of 1,877 LGVs travelling inbound through this junction over a 24-hour period.

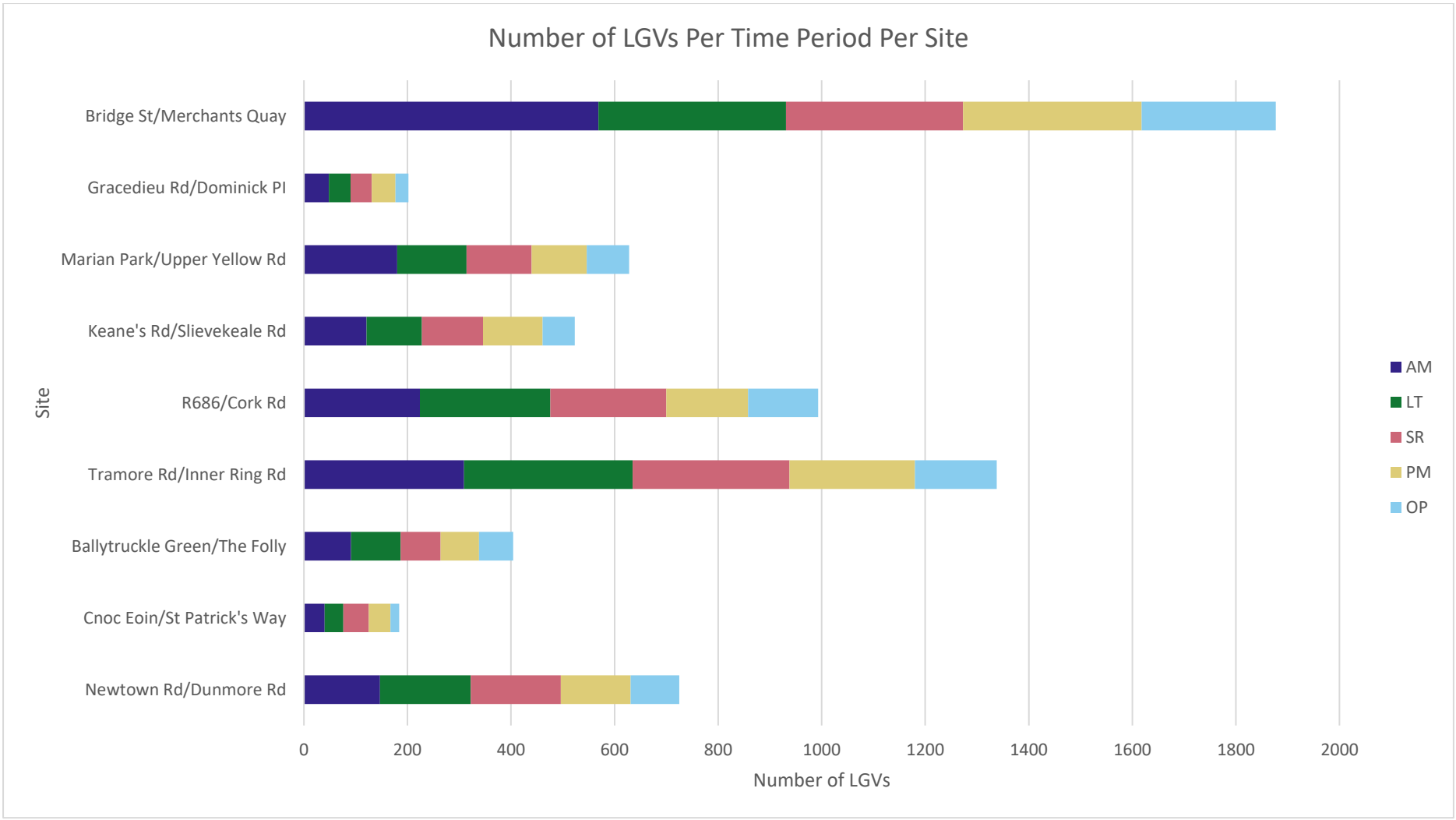

Figure 3-7:Number of LGVs Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Please also refer to Appendix A for further information on the total number of LGVs, with reference to each individual time period.

Ordinary Goods Vehicle 1

Figure 3-8 below presents the total number of OGV1s crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the LT time period has the highest volume of OGV1s, with a total of 336 OGV1s travelling inbound.

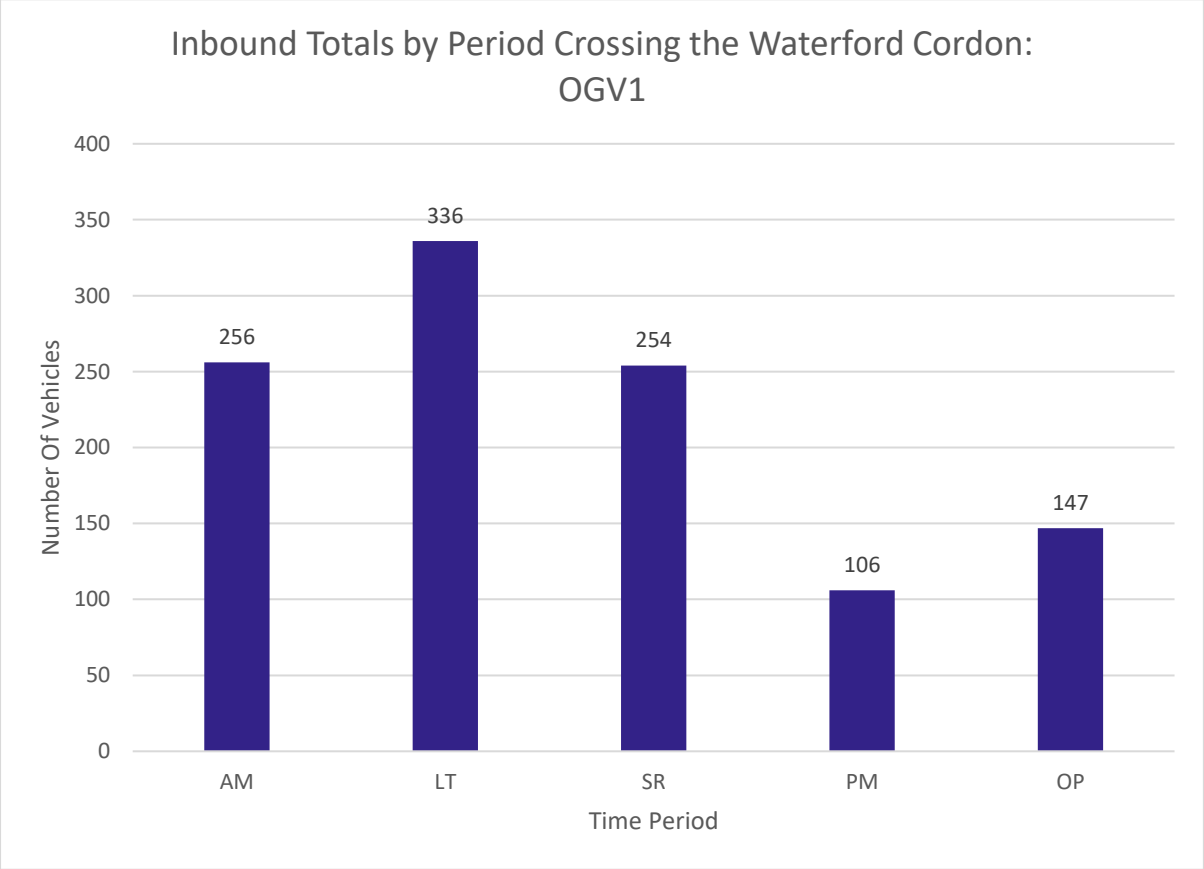

Figure 3-8:Total Number of OGV1 journeys per Time Period

Figure 3-9 presents a further breakdown of the total number of OGV1s, with reference to each site location. The busiest location for OGV1s crossing the Waterford City Cordon was the Bridge St/Merchants Quay junction, with a total of 300 OGV1s travelling inbound through this junction over a 24-hour period.

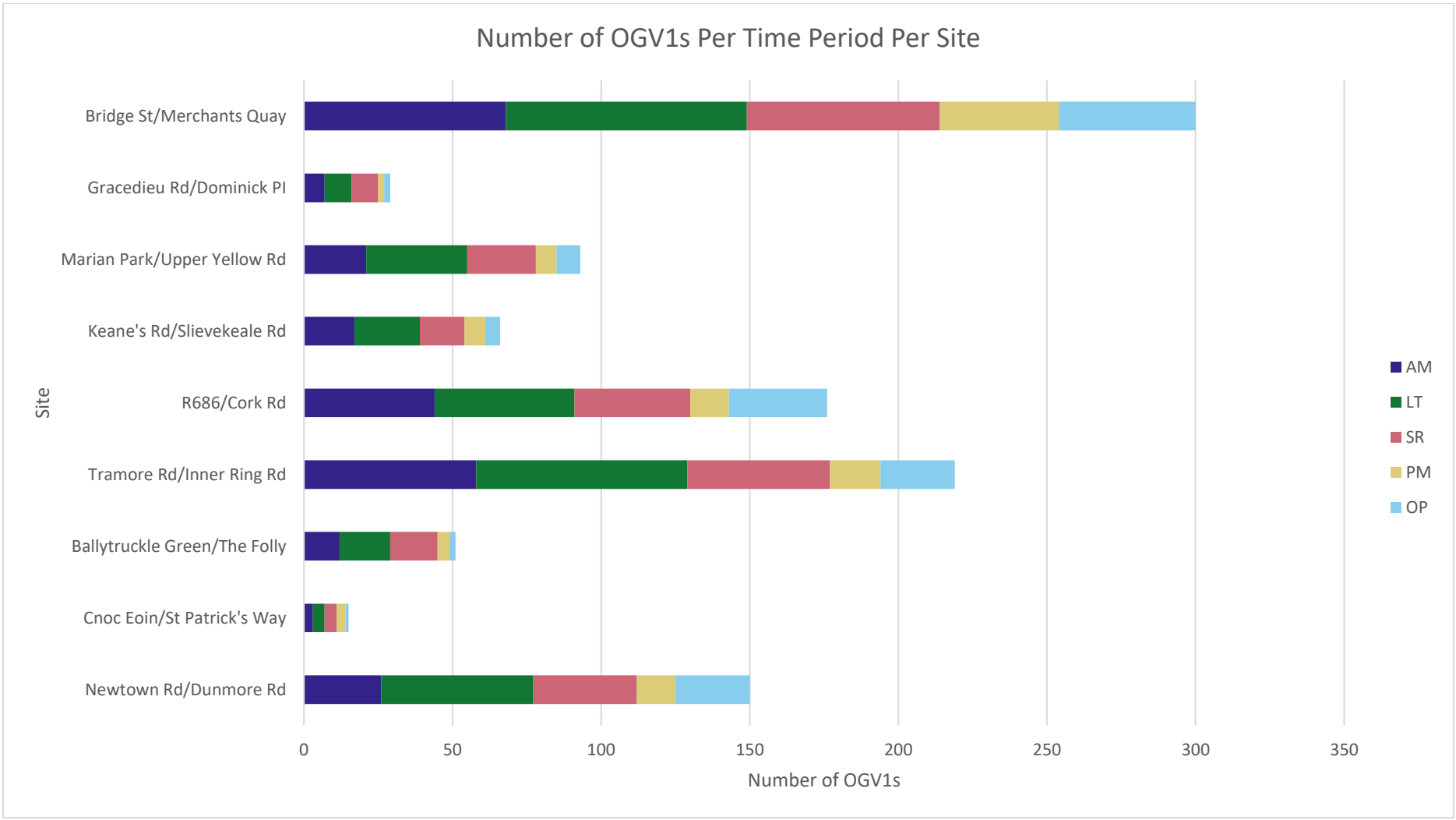

Figure 3-9:Number of OGV1s Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Ordinary Goods Vehicle 2

Figure 3-10 below presents the total number of OGV2s crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the LT time period has the highest volume of OGV2s, with a total of 79 OGV2s travelling inbound.

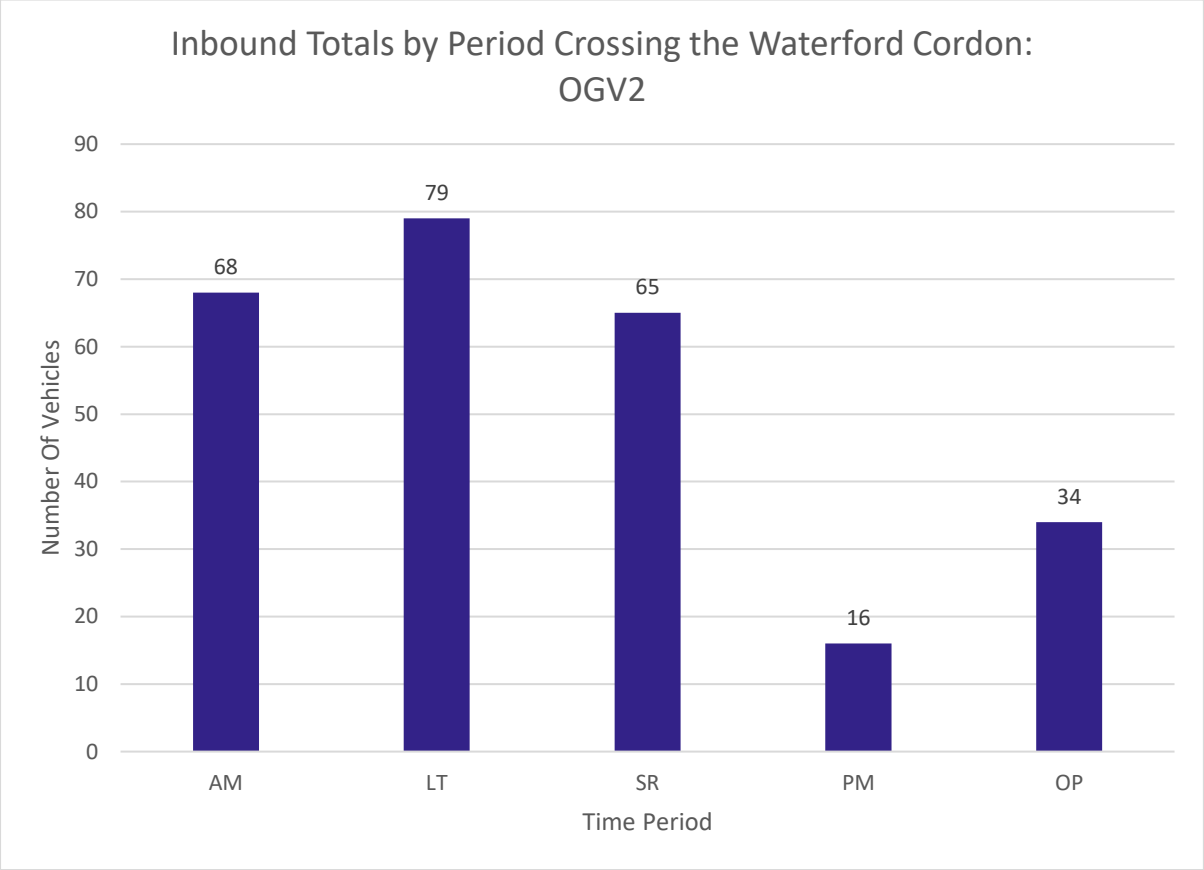

Figure 3-10:Total Number of OGV2 journeys per Time Period

Figure 3-11 presents a further breakdown of the total number of OGV2s, with reference to each site location. The busiest location for OGV2s crossing the Waterford City Cordon was the Bridge St/Merchants Quay junction, with a total of 112 OGV2s travelling inbound through this junction over a 24-hour period.

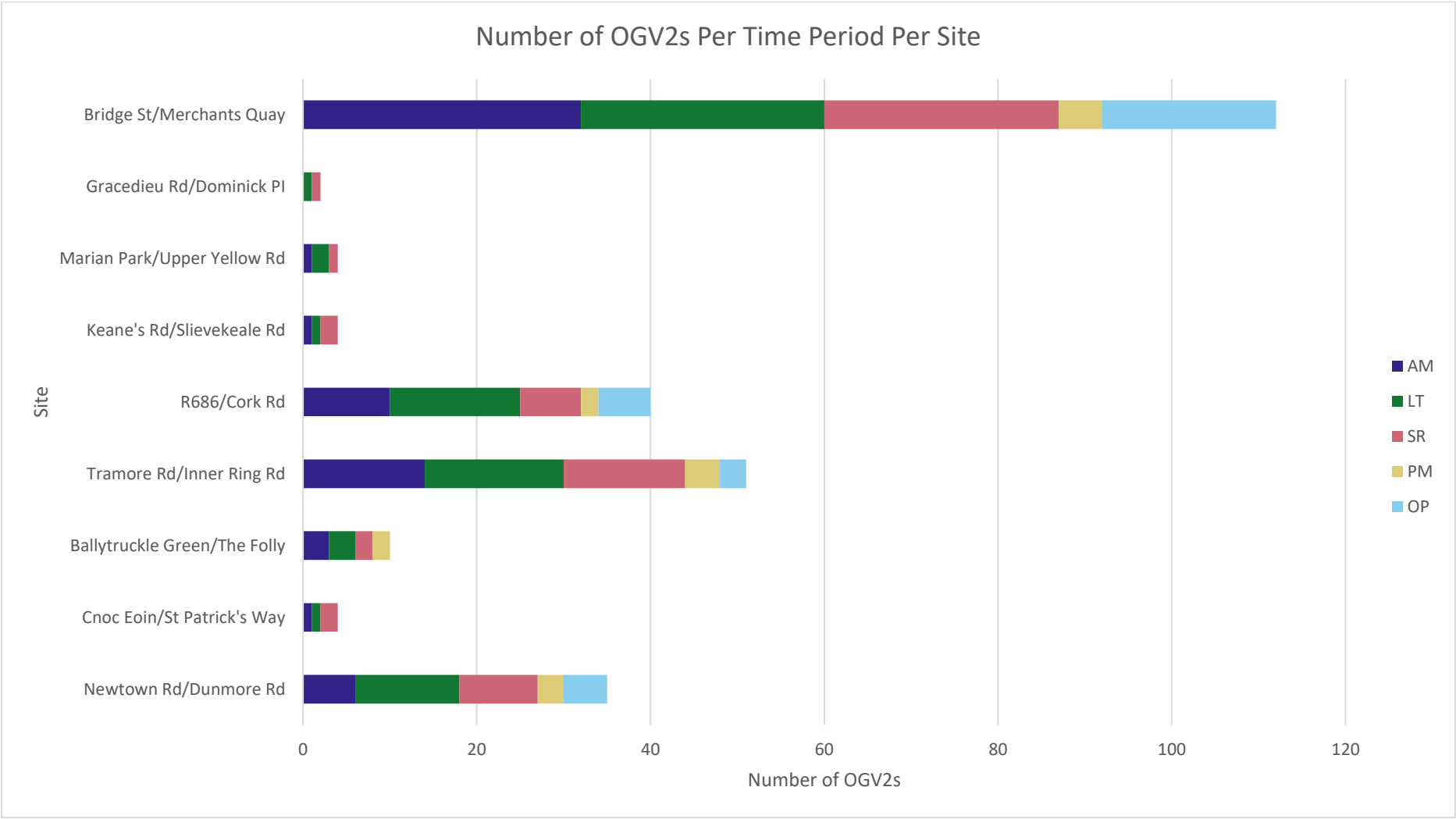

Figure 3-11:Number of OGV2s Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Motorcycle

Figure 3-12 below presents the total number of motorcycles crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the SR time period has the highest volume of motorcycles, with a total of 60 motorcycles travelling inbound.

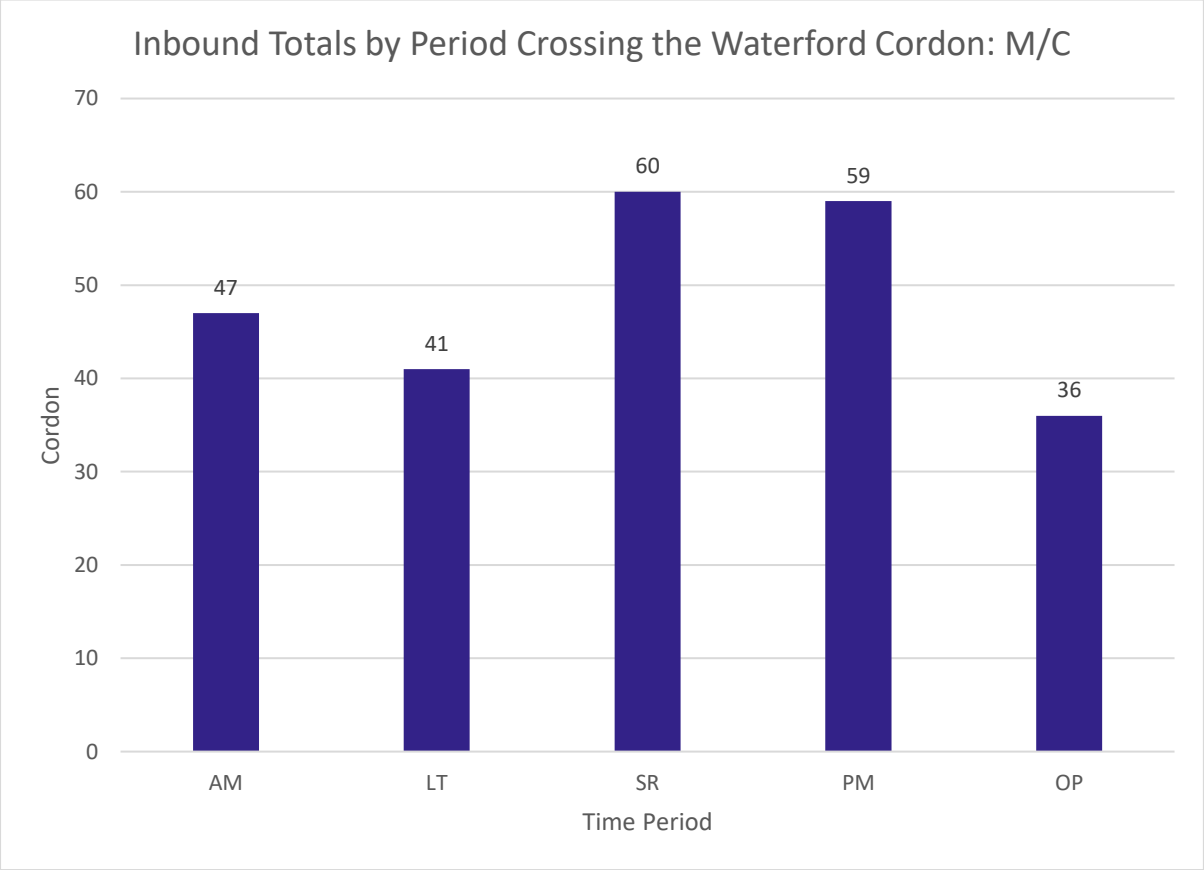

Figure 3-12:Total Number of Motorcycle journeys per Time Period

Figure 3-13 presents a further breakdown of the total number of motorcycles, with reference to each site location. The busiest location for motorcycles crossing the Waterford City Cordon was the Bridge St/Merchants Quay junction, with a total of 68 motorcycles travelling inbound through this junction over a 24-hour period.

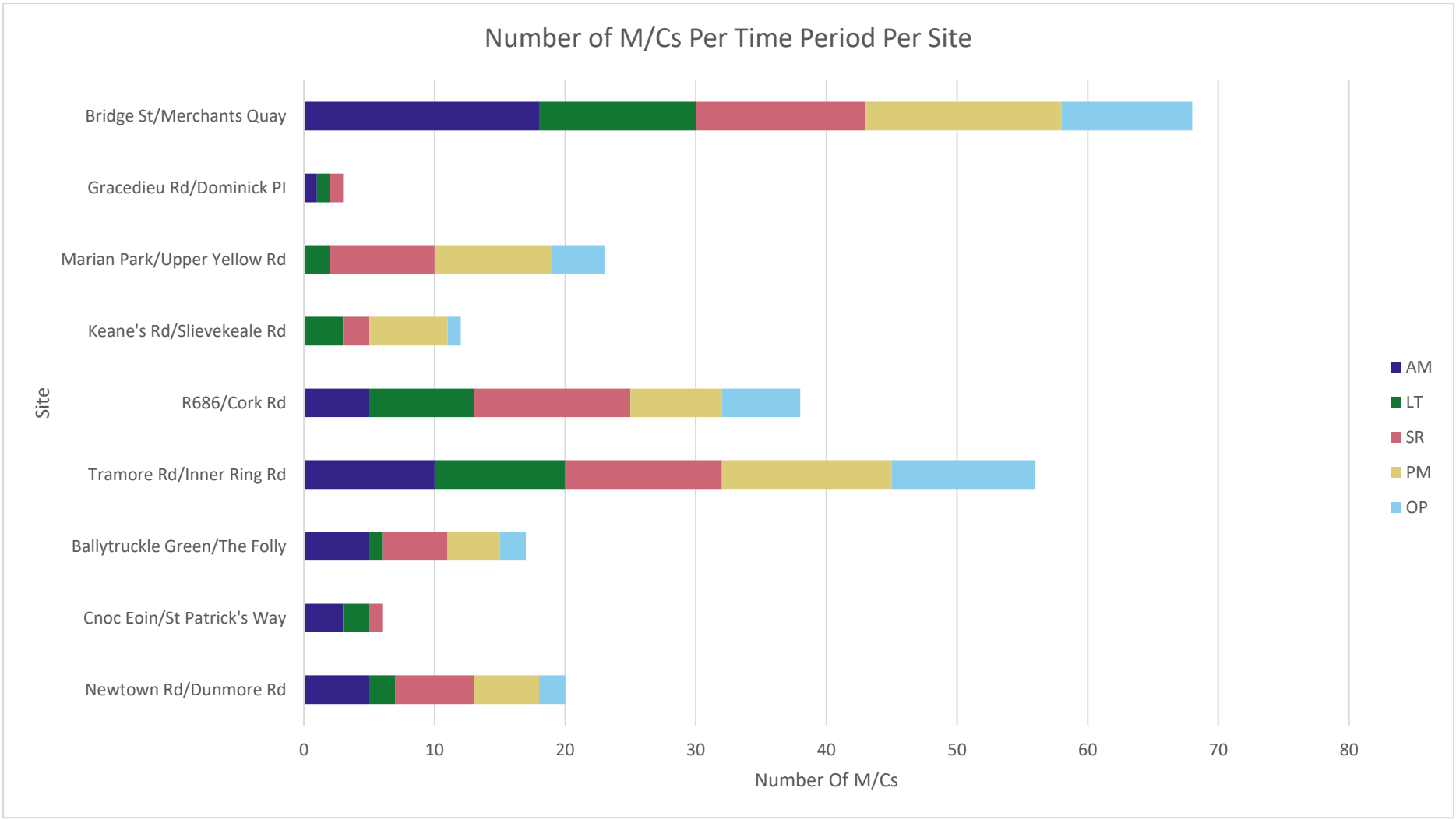

Figure 3-13:Number of Motorcycles Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Pedal Cycle

Figure 3-14 below presents the total number of pedal cycles crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the PM time period has the highest volume of pedal cycles, with a total of 206 pedal cycles travelling inbound.

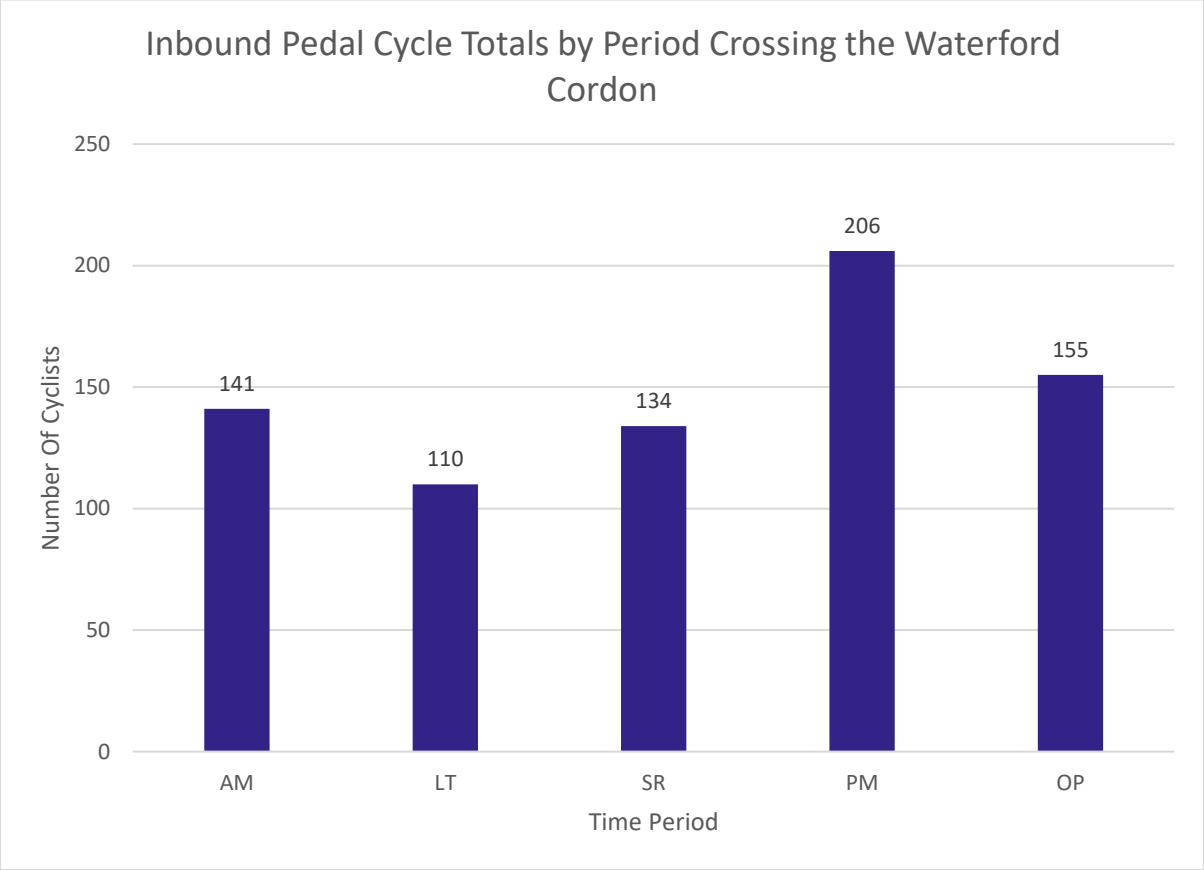

Figure 3-14:Total Number of Pedal Cycle journeys per Time Period

Figure 3-15 presents a further breakdown of the total number of pedal cycles, with reference to each site location. The busiest location for pedal cycles crossing the Waterford City Cordon was the R686/Cork Rd junction, with a total of 173 pedal cycles travelling inbound through this junction over a 24-hour period.

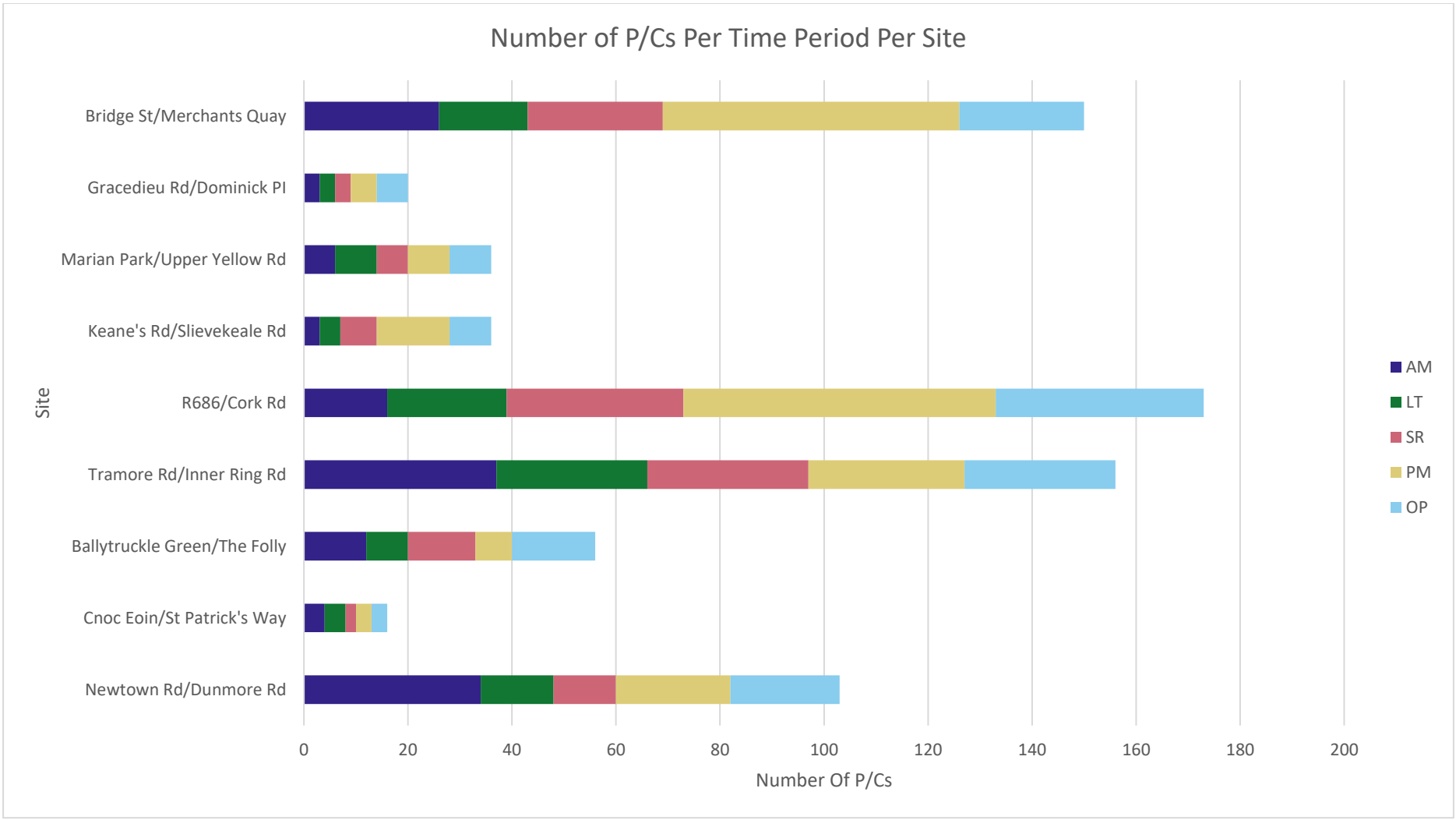

Figure 3-15:Number of Pedal Cycles Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Taxi

Figure 3-16 below presents the total number of taxis crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the LT time period has the highest volume of taxis, with a total of 380 taxis travelling inbound.

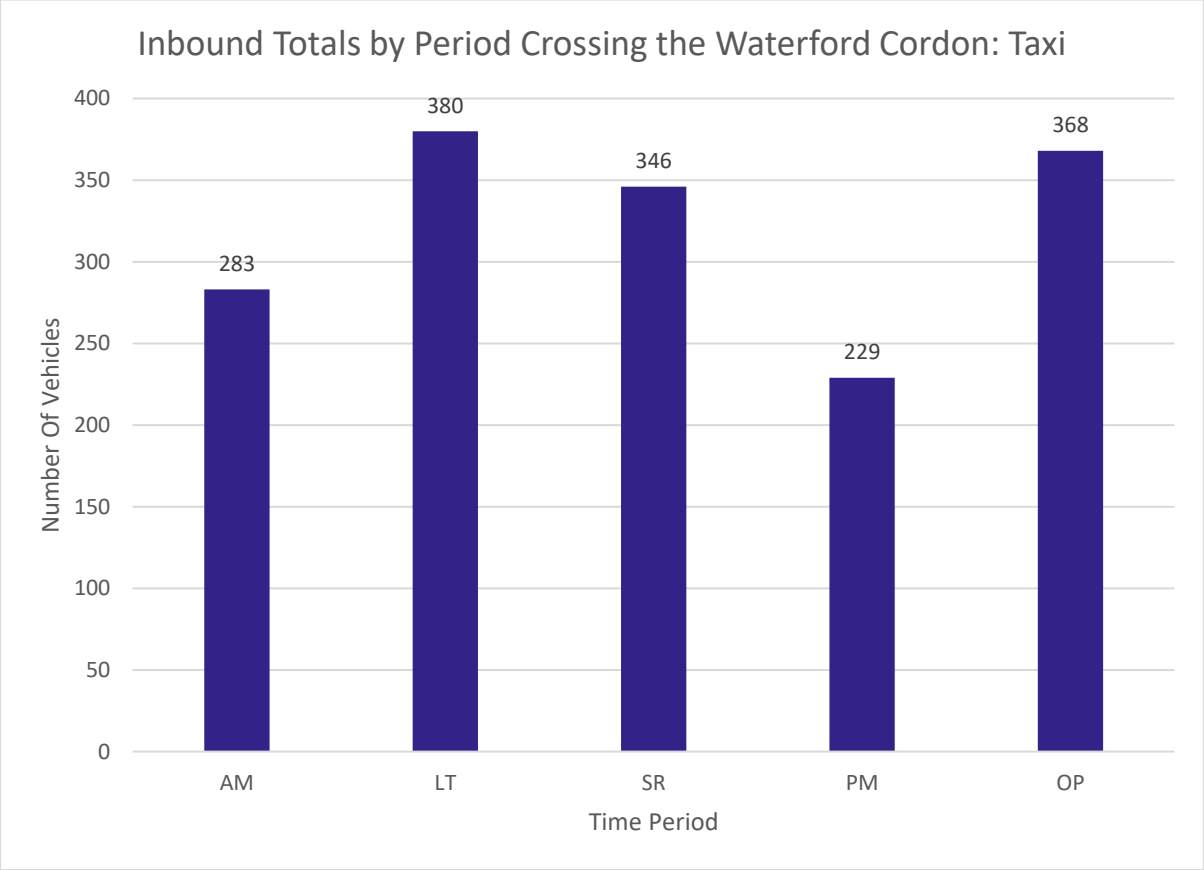

Figure 3-16:Total Number of Taxi journeys per Time Period

Figure 3-17 presents a further breakdown of the total number of taxis, with reference to each site location. The busiest location for taxis crossing the Waterford City Cordon was the Newtown Rd/Dunmore Rd junction, with a total of 289 taxis travelling inbound through this junction over a 24-hour period.

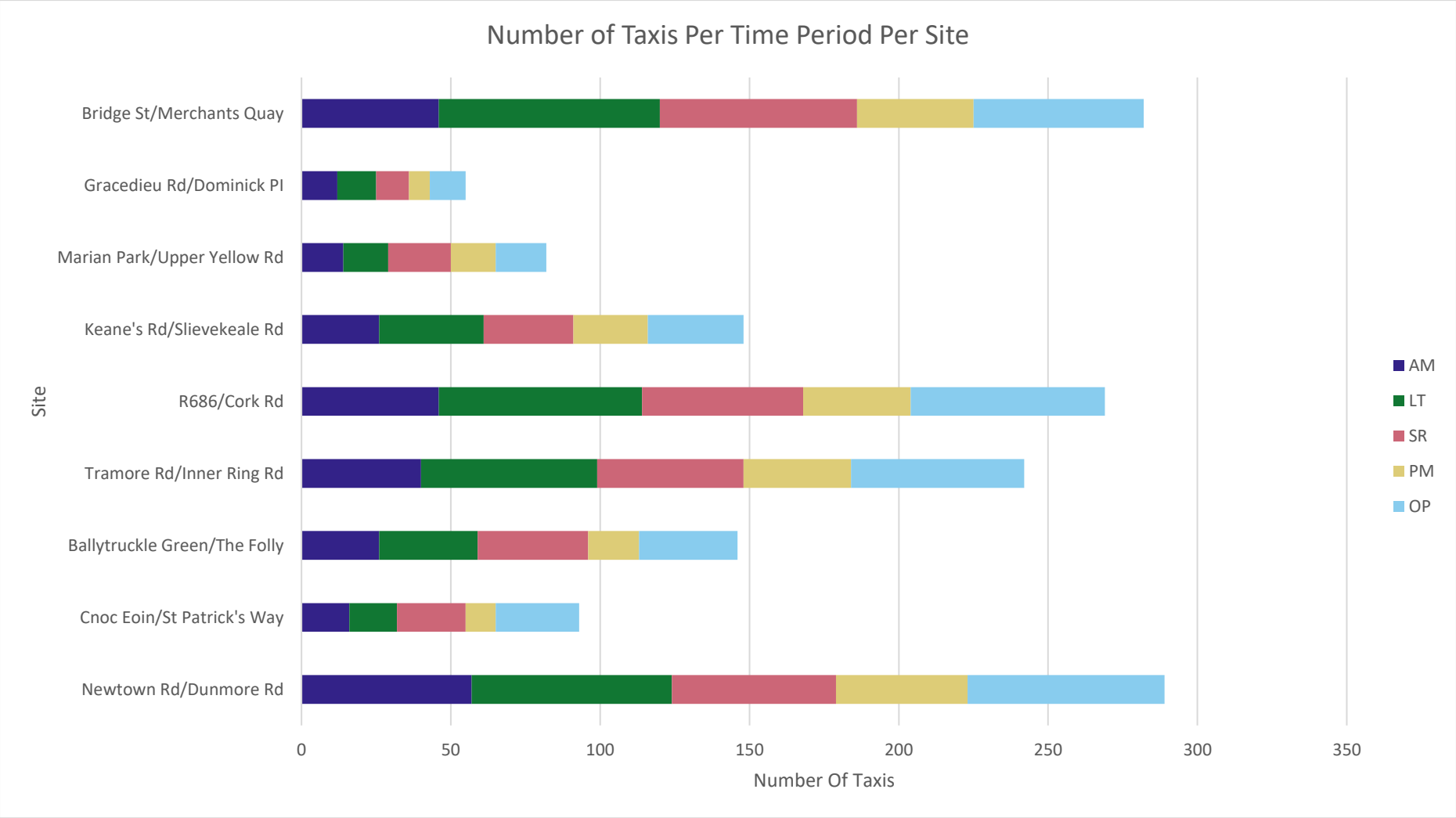

Figure 3-17:Number of Taxis Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Bus

Figure 3-18 below presents the total number of buses crossing the Waterford City Cordon for each surveyed time period. Overall, it is evident that the OP time period has the highest volume of buses, with a total of 171 buses travelling inbound.

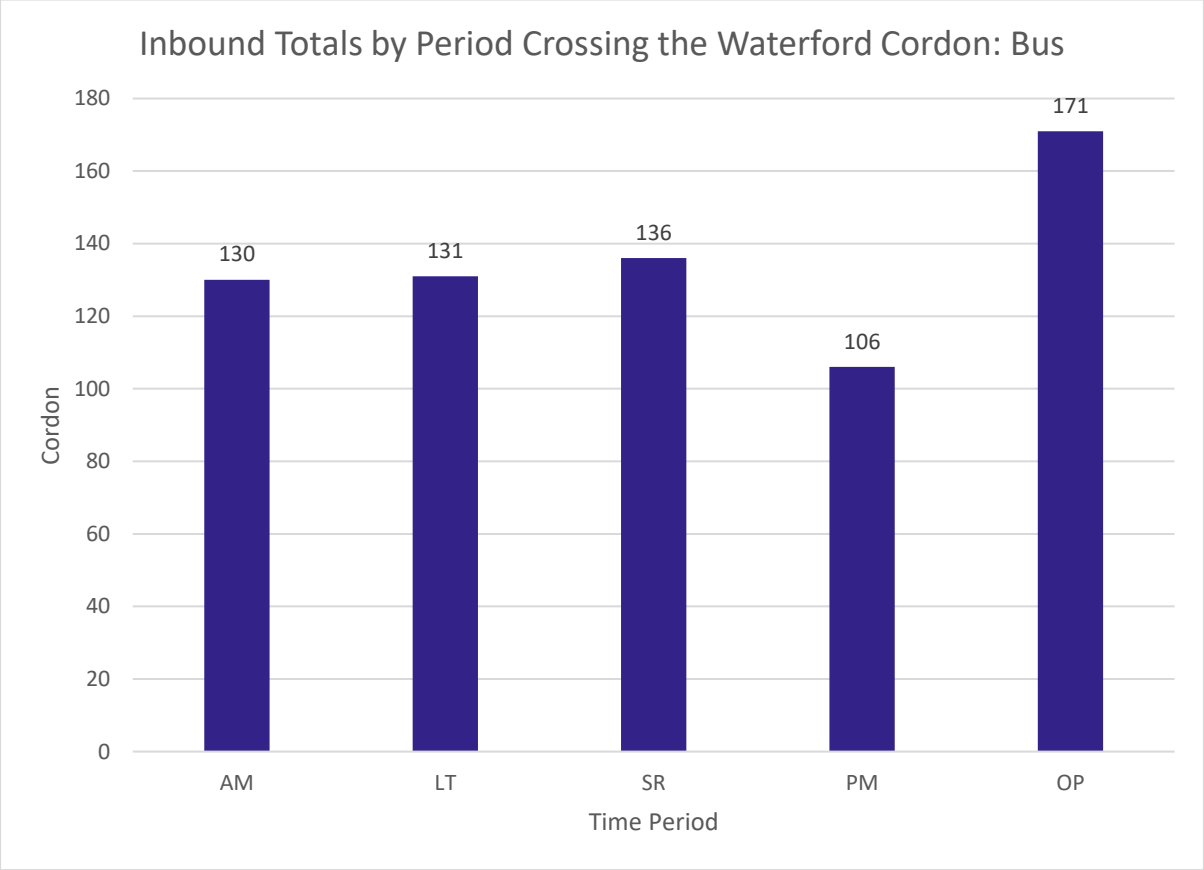

Figure 3-18:Total Number of Bus journeys per Time Period

Figure 3-19 presents a further breakdown of the total number of buses, with reference to each site location. The busiest location for buses crossing the Waterford City Cordon was the R686/Cork Rd junction, with a total of 180 buses travelling inbound through this junction over a 24-hour period.

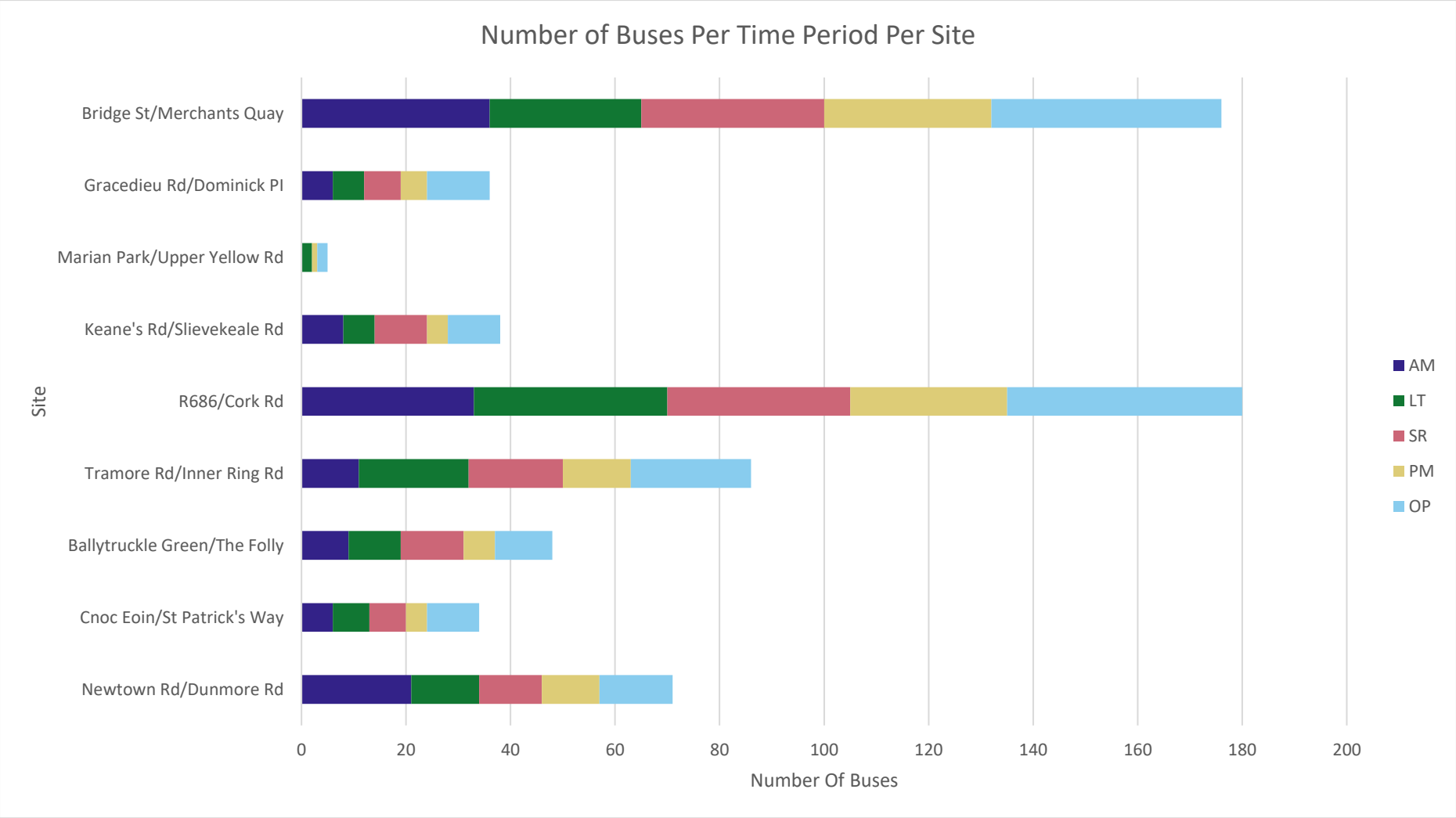

Figure 3-19:Number of Buses Crossing the Waterford City Cordon Inbound at all Sites Per Time Period

Pedestrians

Figure 3-20 presents the total number of pedestrian movements crossing the Waterford City Cordon per surveyed time period. Overall, it is evident that the PM period has the highest volume of pedestrians, with a total of 1,423 pedestrians travelling inbound.

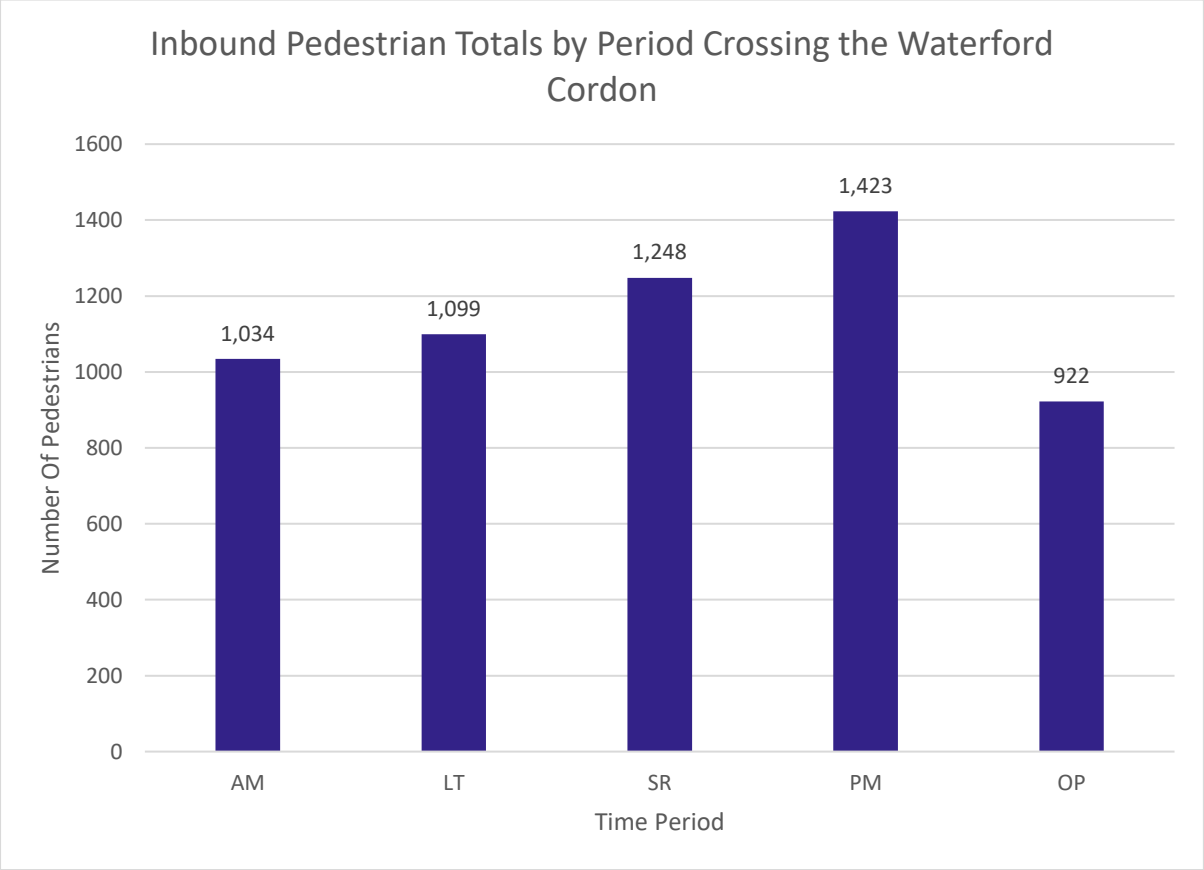

Figure 3-20:Total Pedestrians per Time Period

Figure 3-21 presents a further breakdown of the total number of pedestrian movements, with reference to each site location. The busiest location for pedestrians crossing the Waterford City Cordon was the Tramore Rd/Inner Ring Rd, with a total of 1,149 pedestrians travelling inbound through this junction over a 24-hour period.

Please also refer to Appendix A for further information on the total number of pedestrian movements, with reference to each individual time period and the classified pedestrian types (i.e. adult, OAP, child < 5, child < 16 and mobility impaired).

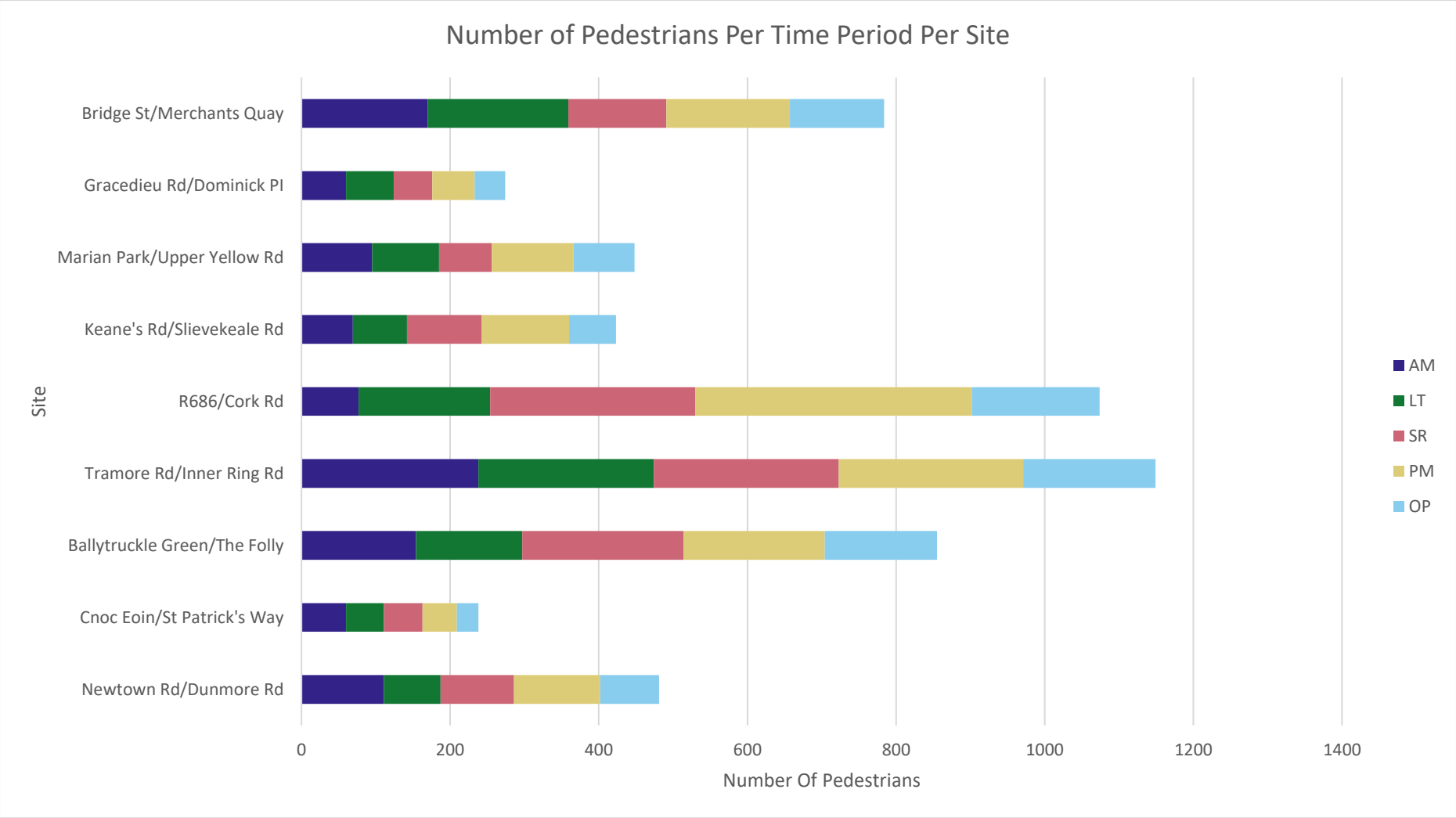

Figure 3-21:Total Pedestrians at all Sites per Time Period

3.1.3 Daily Movements Across the Waterford City Cordon

ATCs recorded traffic flows at 15-minute intervals at 10 sites on the main radial routes into and around the city for a period of two weeks to understand daily two-way traffic movements. These surveys were primarily used to provide insight into the variation in demand across the week. The results from these surveys show that the day with the highest number of vehicles travelling inbound is Friday, as can be seen in Figure 3-22.

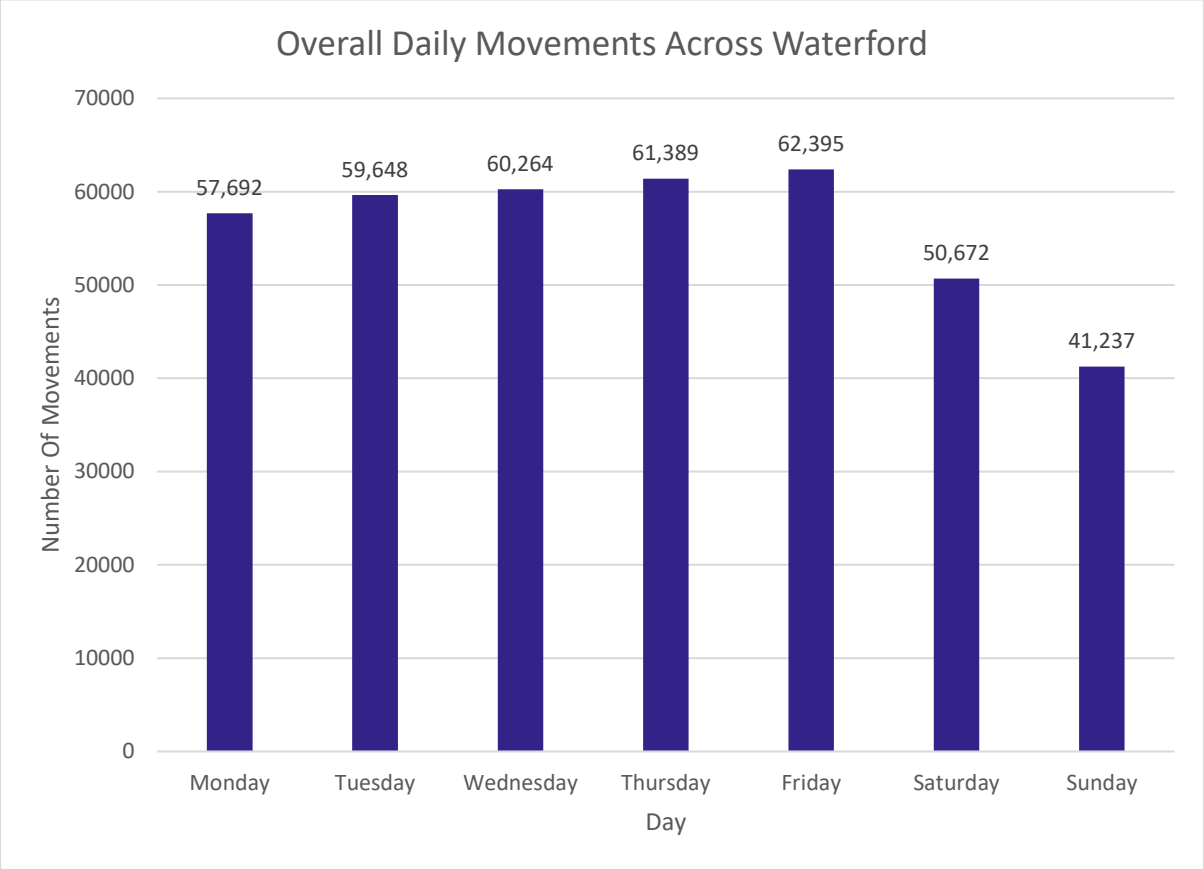

Figure 3-22:Average Daily Traffic at ATC Sites

3.2 Vehicle Occupancy Data

3.2.1 Bus Occupancy

Bus occupancy information was obtained from 8 bus stop survey locations, recorded at hourly intervals over a 12-hour period (i.e. 07:00 - 19:00) on the day of the survey.

Figure 3-23, Figure 3-24, Figure 3-25, Figure 3-26 and Figure 3-27 display the recorded bus occupancies crossing the Waterford City Cordon inbound towards the city during the respective time periods. The bus occupancies are displayed in terms of 5 different capacity bands (0-24%, 25-49%, 50-74%, 75-99% and 100%). Please note that these graphs display both the absolute values and the percentage occupancy for each time period. The figure below shows that, over the full 12-hour survey period, approximately 6% of buses were at less than 25% capacity, 59% were at between 25% and 49% capacity, 27% were at between 50% and 74% capacity, 7% were at between 75% and 99% capacity and approximately 1% were full.

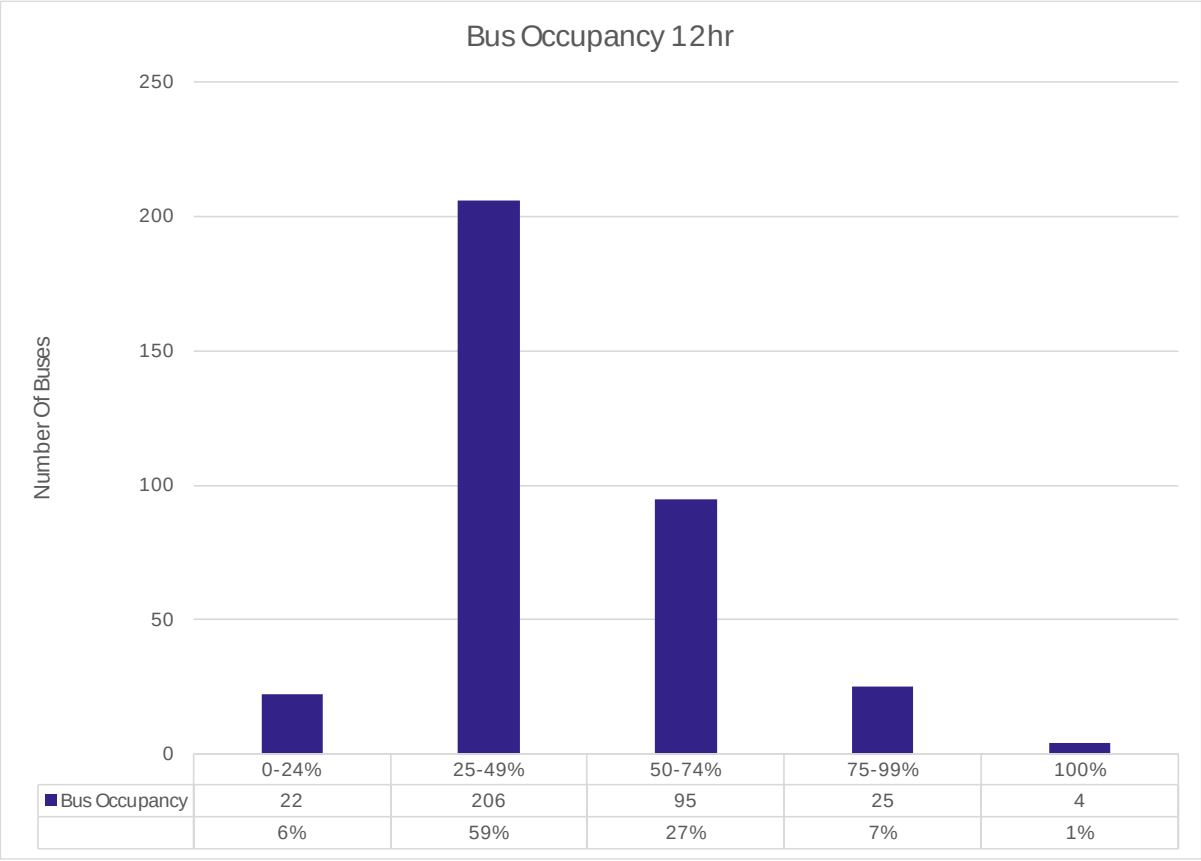

Figure 3-23:Bus Occupancy: 12 Hour

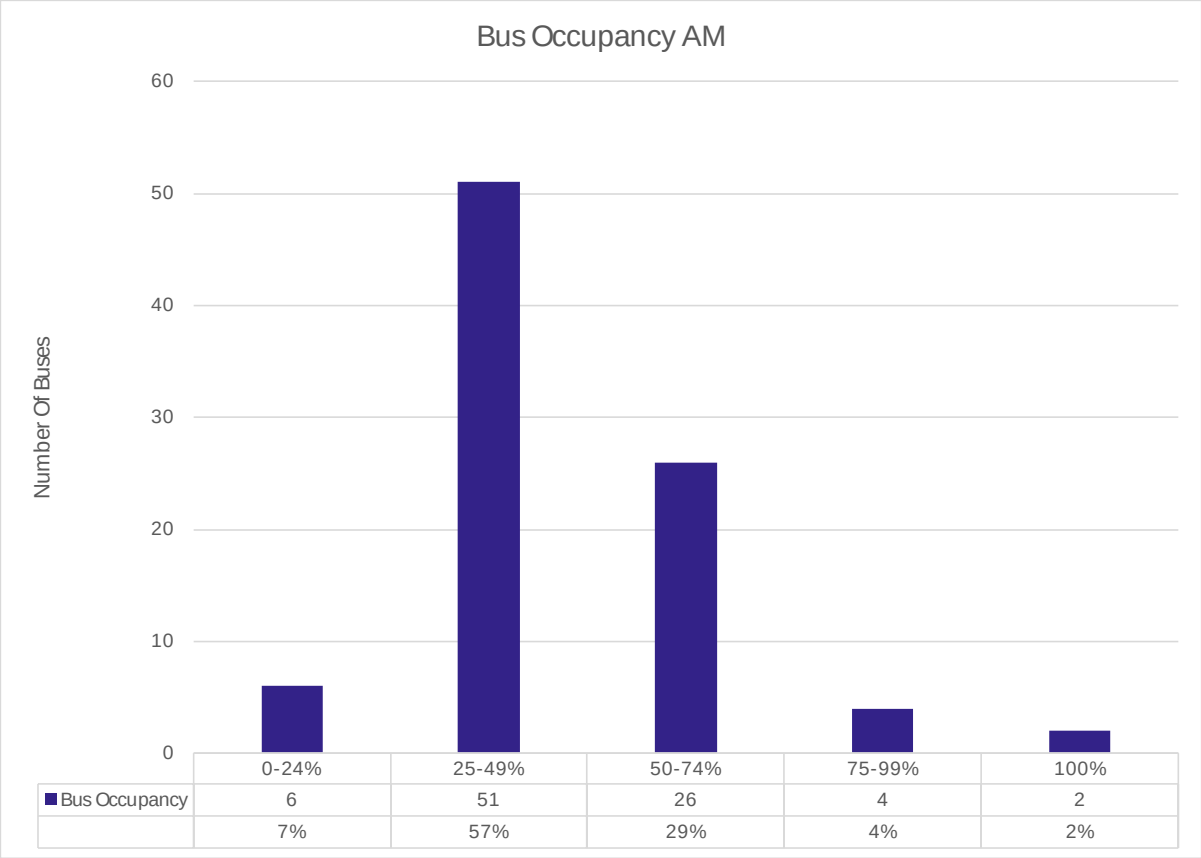

Figure 3-24:Bus Occupancy: AM

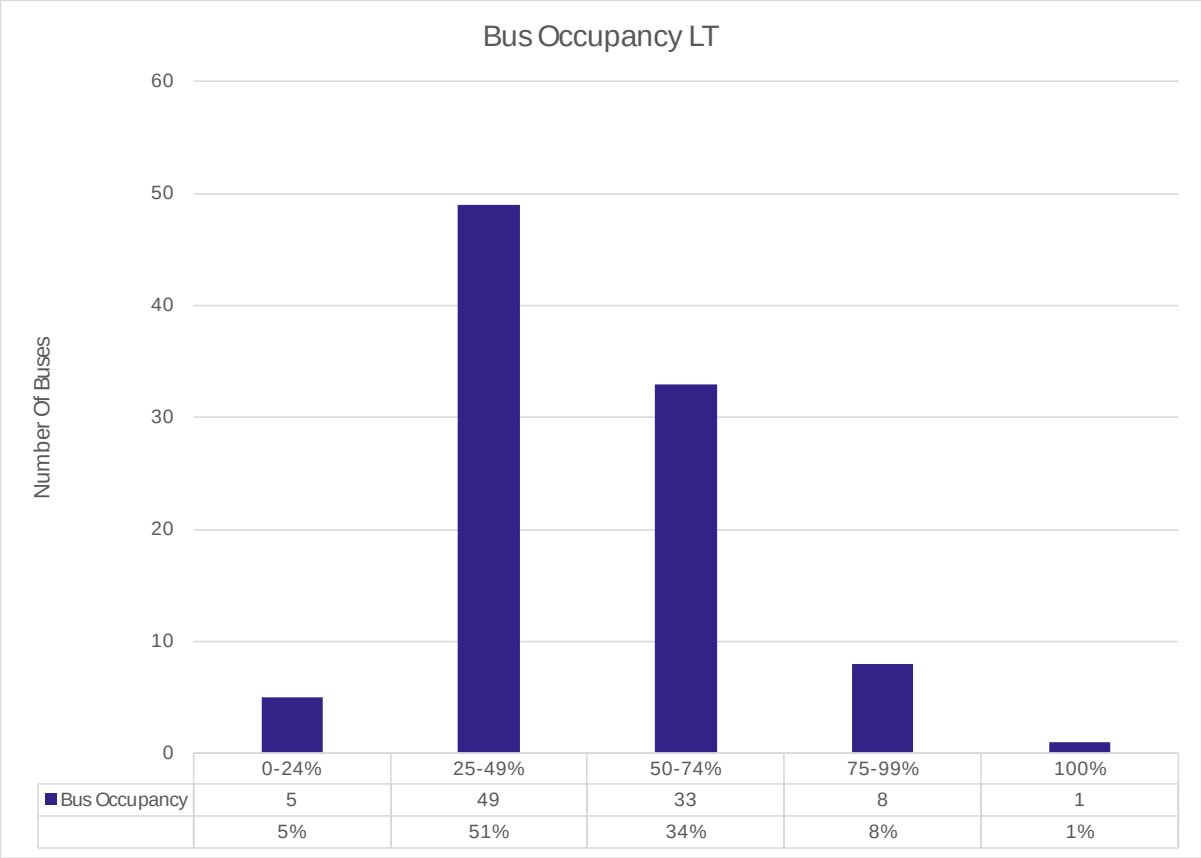

Figure 3-25:Bus Occupancy: LT

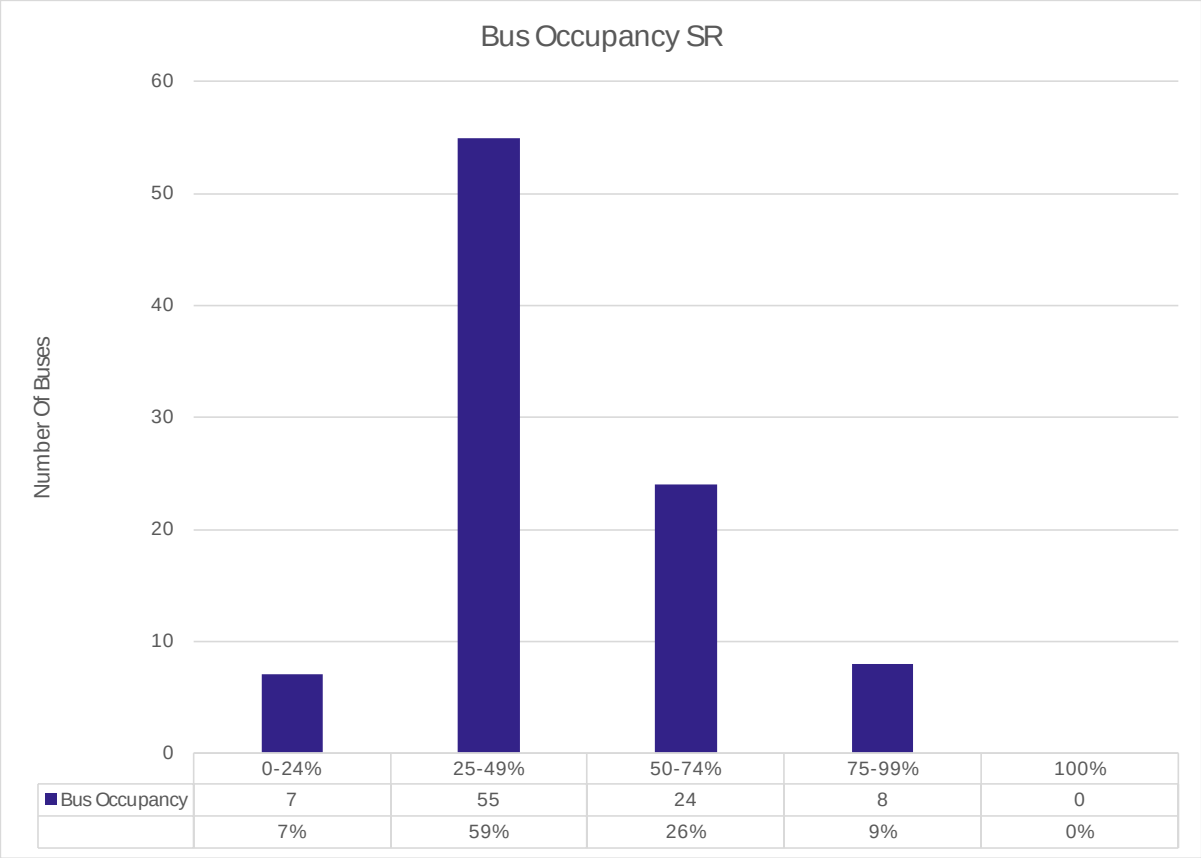

Figure 3-26:Bus Occupancy: SR

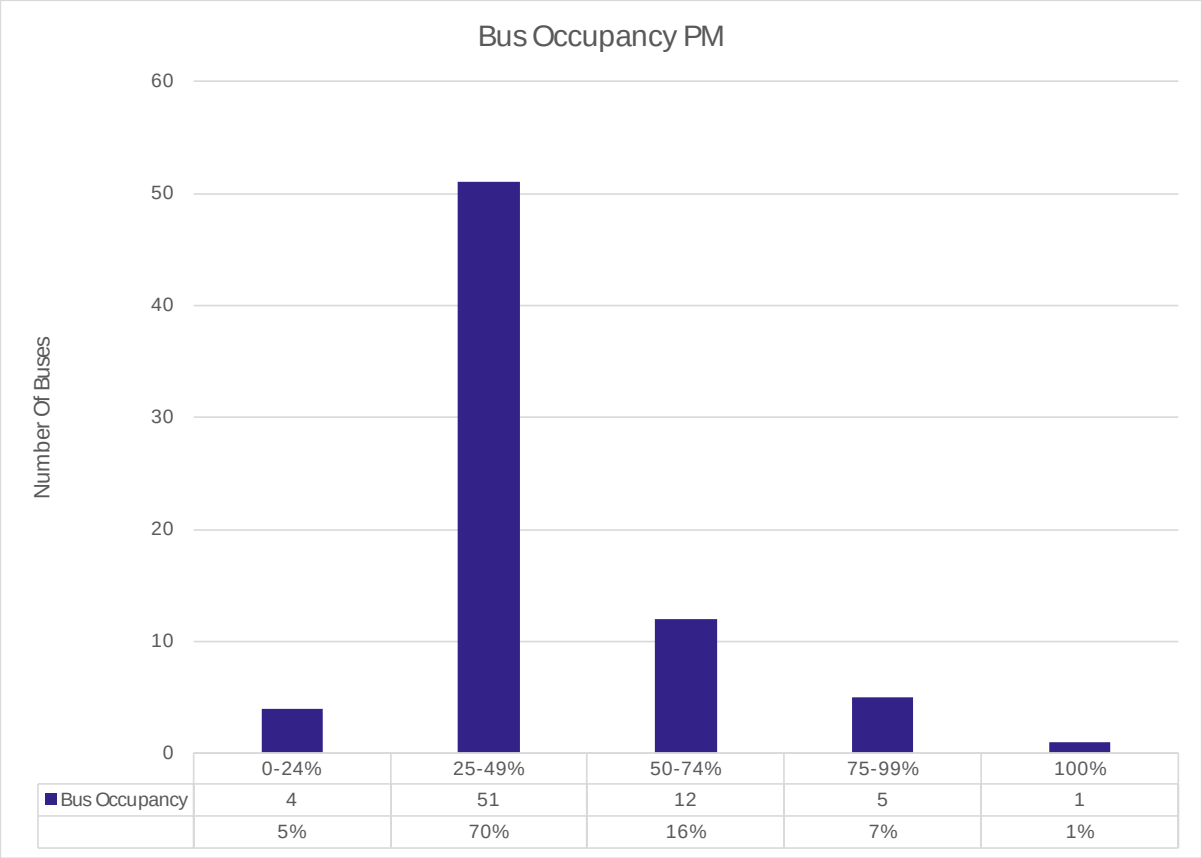

Figure 3-27:Bus Occupancy: PM

Bus Occupancy per Site

Figure 3-28, Figure 3-29, Figure 3-30, Figure 3-31 and Figure 3-32 display the vehicle occupancy for buses crossing the Waterford City Cordon during the respective time periods, with further reference to each individual bus stop location.

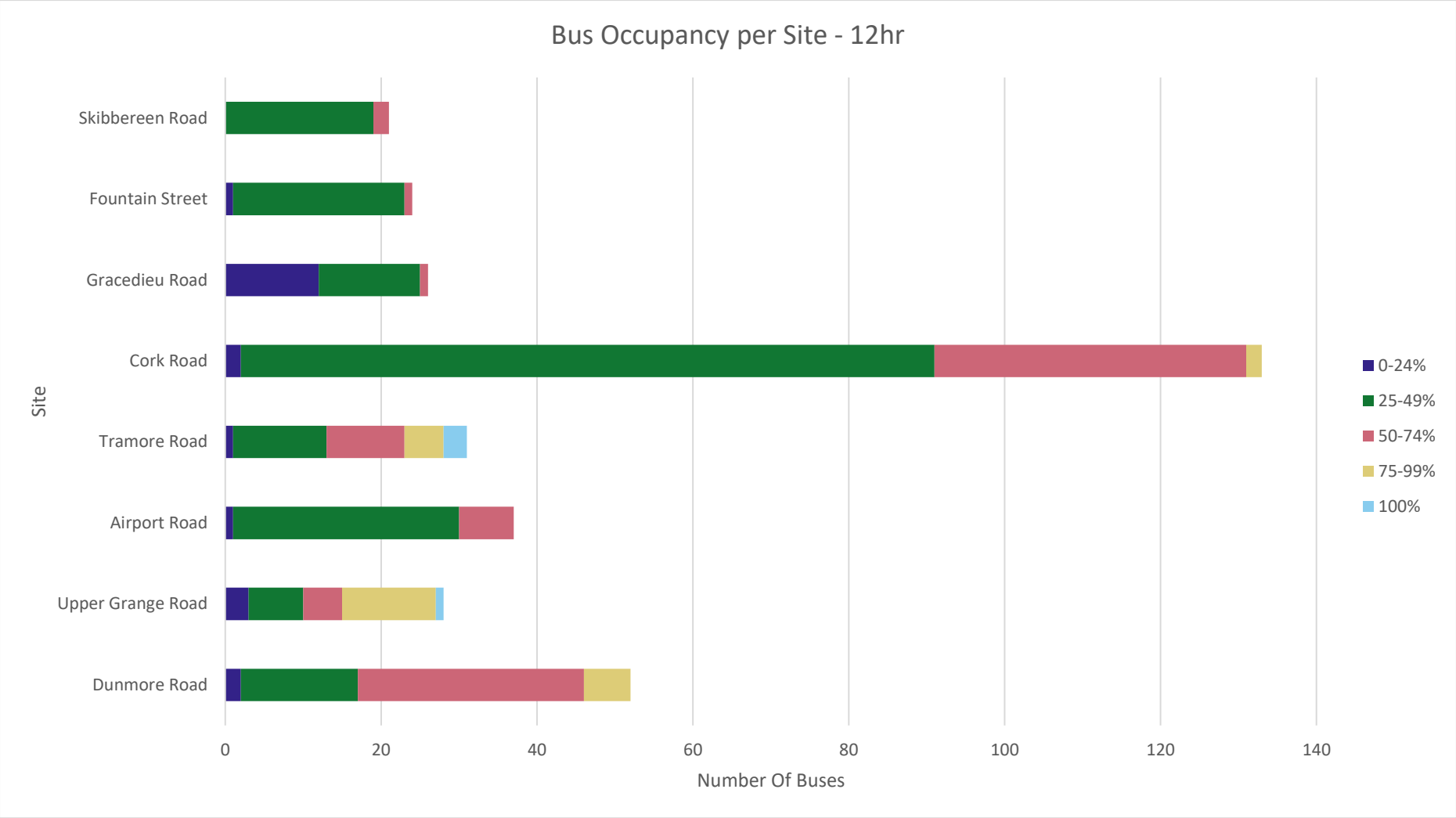

Figure 3-28:Bus Occupancy per Site: 12 Hour

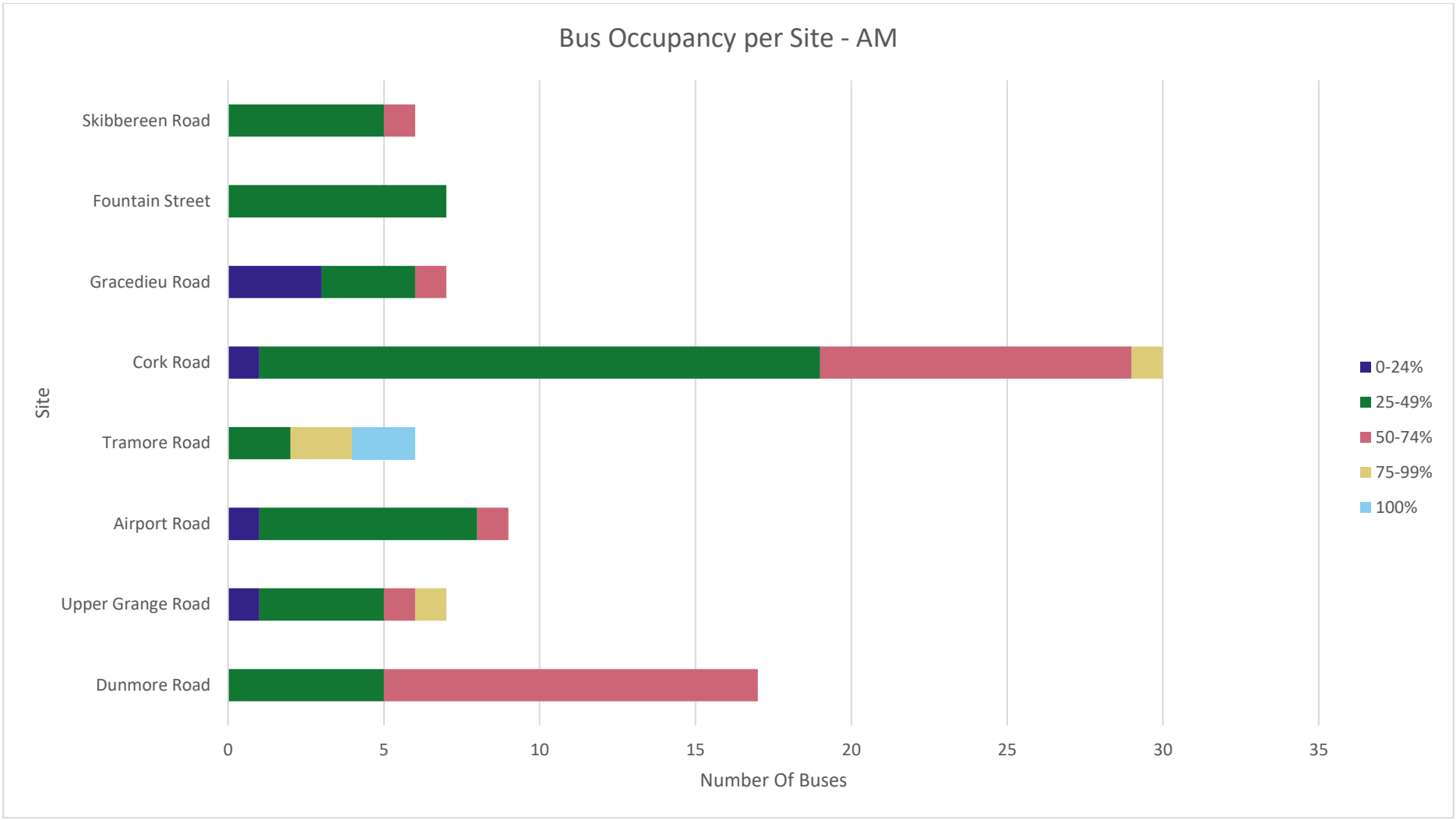

Figure 3-29:Bus Occupancy per Site: AM

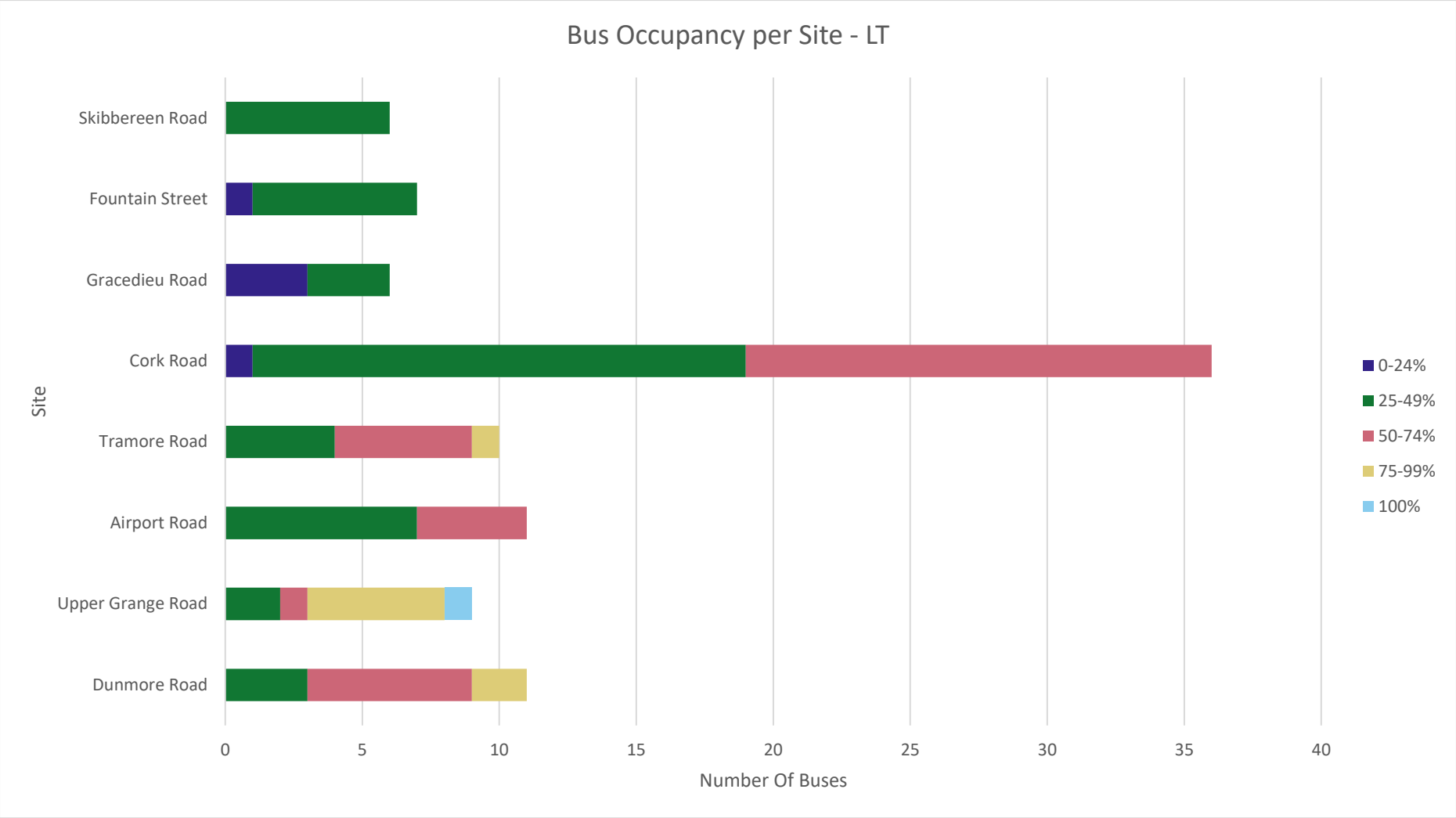

Figure 3-30:Bus Occupancy per Site: LT

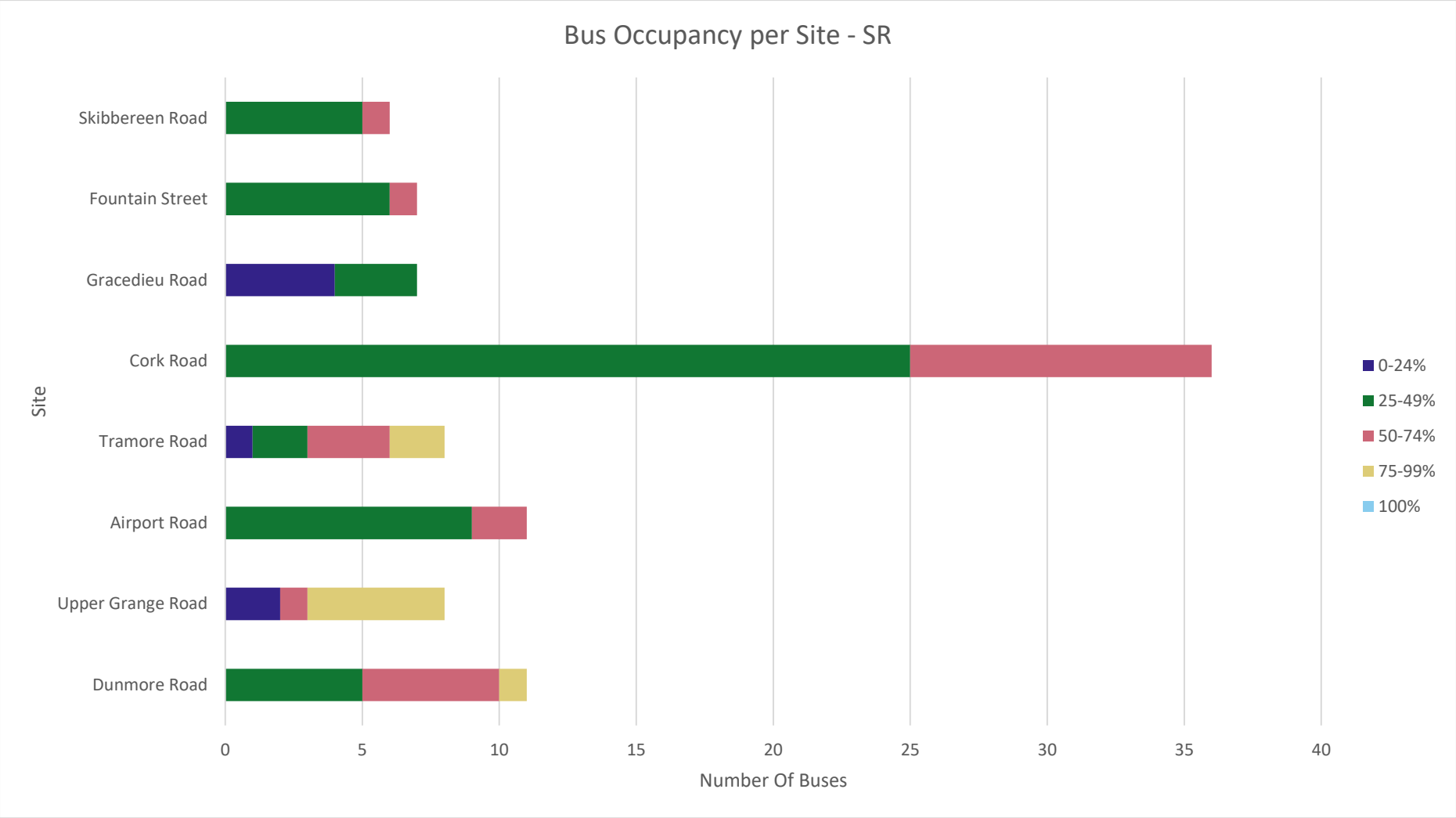

Figure 3-31:Bus Occupancy per Site: SR

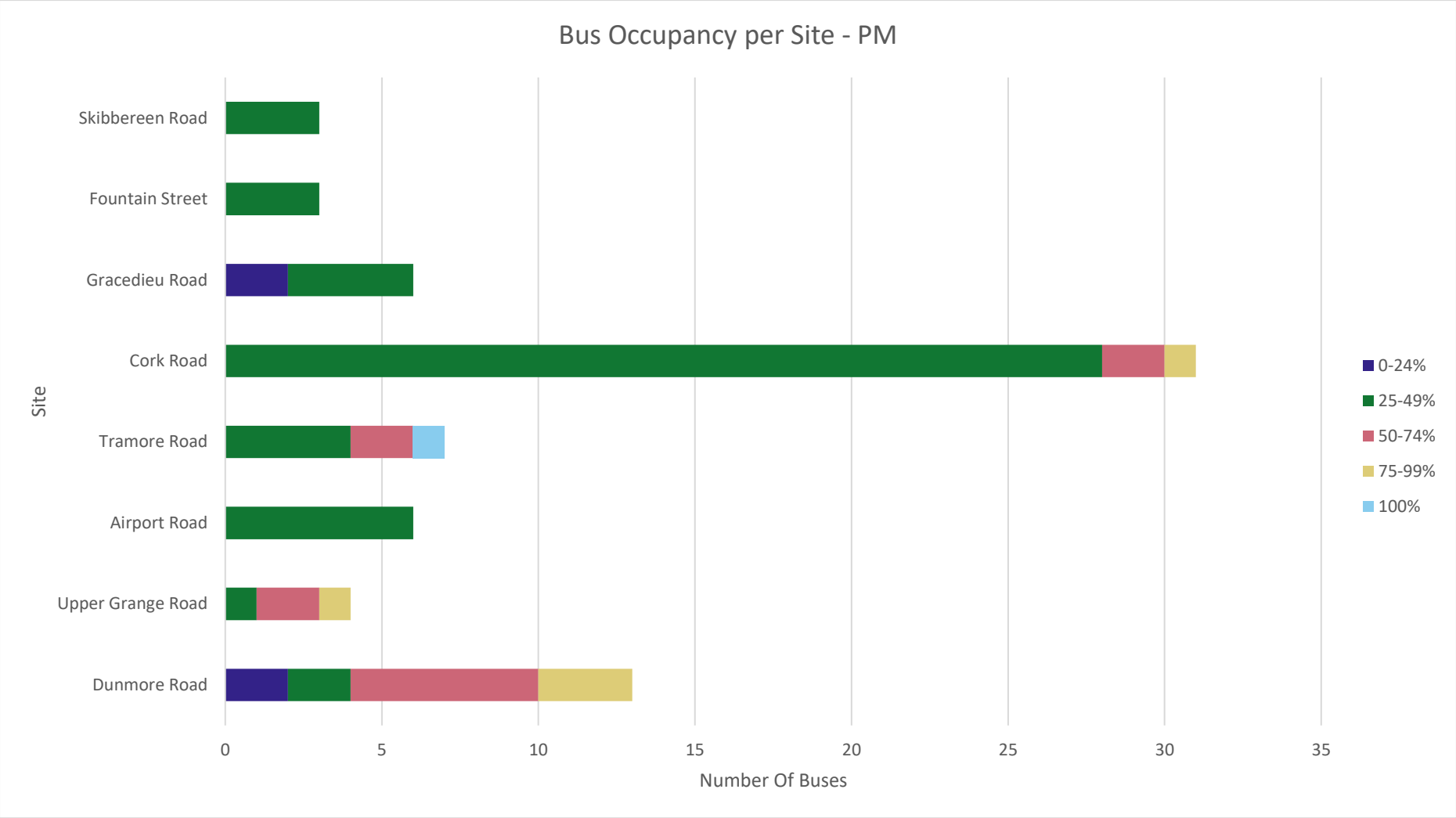

Figure 3-32:Bus Occupancy per Site: PM

4 People Movements

4.1 Methodology

Chapter 3 provided details on the number of vehicles, pedestrians and cyclists crossing the Waterford City Cordon. In order to convert these to total person trips crossing the cordon, it is necessary to estimate the occupancy of each vehicle type. Further details on how this was done is outlined below.

- Road Passenger Movements were calculated in the following ways:
    - As there are no car or taxi occupancy surveys, person movements were calculated by applying an occupancy factor of 1.5, derived from the National Household Travel Survey, to the number of vehicles for each vehicle classification at each equivalent site from the JTC surveys. This value is comparable to the value of 1.38 from table 6.11.34 of the Project Appraisal Guidelines[1].
    - Total bus passenger movements were calculated by applying average bus occupancy factors (as outlined in Appendix B) to the number of buses observed in the bus occupancy surveys.
    - Cyclist and pedestrian people movements were taken directly from the JTC surveys.
- Rail Passenger Movements were calculated using the following methodology:
    - Rail movements include passengers crossing the cordon inbound from the National Rail Census, which is a boarding and alighting survey conducted by Iarnród Éireann on a single day each year at every rail station throughout the country. The most recent survey was performed on 09/11/2023. While this is different to the dates of the other surveys, the Rail Census is considered representative of rail movements.

The resulting people movements by mode are discussed in detail in the following sections of this Chapter.

4.2 Road Person Trips

Figures 4-1 to 4-5 below show the number of person trips crossing the Cordon via the road network, by mode, over the 12-hour survey period and each of the time periods analysed.

[1] https://www.tiipublications.ie/advanced-search/results/document/?id=3276

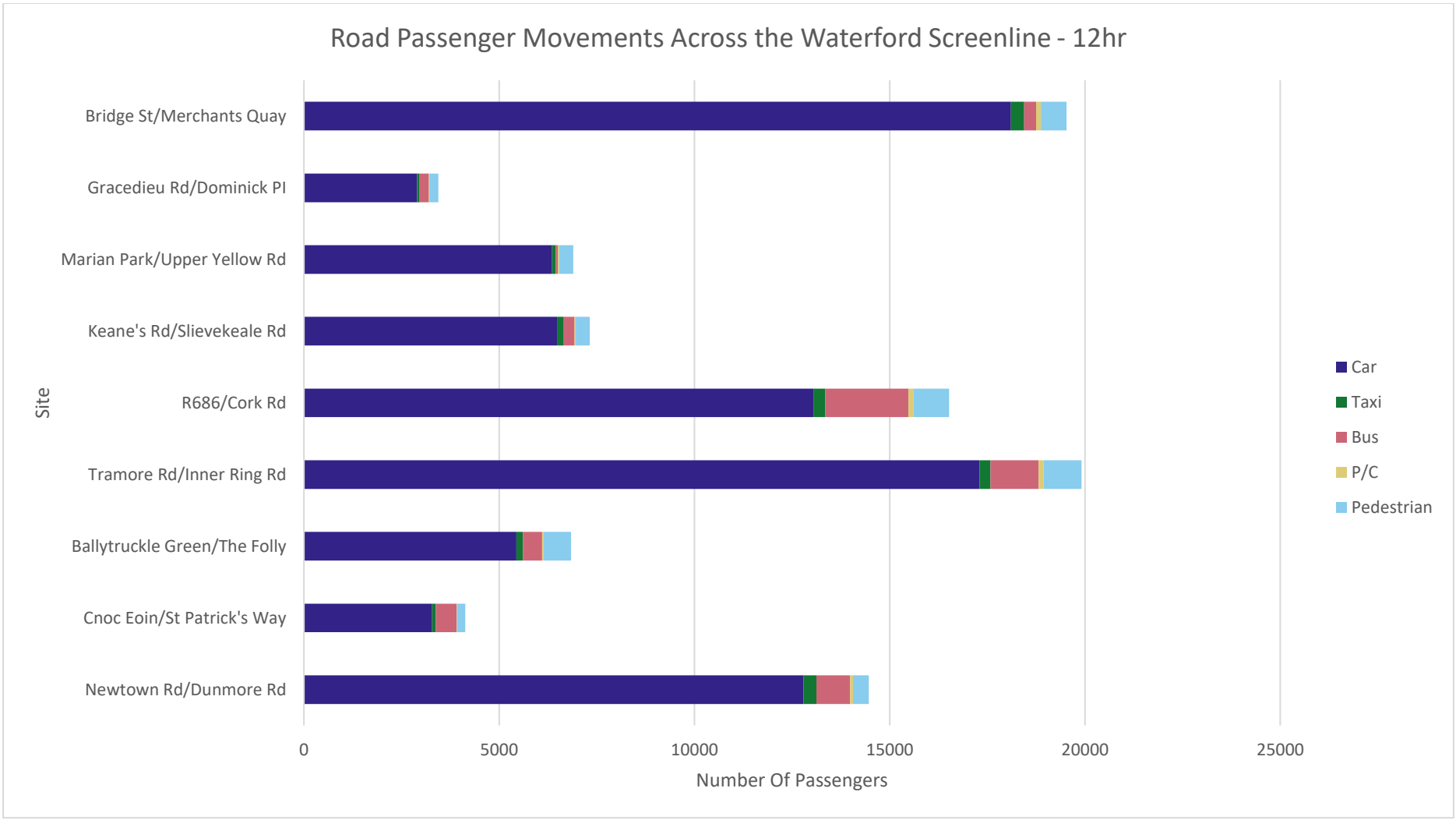

Figure 4-1:Road Passenger Movements per Mode per Site: 12 Hour

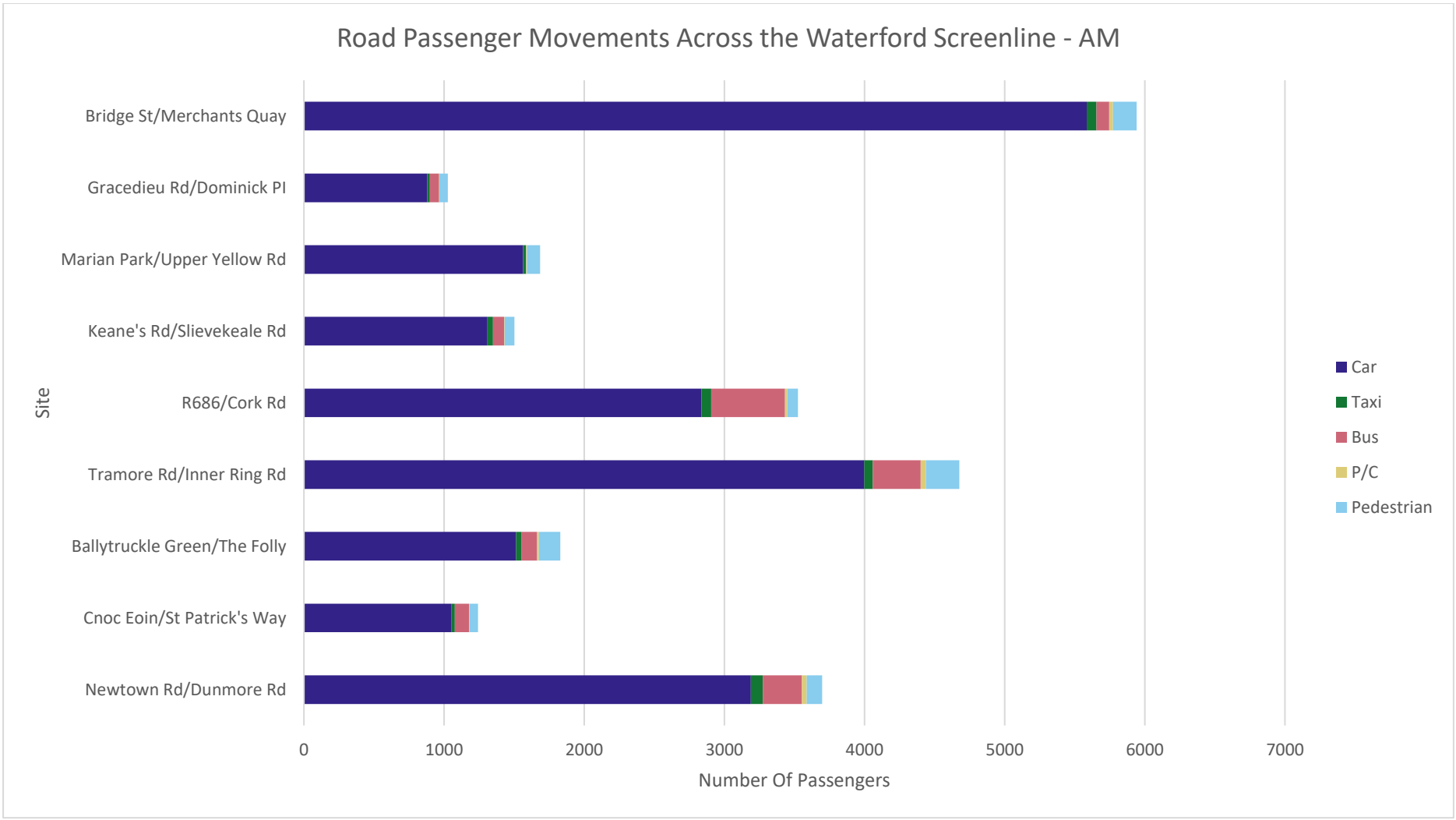

Figure 4-2:Road Passenger Movements per Mode per Site: AM

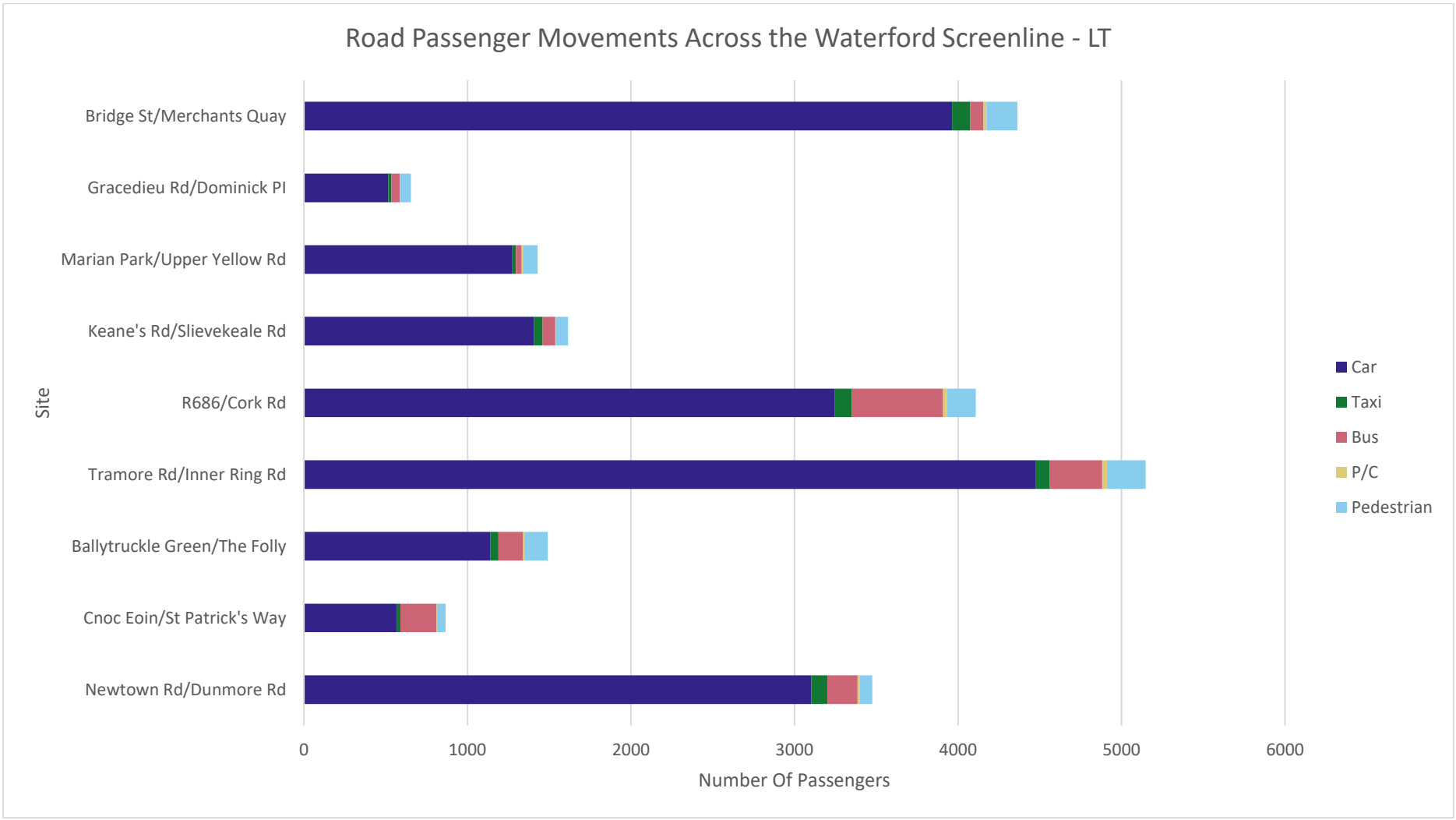

Figure 4-3:Road Passenger Movements per Mode per Site: LT

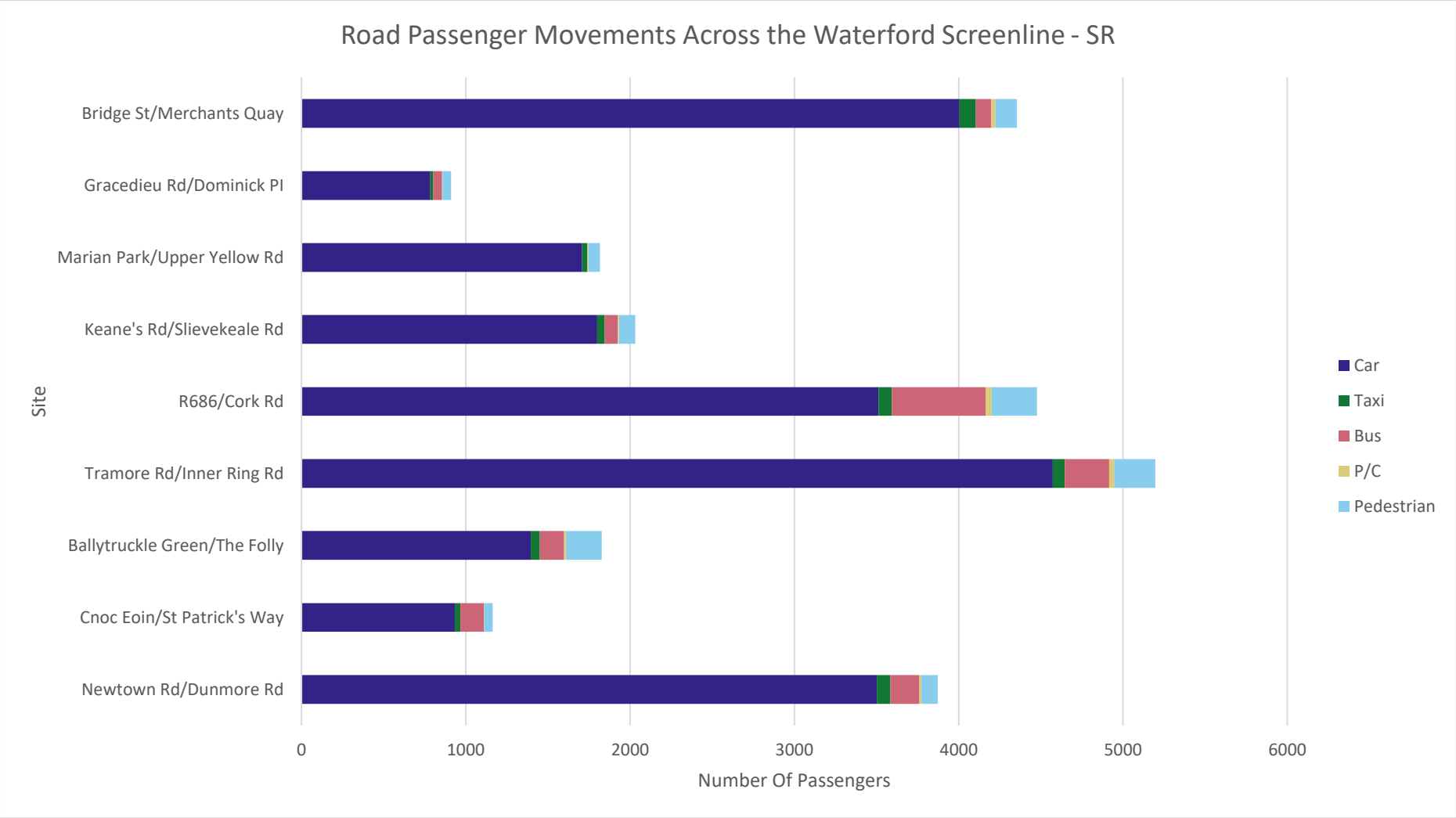

Figure 4-4:Road Passenger Movements per Mode per Site: SR

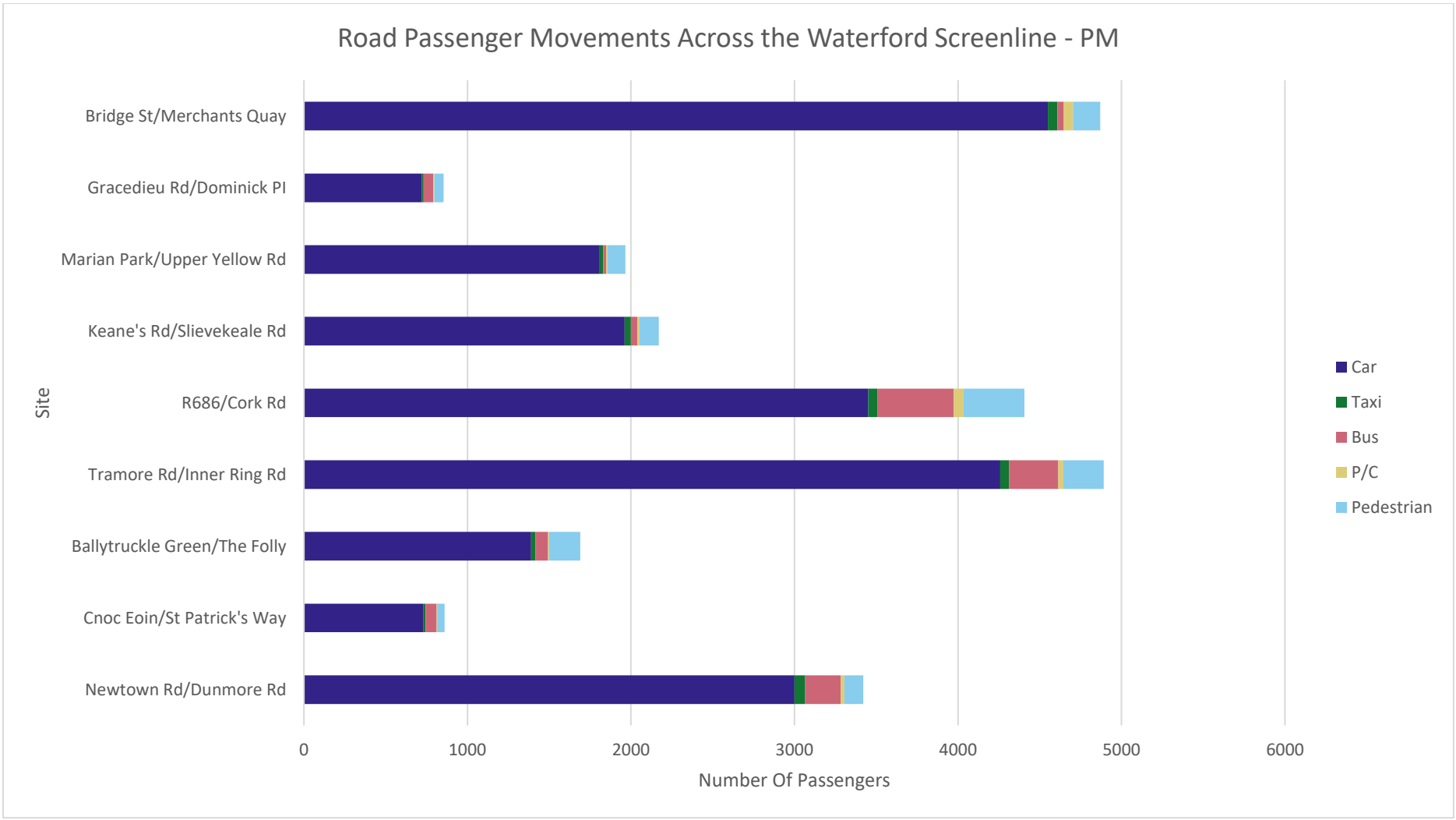

Figure 4-5:Road Passenger Movements per Mode per Site: PM

4.3 Rail Passenger Movements

4.3.1 Heavy Rail Passenger Movements

The National Rail Census is a survey carried out by Iarnród Éireann every year which records the boardings and alightings at every rail station in the country on a 09/11/2023. This report extracts the number alighting passengers at Waterford City Cordon from that survey.

Waterford Plunkett Station is served by trains on the Dublin Heuston - Waterford line and those on the Galway - Clonmel - Limerick Junction line, offering connections with Dublin, Cork, Limerick and Galway. It is served by 8 direct trains a day from Heuston, and 2 trains a day from Limerick Junction.

Figure 4-6 shows the total number of people alighting at Waterford station grouped by the origin of the service. In total, 325 people alighted at Waterford Train Station over the 12-hour survey period.

Note that Limerick Junction is a key interchange station for trains serving Waterford, and thus trips from this station are likely have their ultimate origin at another station (e.g. Cork or Limerick).

Appendix C presents the breakdown of heavy rail passenger movements in further detail.

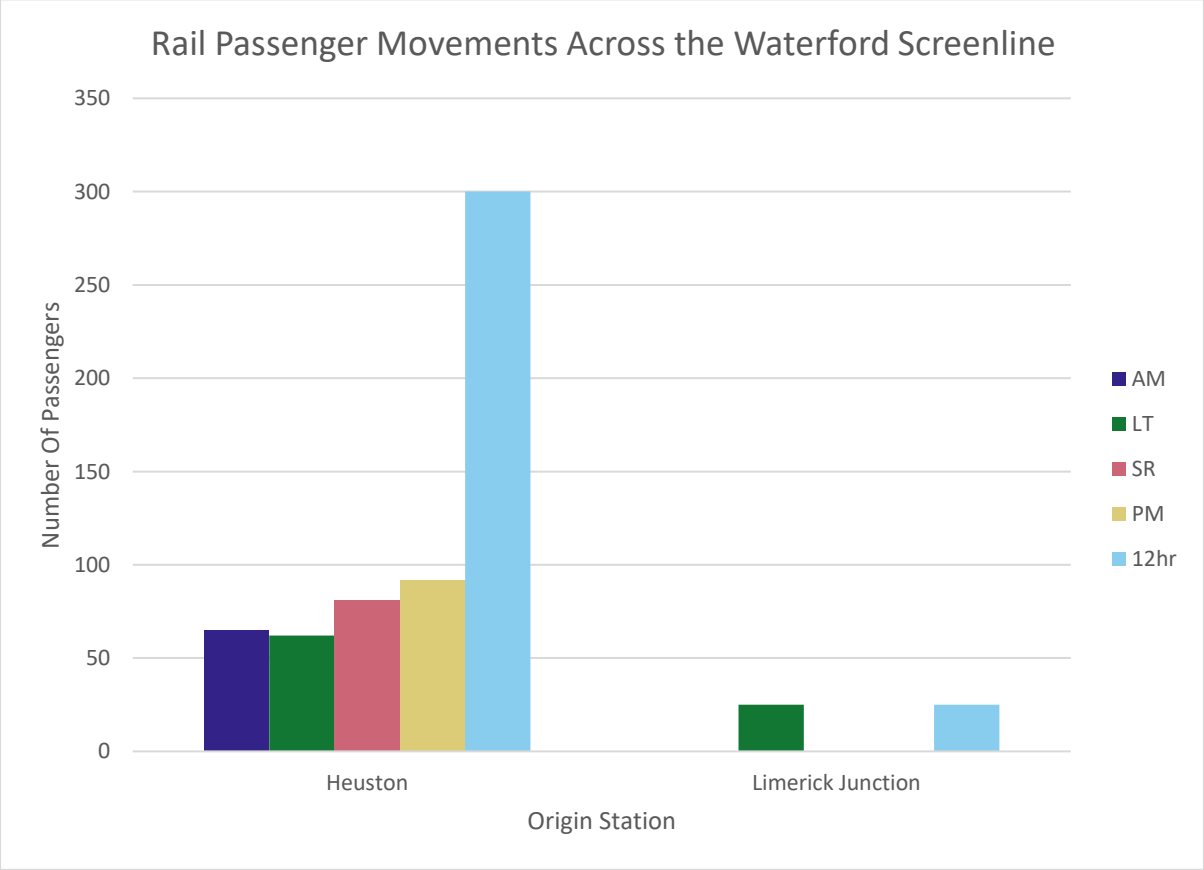

Figure 4-6:Heavy Rail Services - Passengers Inbound

4.4 Total Person Movements

Figure 4-7 and Figure 4-8 display the total number of person trips crossing the Waterford City Cordon by Pedal Cycle, Pedestrian, Bus, Rail, Car and Taxi for each time period.

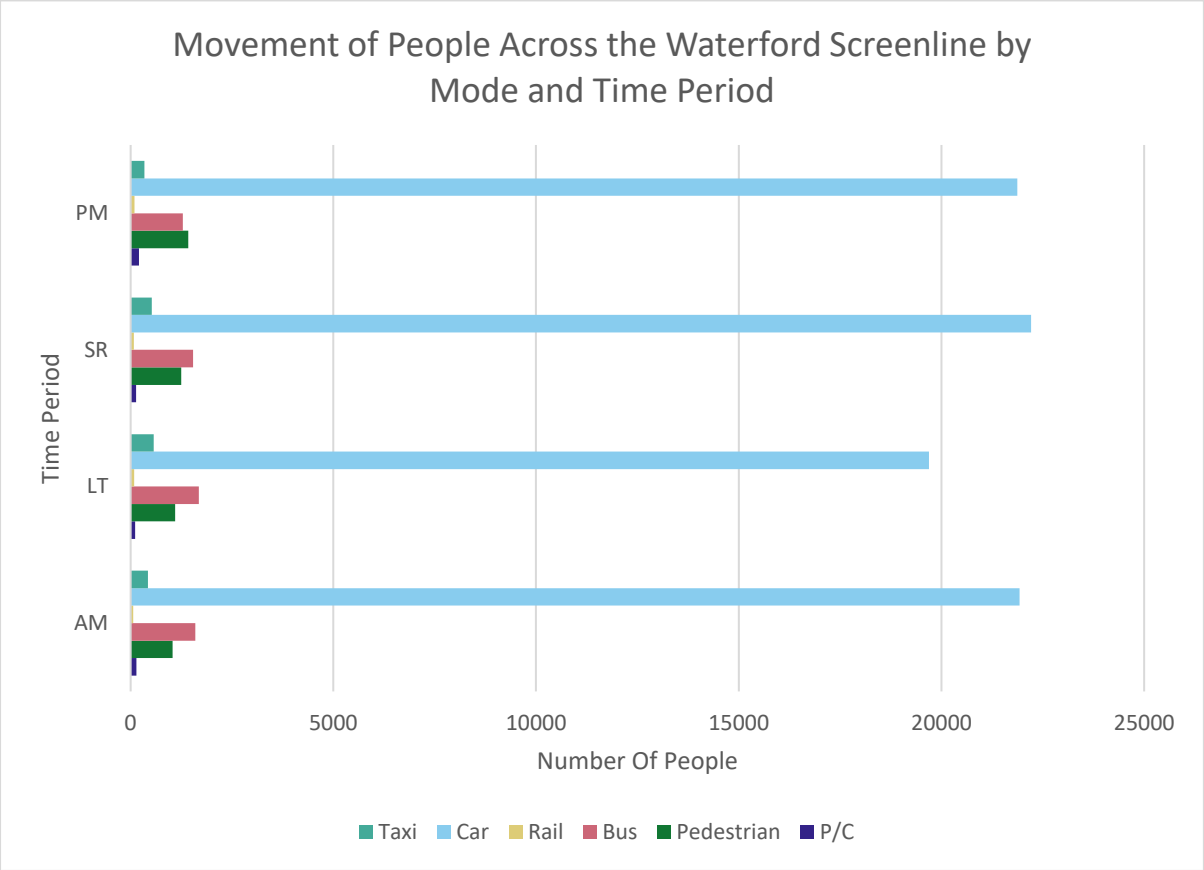

Figure 4-7:Car, Cycle, Taxi, Pedestrian and Rail Trips Inbound Across the Waterford City Cordon During Each Time Period

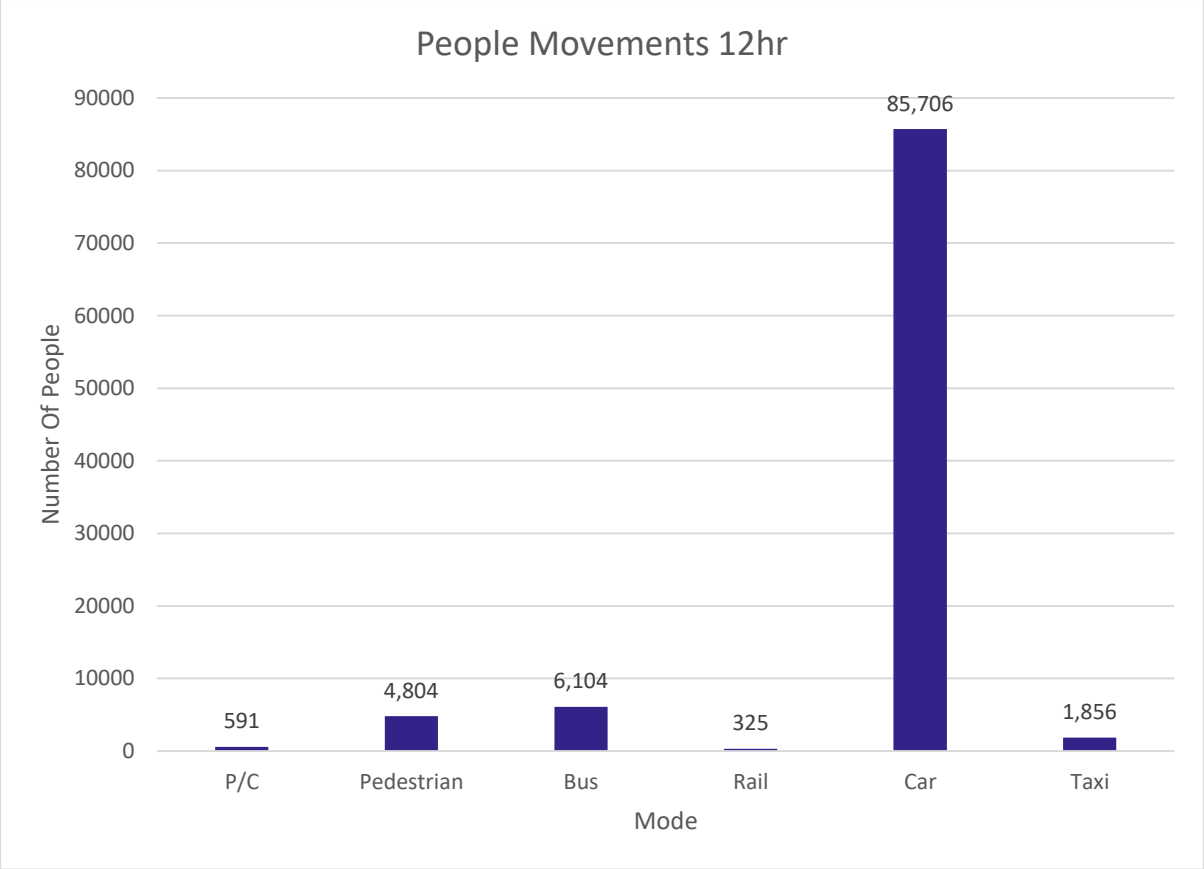

Figure 4-8:Trips Inbound across the Waterford City Cordon: 12 Hour

4.5 Modal Split

Table 4-1 shows the number of sustainable and vehicular modes crossing the Waterford City Cordon during the 12hr period.

Table 4-1:Number of Journeys Across the Waterford City Cordon by Mode

Mode	Trips	% Trips
P/C	591	1%
Pedestrian	4,804	5%
Bus	6,104	6%
Rail	325	0%
Car	85,706	86%
Taxi	1,856	2%

As can be seen from Figure 4-9, the mode with the highest share over a 12 hr period is Car with 86%.

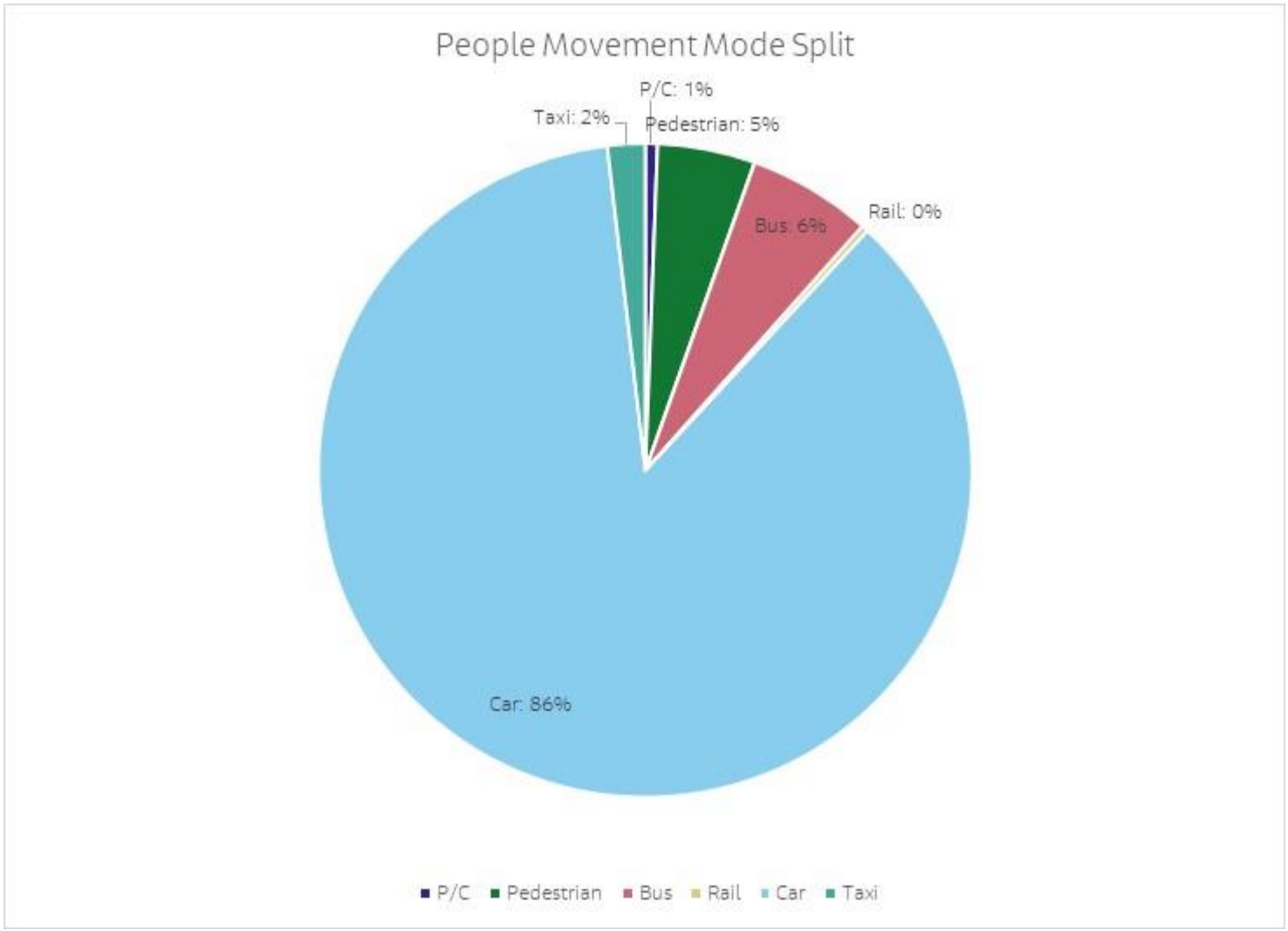

Figure 4-9:Mode share of people crossing the Waterford City Cordon by Sustainable and Vehicular Modes

5 Summary Results

Based on the analysis of the 2023 traffic surveys, this report demonstrates the following:

- In terms of overall people movements, 11,824 (12%) of a total of 99,386 people travelling inbound towards the City between 07:00 and 19:00 used sustainable modes of travel, i.e. Pedal Cycle, Pedestrian, Bus and Rail.
- The total number of vehicles, pedestrians and cyclists that crossed the Waterford Cordon inbound was 87,046 on the day of the survey.
- The busiest time period for vehicles and cyclists was the AM peak with 17,275 crossing the Waterford City Cordon inbound towards the city. The busiest time period for Pedestrians was the PM peak with 1,423 crossing the Waterford City Cordon inbound.
- Between the hours of 07:00 and 19:00, cars were recorded to have the highest vehicular traffic split, with 80% of the total inbound flows. Light Goods Vehicles (LGVs) recorded 8%, Ordinary Goods Vehicles 1 (OGV1) recorded 1%, Ordinary Goods Vehicles 2 (OGV2) recorded <1% and taxis recorded 2%. The remaining vehicle classifications recorded 2% or less of the total flows.
- Between 07:00 and 19:00, 59% of buses were at 25-49% capacity. Approximately 6% of buses were at 0-24%. 27% were at 50-74% capacity, 7% were at 75-99% capacity and 1% were at 100% capacity.

Appendix A - Additional Graphs

Car Movements by Site and Period

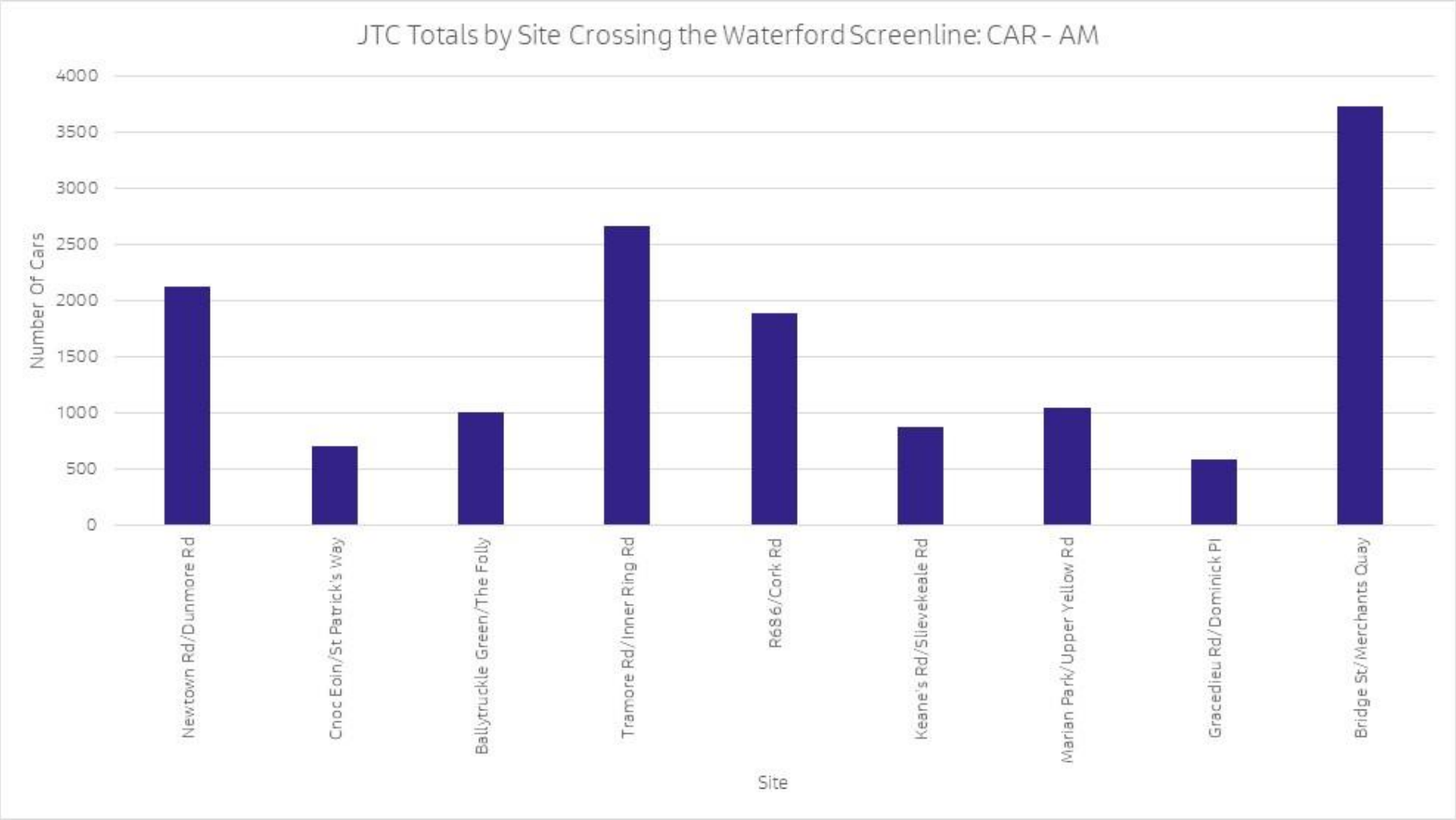

Figure 0-1:Number of Car Journeys for JTC Surveys for AM per Site

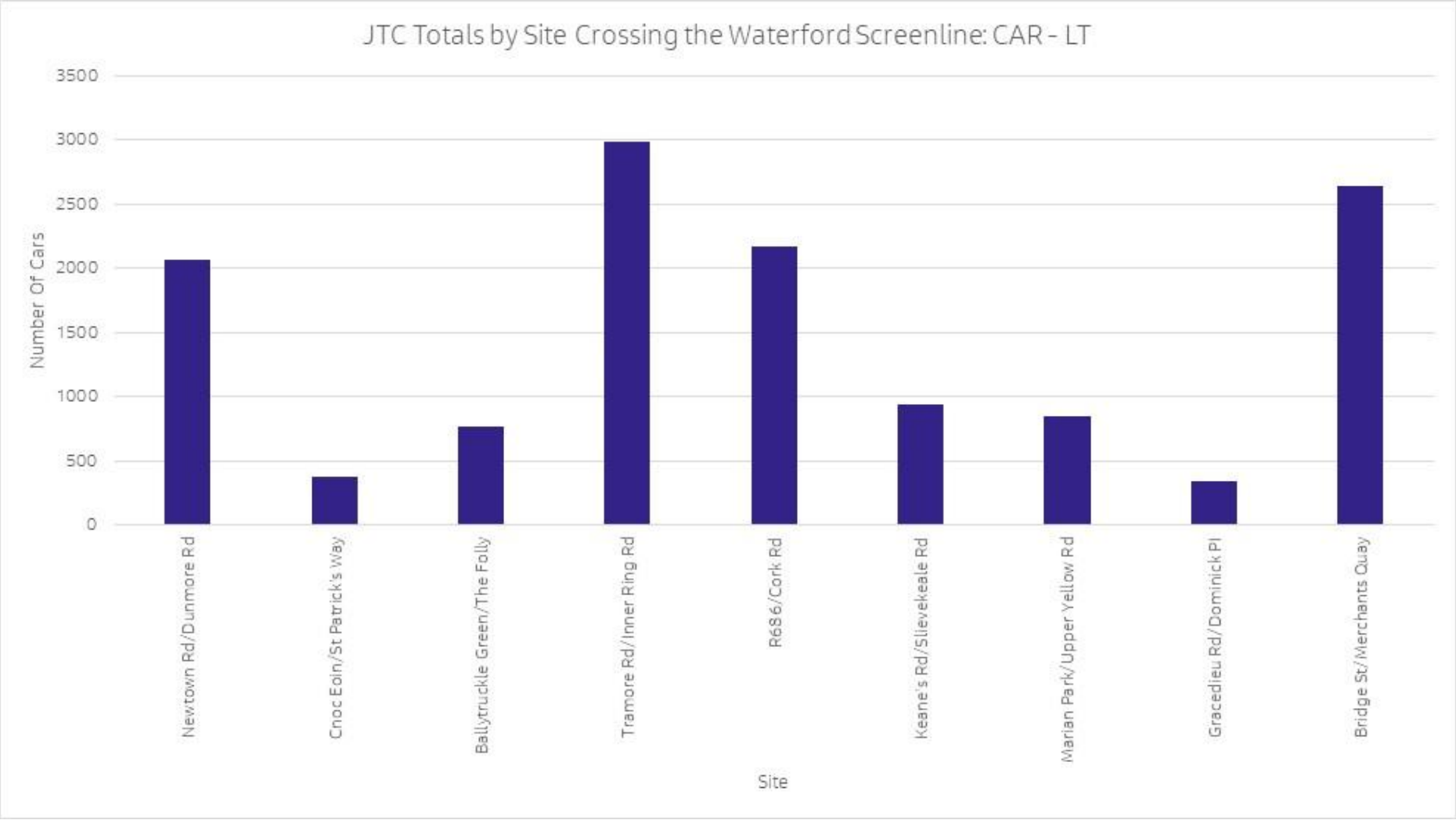

Figure 0-2:Number of Car Journeys for JTC Surveys for LT per Site

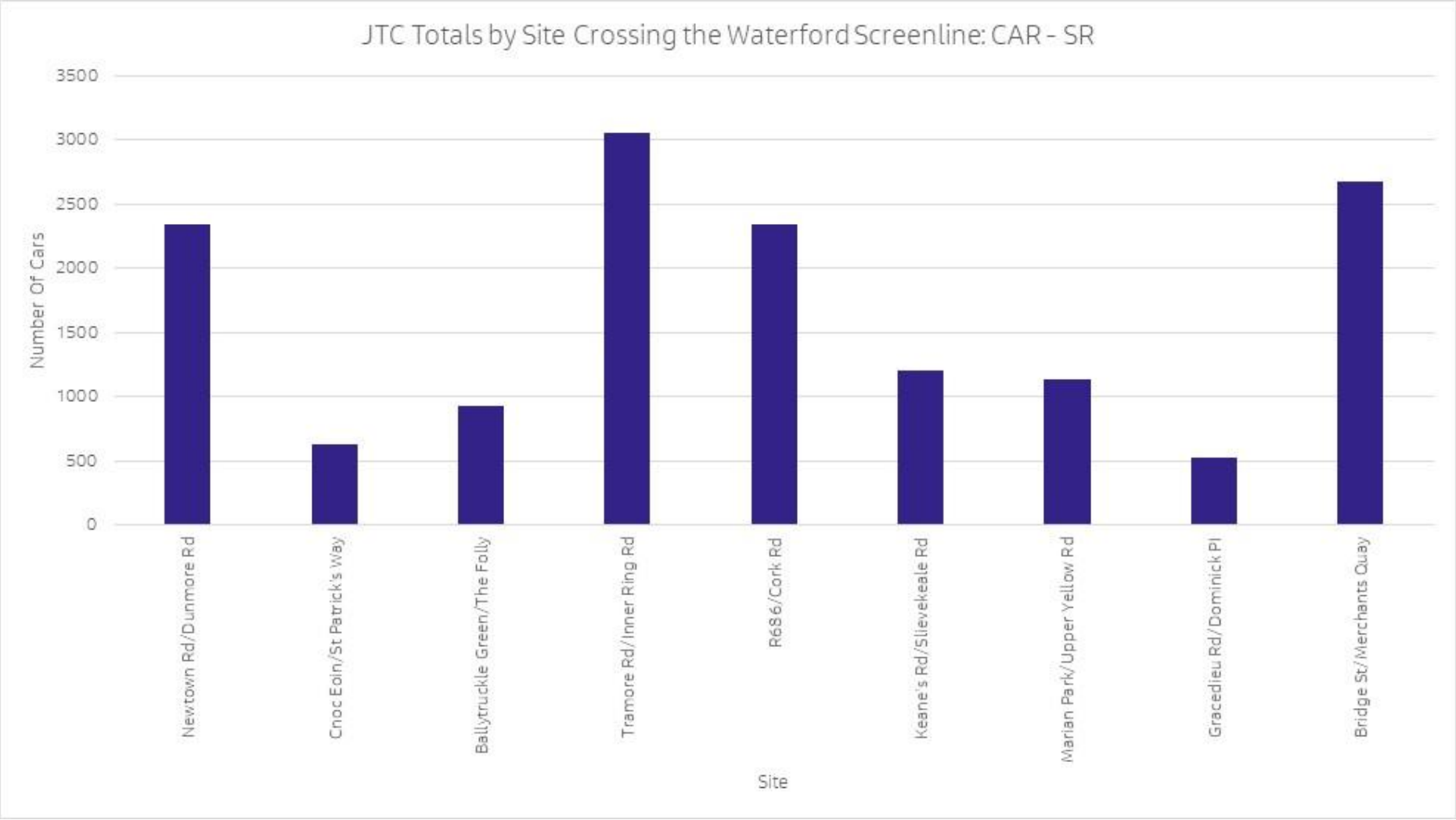

Figure 0-3:Number of Car Journeys for JTC Surveys for SR per Site

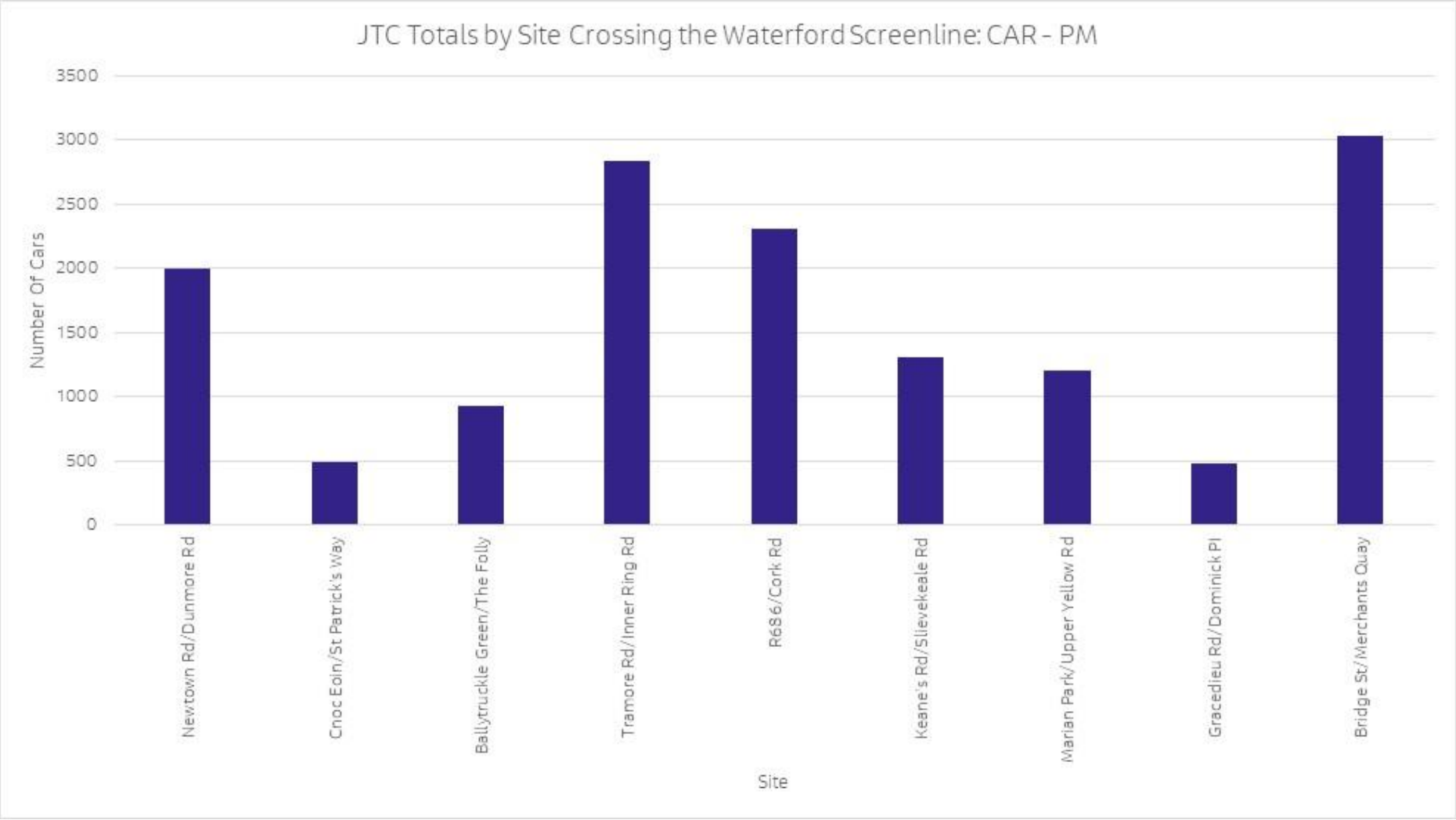

Figure 0-4:Number of Car Journeys for JTC Surveys for PM per Site

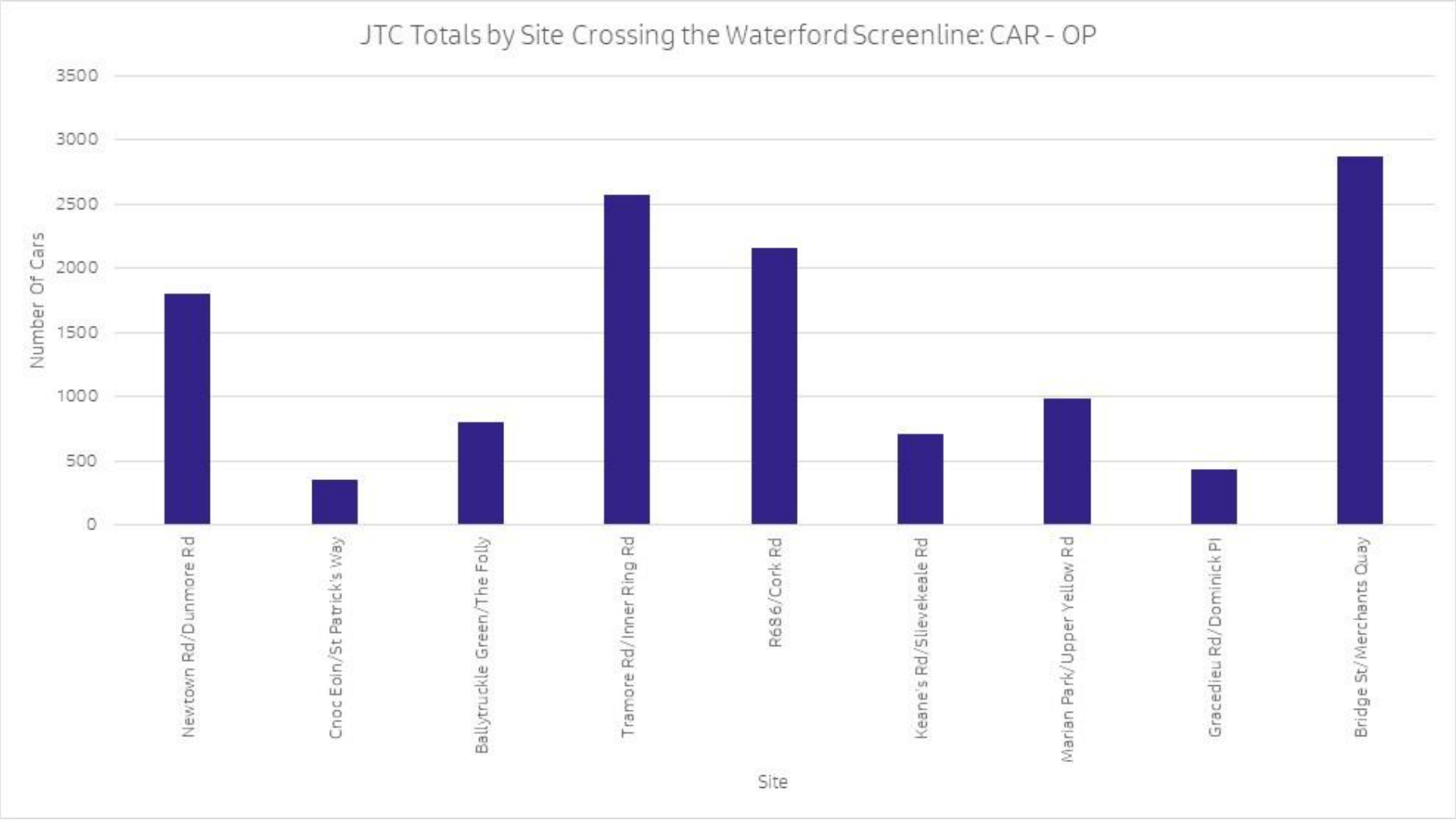

Figure 0-5:Number of Car Journeys for JTC Surveys for OP per Site

Light Goods Vehicle Movements by Site and Period

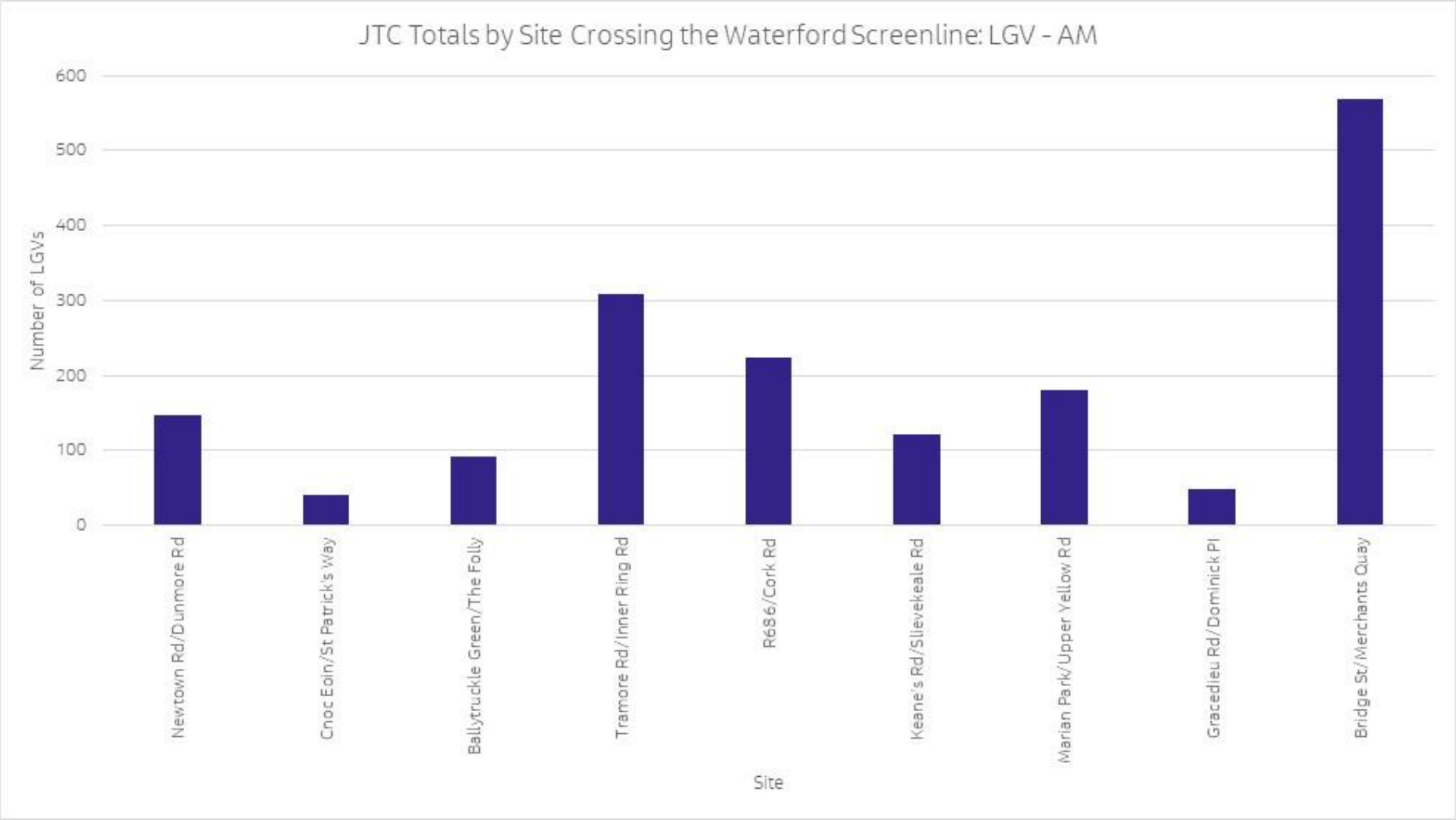

Figure 0-6:Number of Light Goods Vehicle Journeys for JTC Surveys for AM per Site

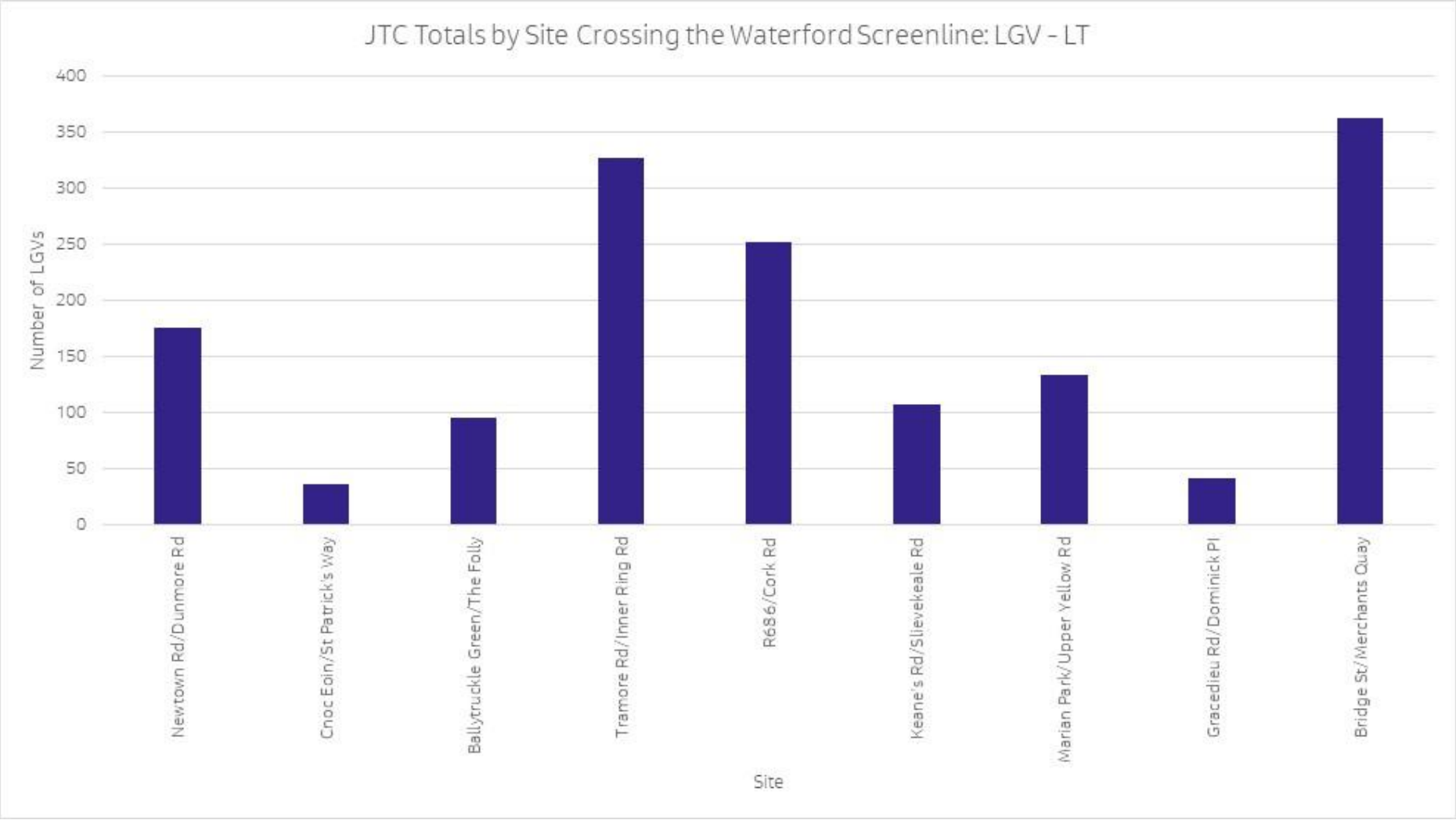

Figure 0-7:Number of Light Goods Vehicle Journeys for JTC Surveys for LT per Site

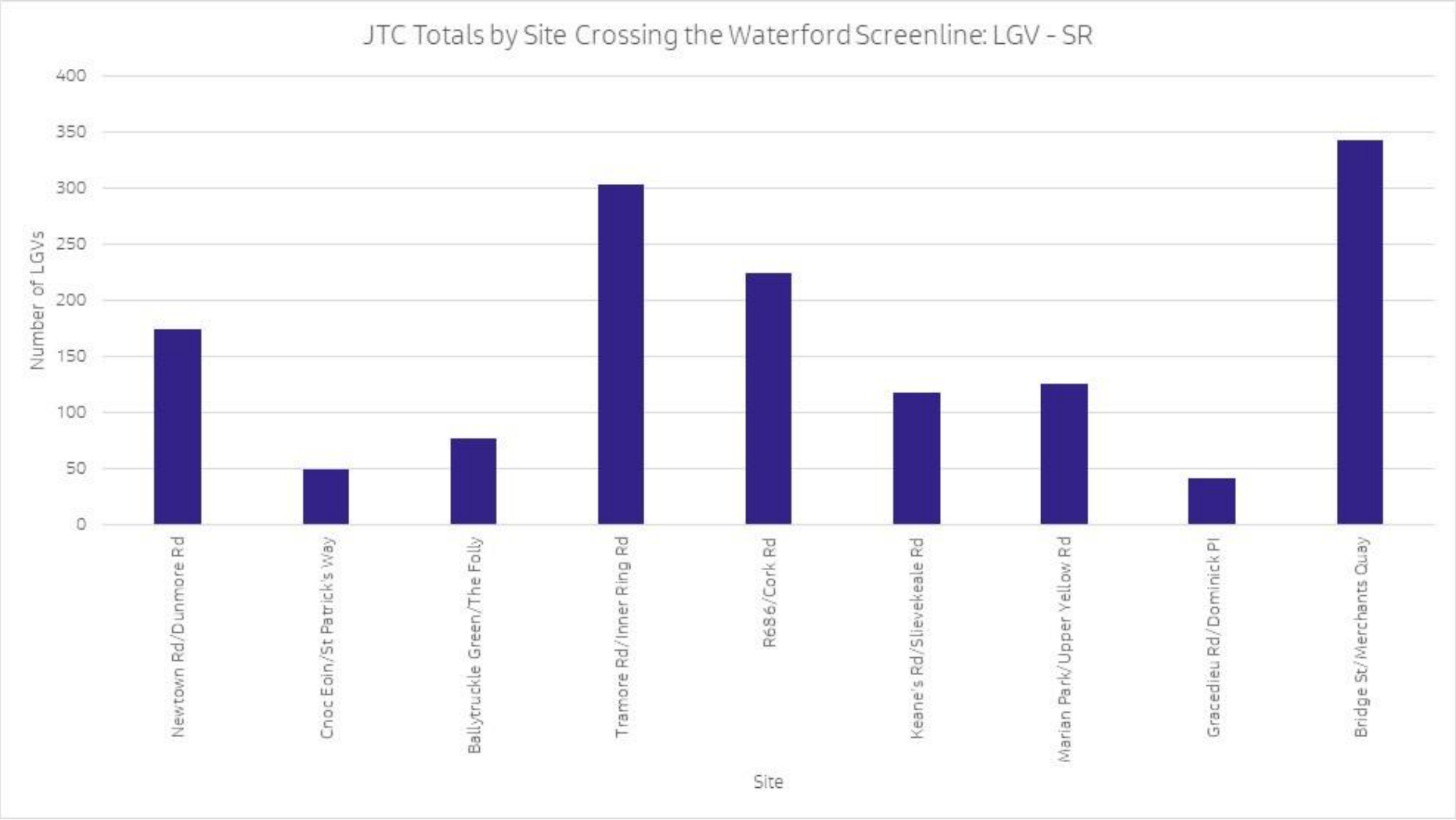

Figure 0-8:Number of Light Goods Vehicle Journeys for JTC Surveys for SR per Site

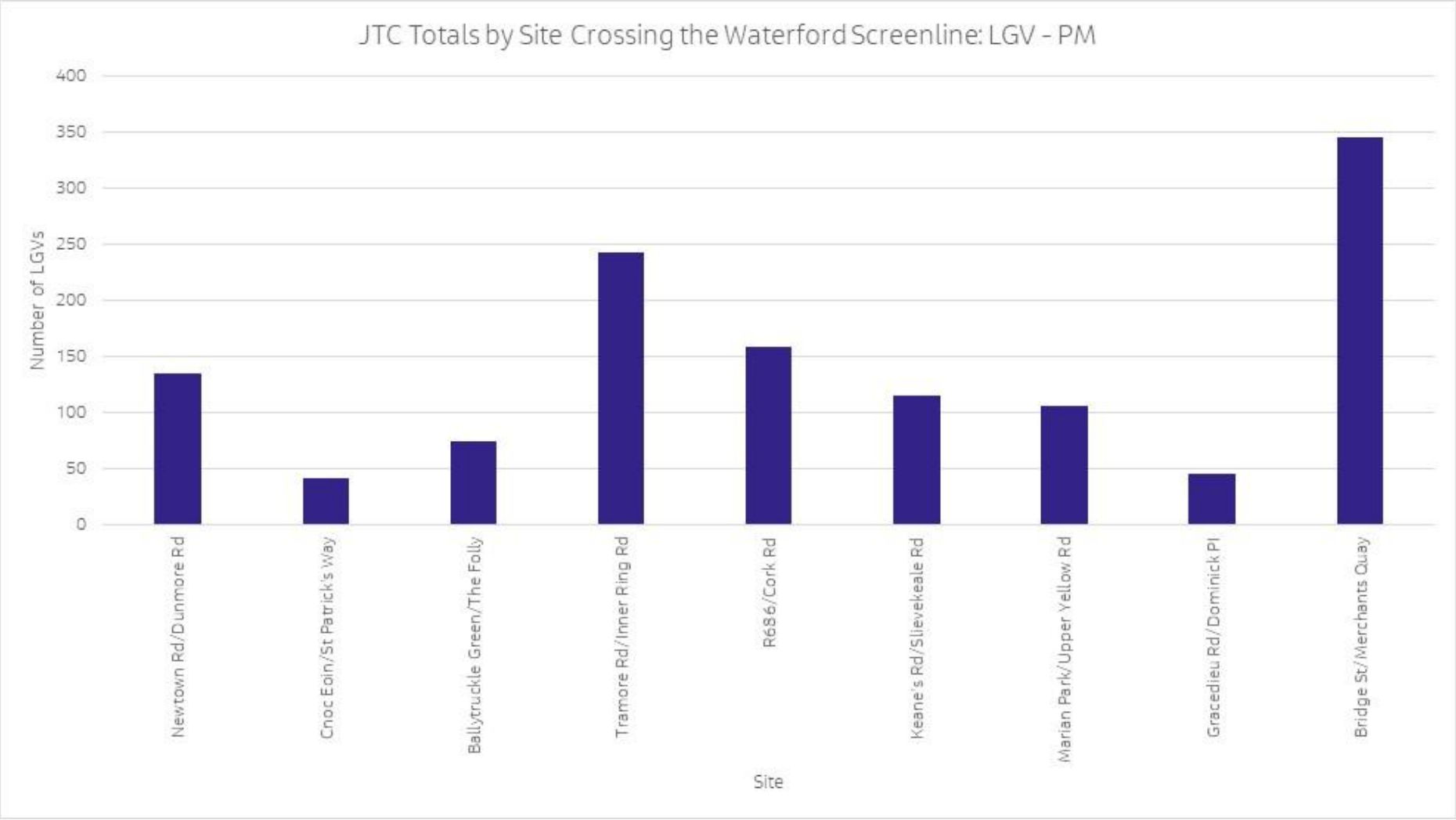

Figure 0-9:Number of Light Goods Vehicle Journeys for JTC Surveys for PM per Site

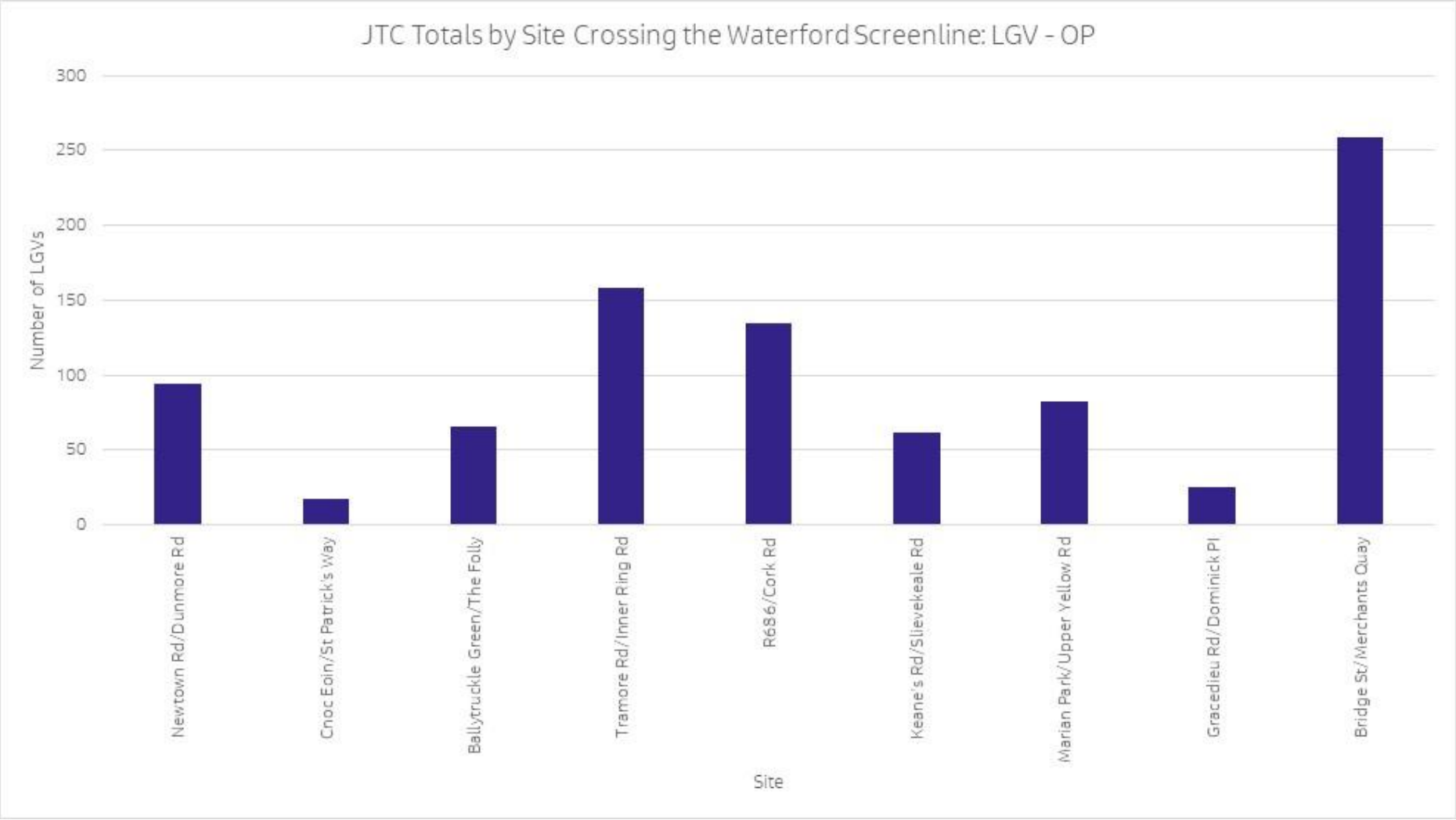

Figure 0-10:Number of Light Goods Vehicle Journeys for JTC Surveys for OP per Site

Ordinary Goods Vehicle 1 Movements by Site and Period

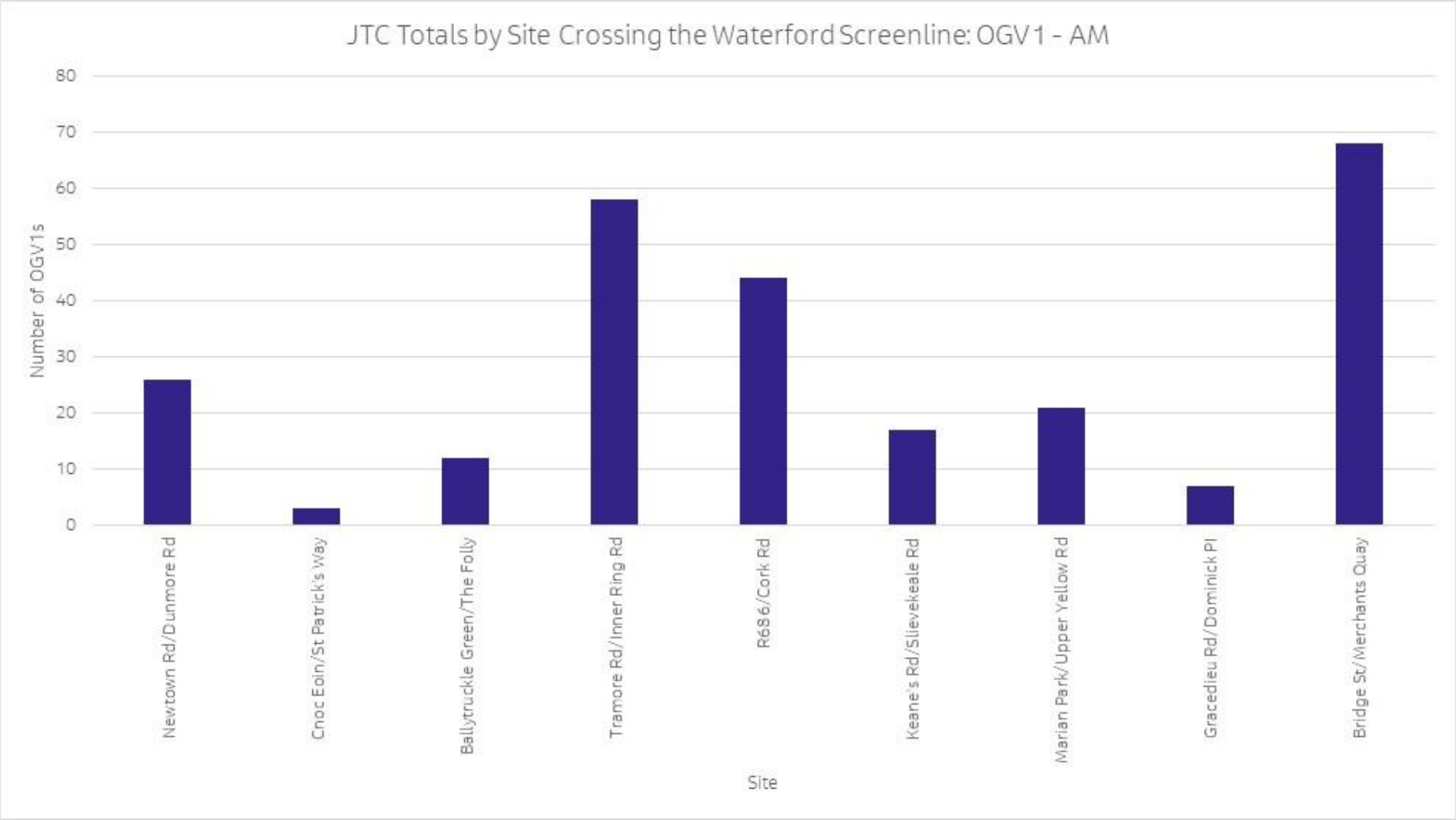

Figure 0-11:Number of Ordinary Goods Vehicle 1 Journeys for JTC Surveys for AM per Site

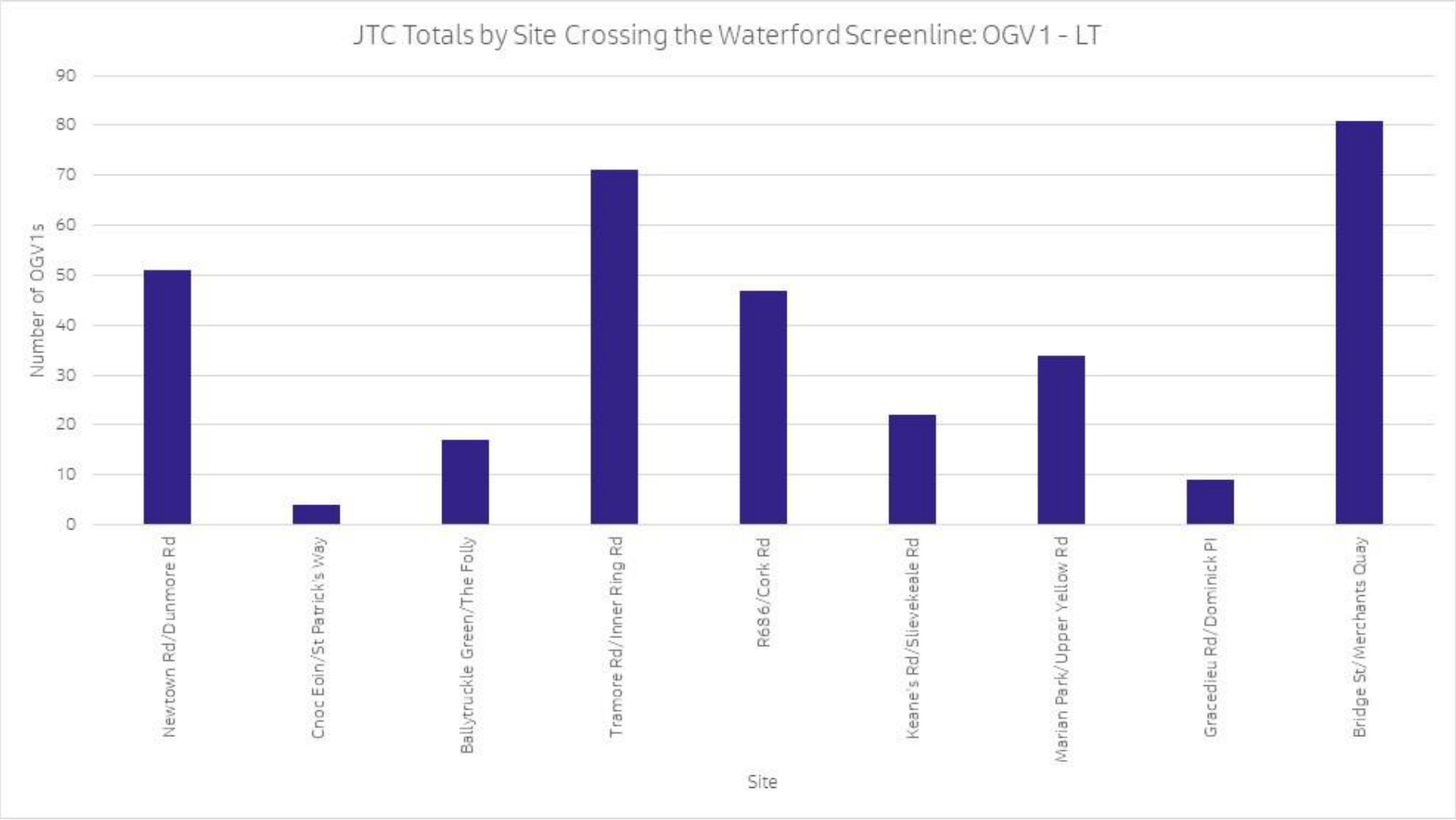

Figure 0-12:Number of Ordinary Goods Vehicle 1 Journeys for JTC Surveys for LT per Site

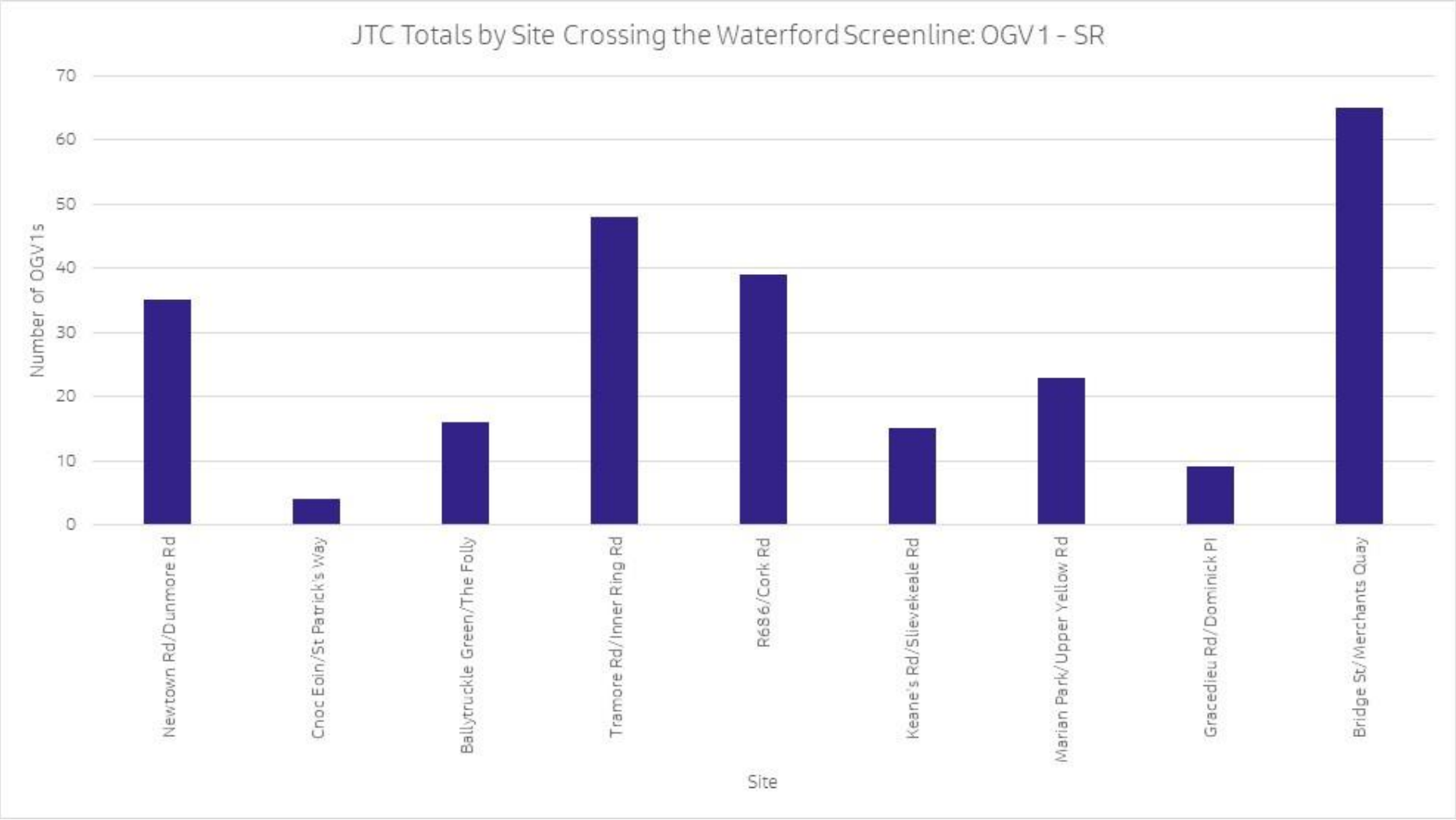

Figure 0-13:Number of Ordinary Goods Vehicle 1 Journeys for JTC Surveys for SR per Site

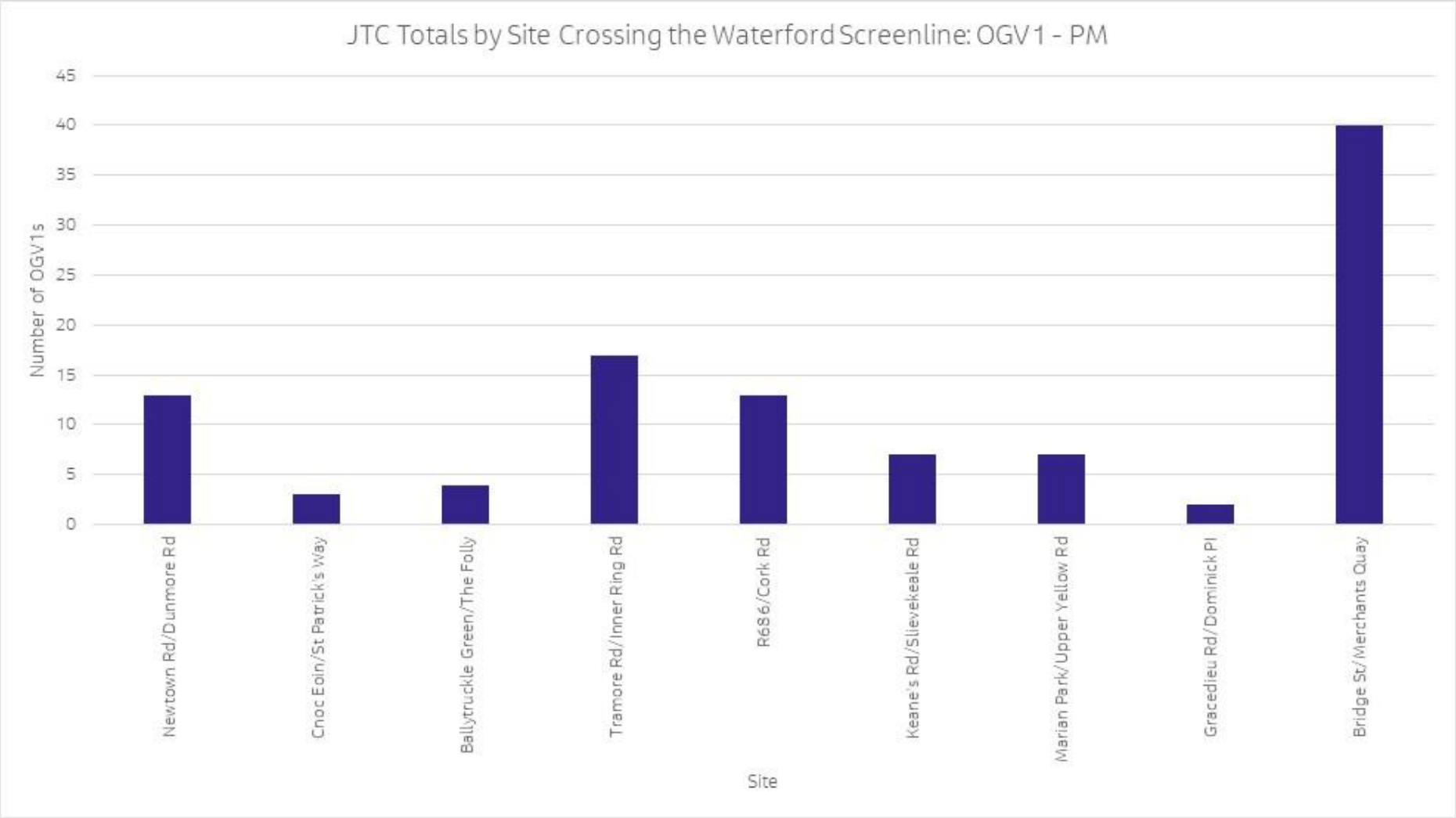

Figure 0-14:Number of Ordinary Goods Vehicle 1 Journeys for JTC Surveys for PM per Site

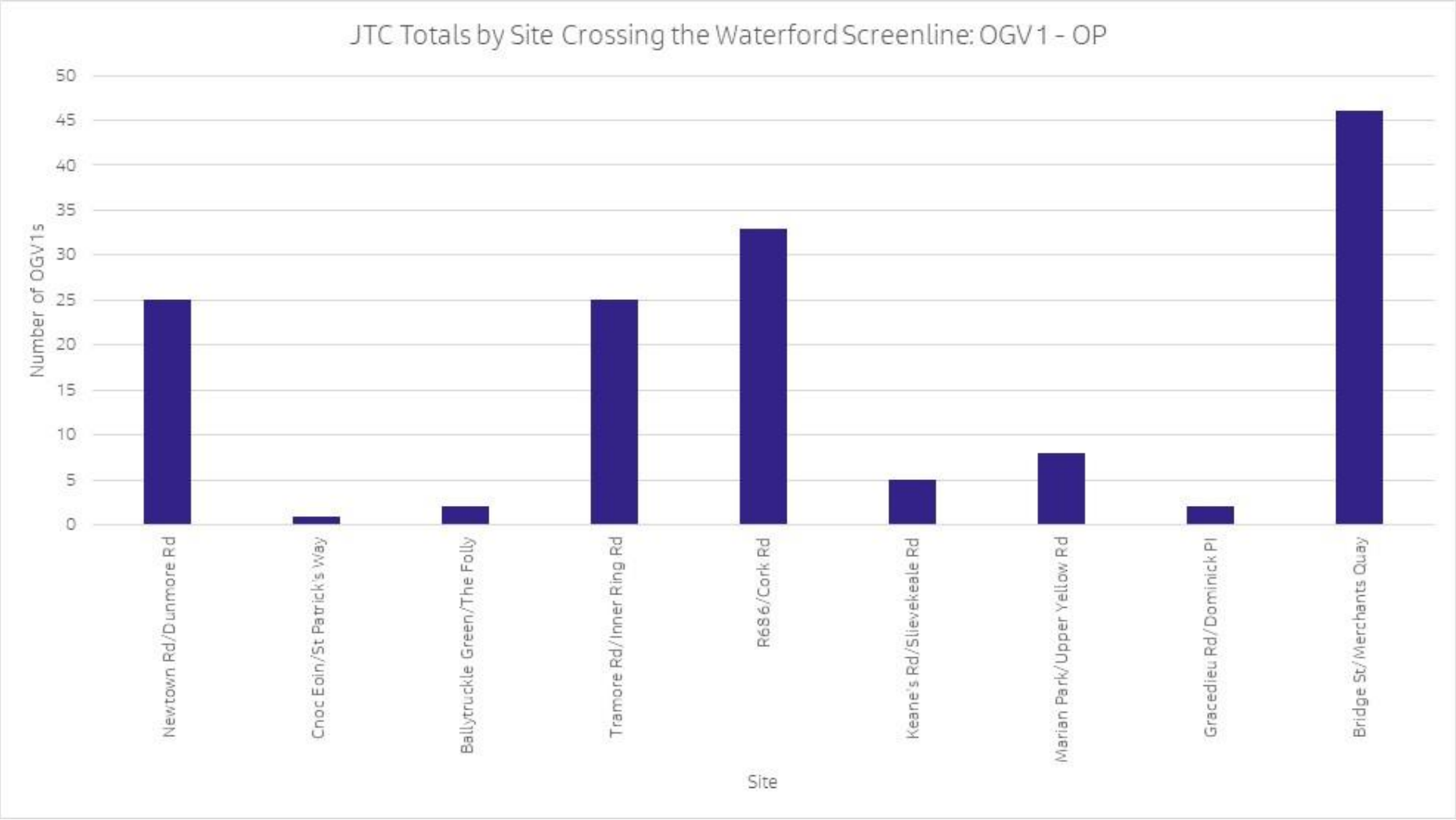

Figure 0-15:Number of Ordinary Goods Vehicle 1 Journeys for JTC Surveys for OP per Site

Ordinary Goods Vehicle 2 Movements by Site and Period

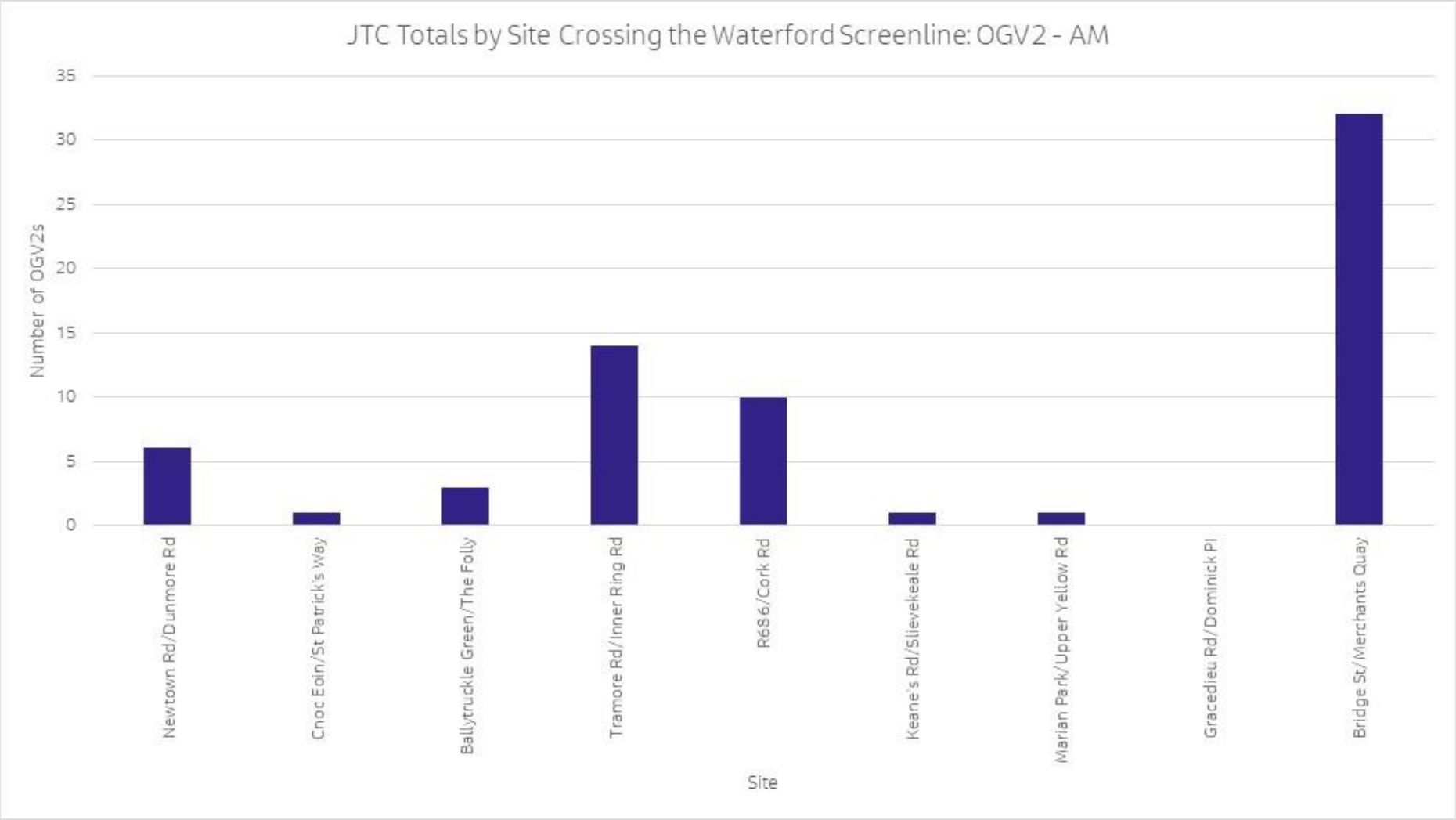

Figure 0-16:Number of Ordinary Goods Vehicle 2 Journeys for JTC Surveys for AM per Site

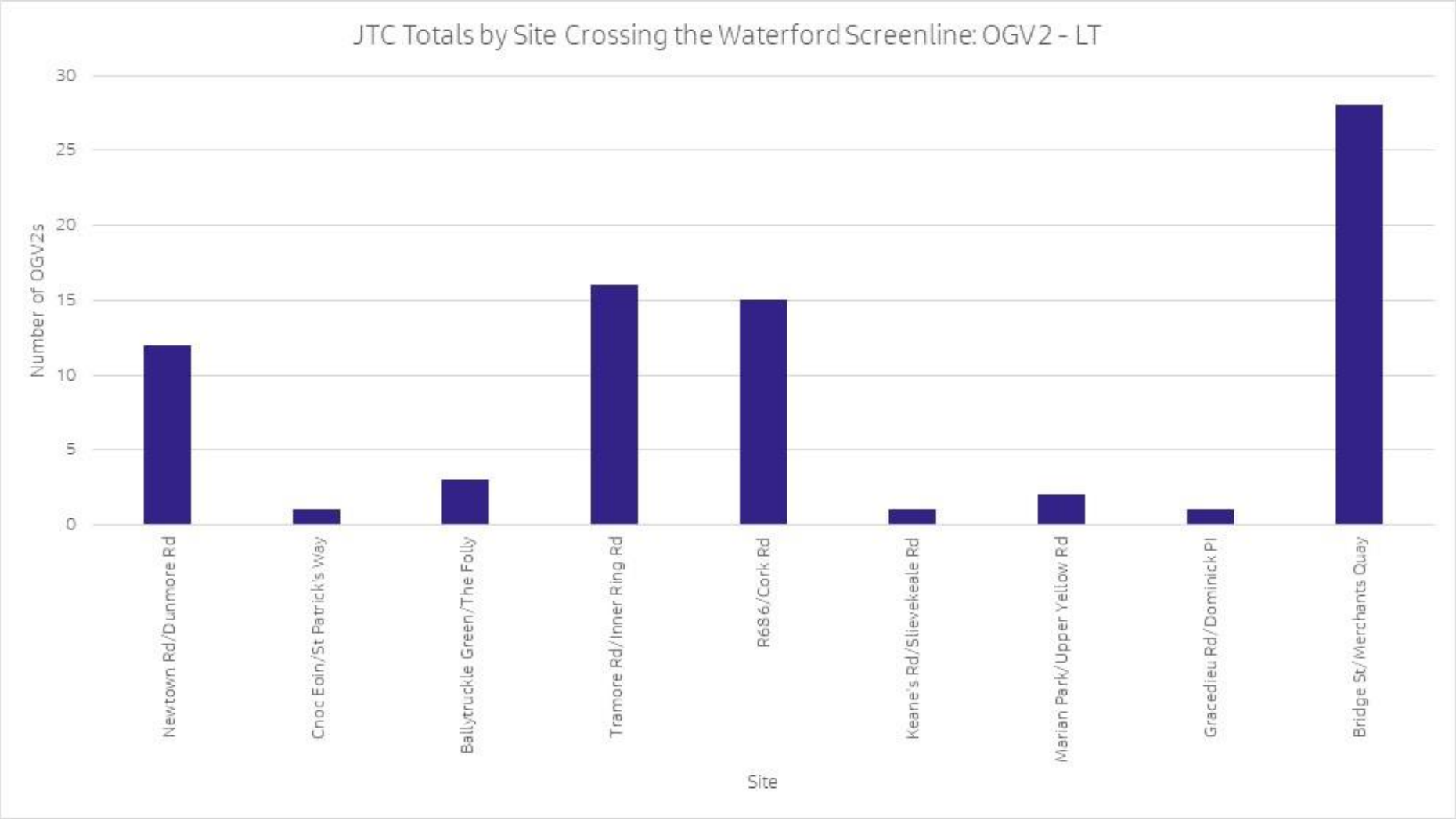

Figure 0-17:Number of Ordinary Goods Vehicle 2 Journeys for JTC Surveys for LT per Site

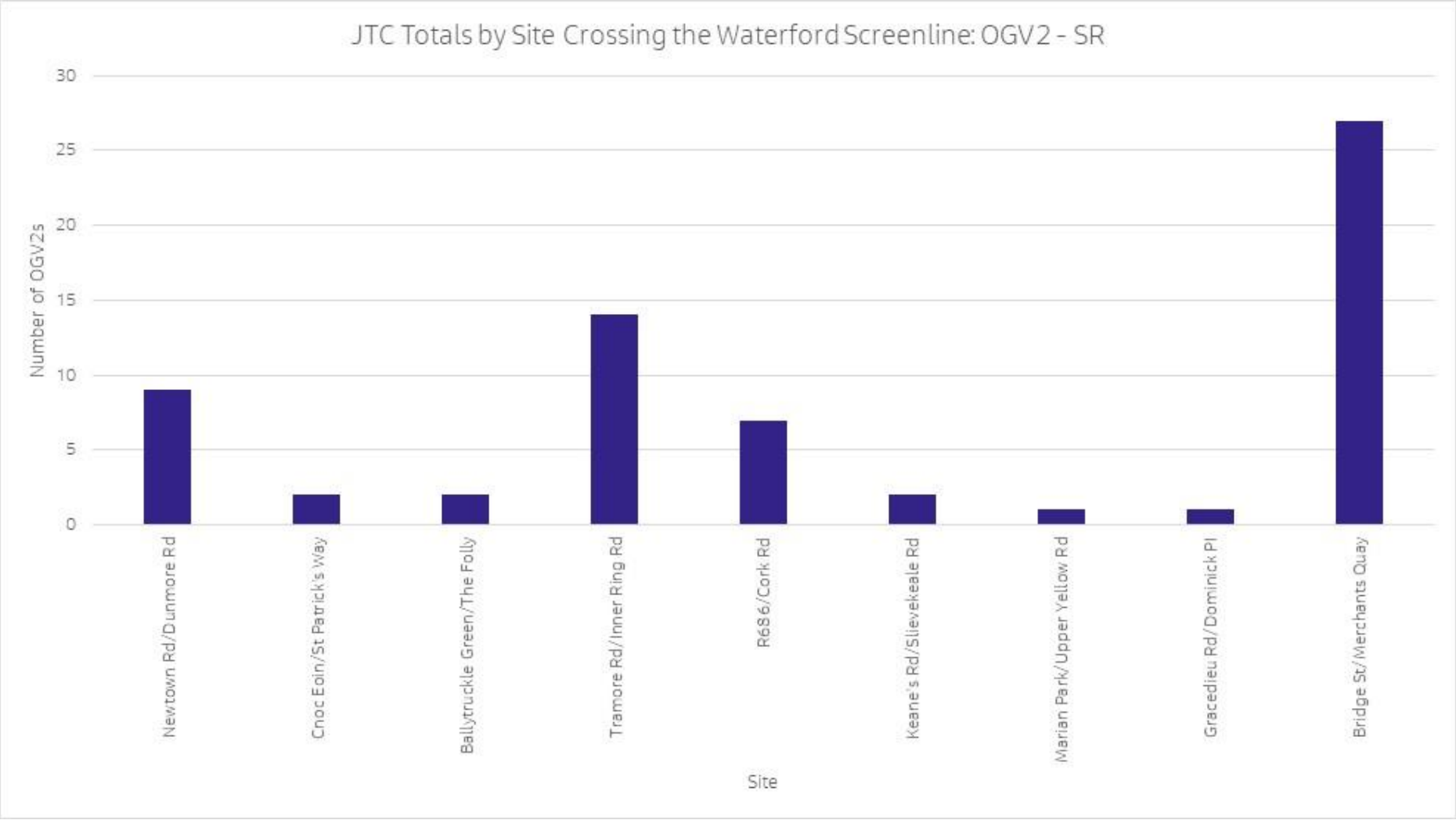

Figure 0-18:Number of Ordinary Goods Vehicle 2 Journeys for JTC Surveys for SR per Site

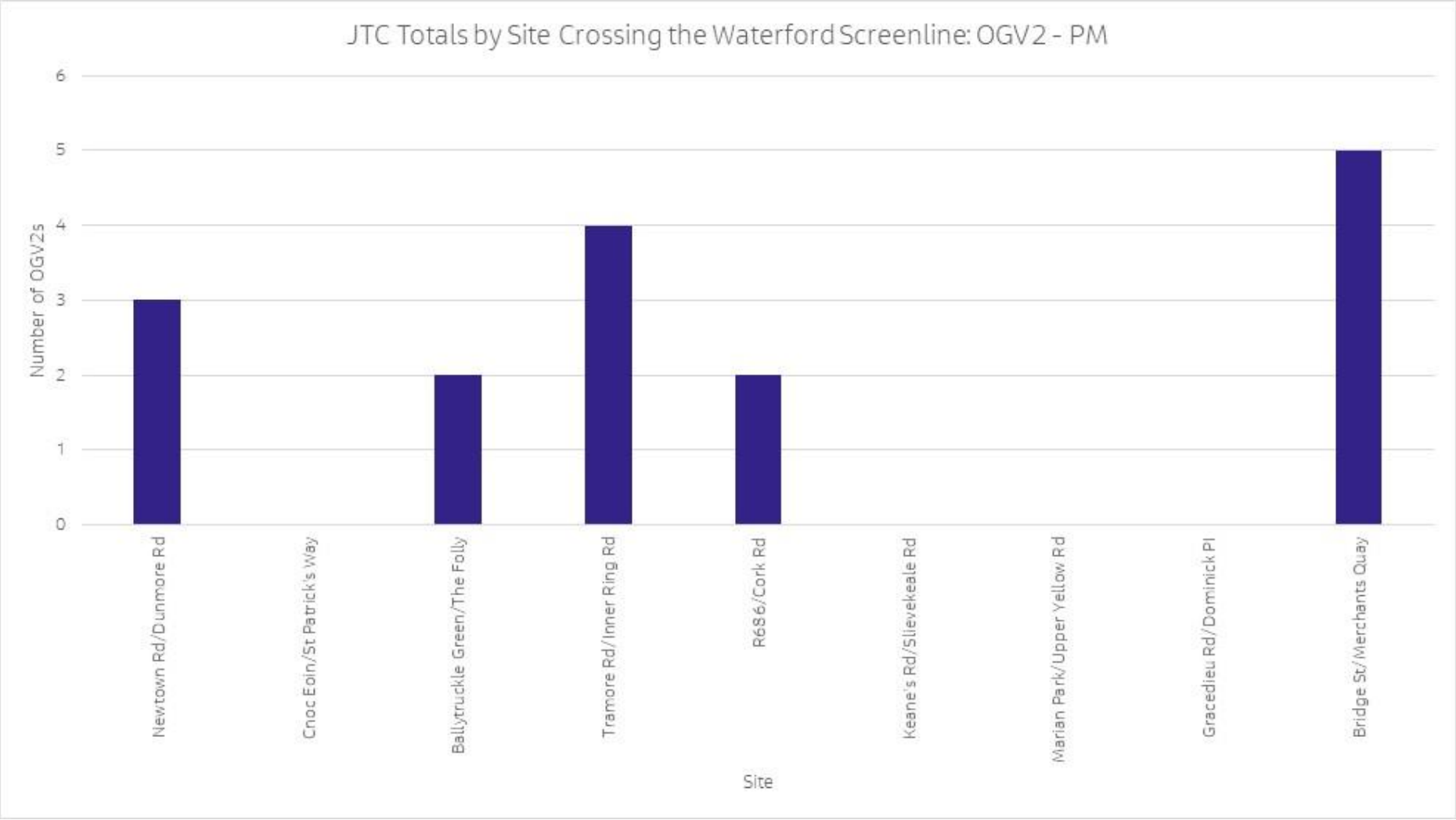

Figure 0-19:Number of Ordinary Goods Vehicle 2 Journeys for JTC Surveys for PM per Site

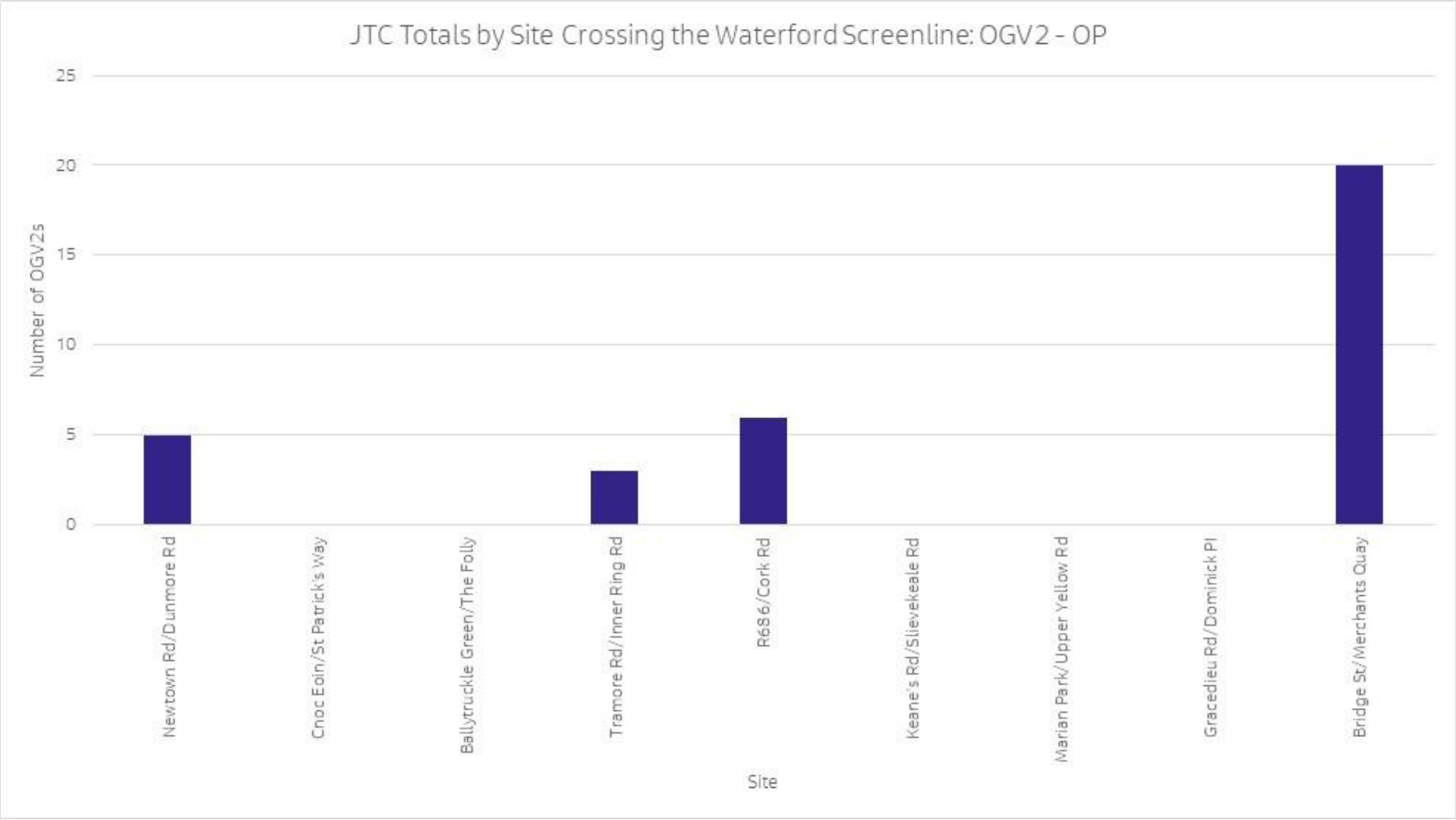

Figure 0-20:Number of Ordinary Goods Vehicle 2 Journeys for JTC Surveys for OP per Site

Motorcycle Movements by Site and Period

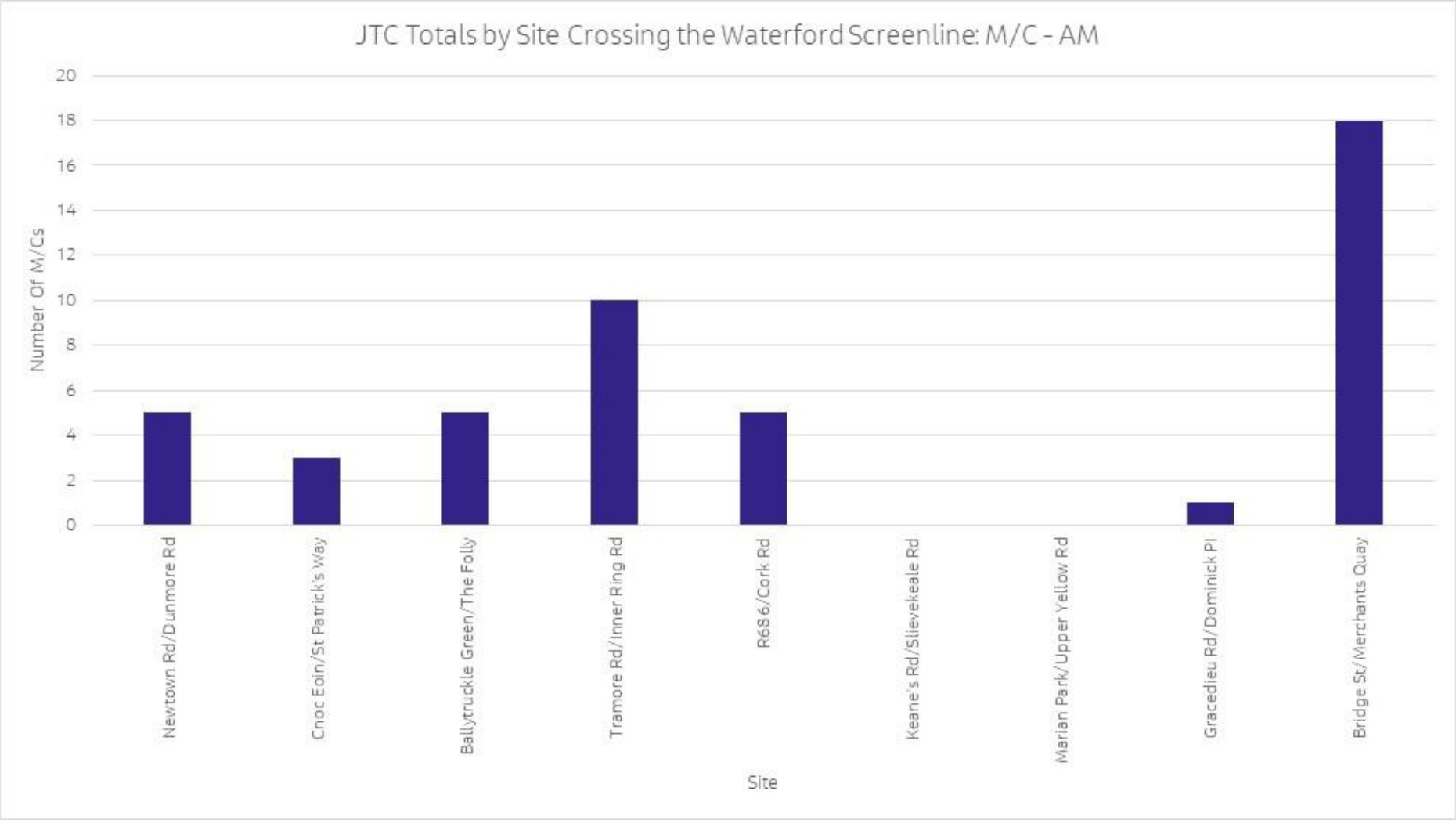

Figure 0-21:Number of Motorcycle Journeys for JTC Surveys for AM per Site

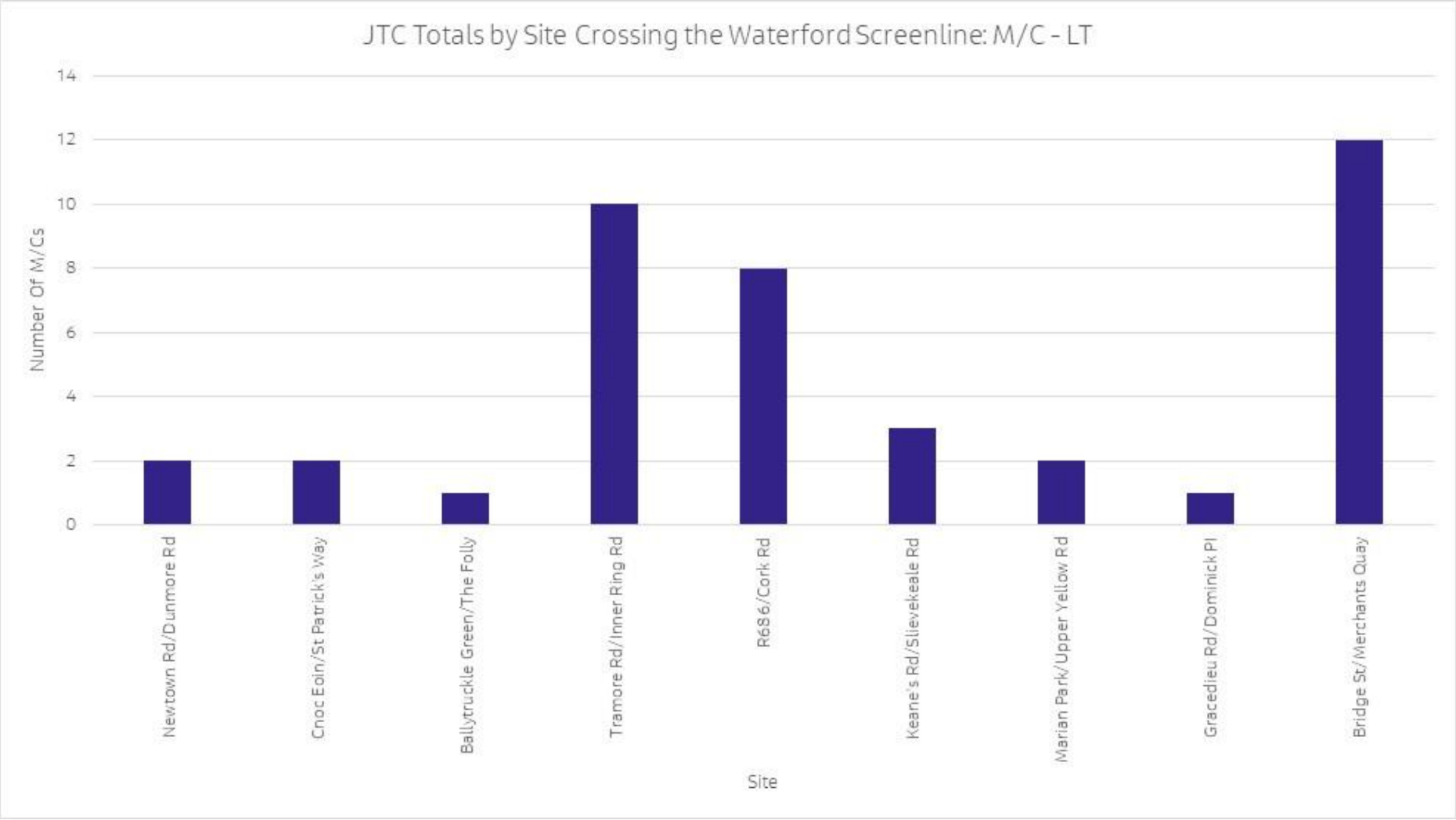

Figure 0-22:Number of Motorcycle Journeys for JTC Surveys for LT per Site

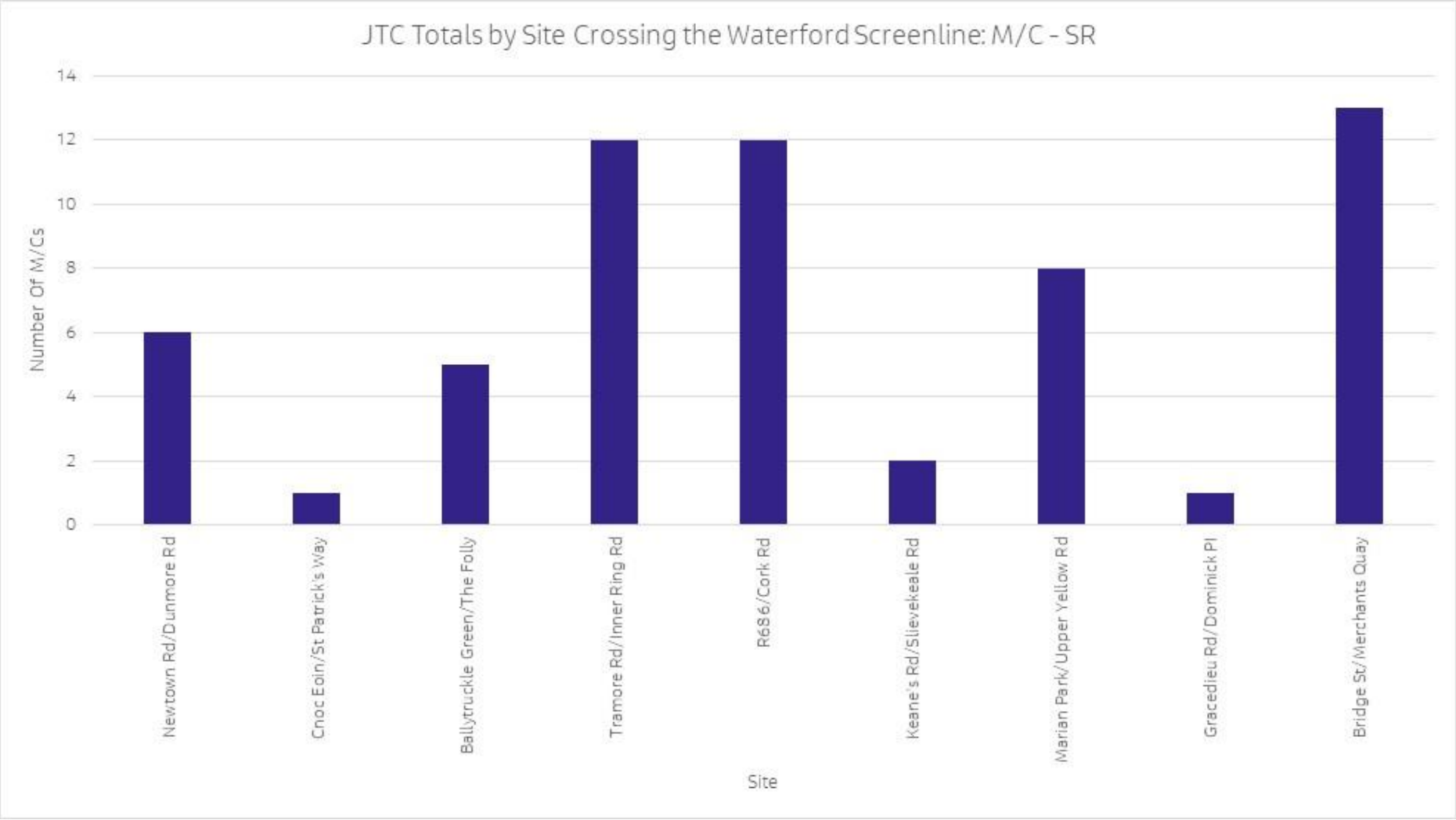

Figure 0-23:Number of Motorcycle Journeys for JTC Surveys for SR per Site

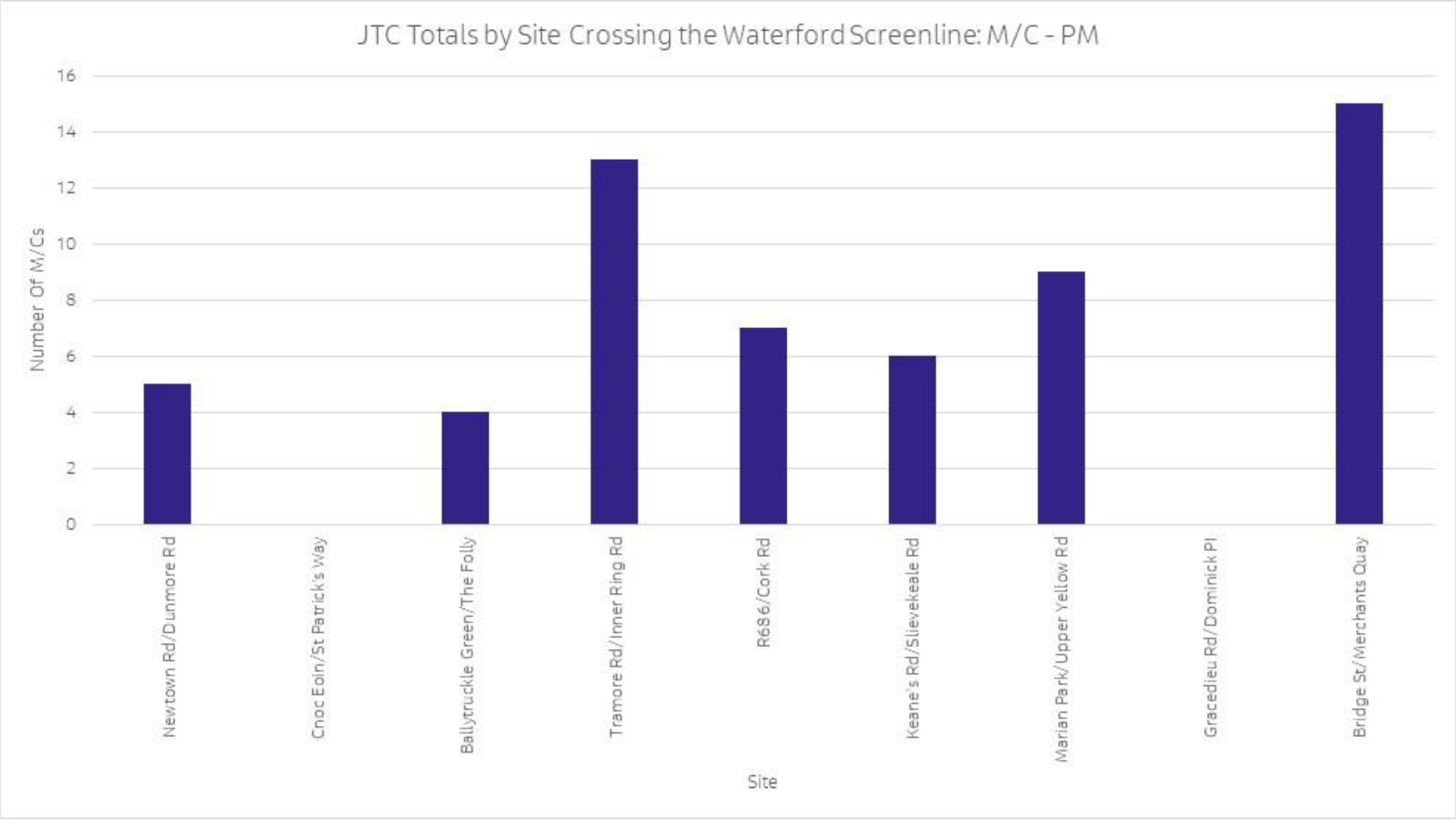

Figure 0-24:Number of Motorcycle Journeys for JTC Surveys for PM per Site

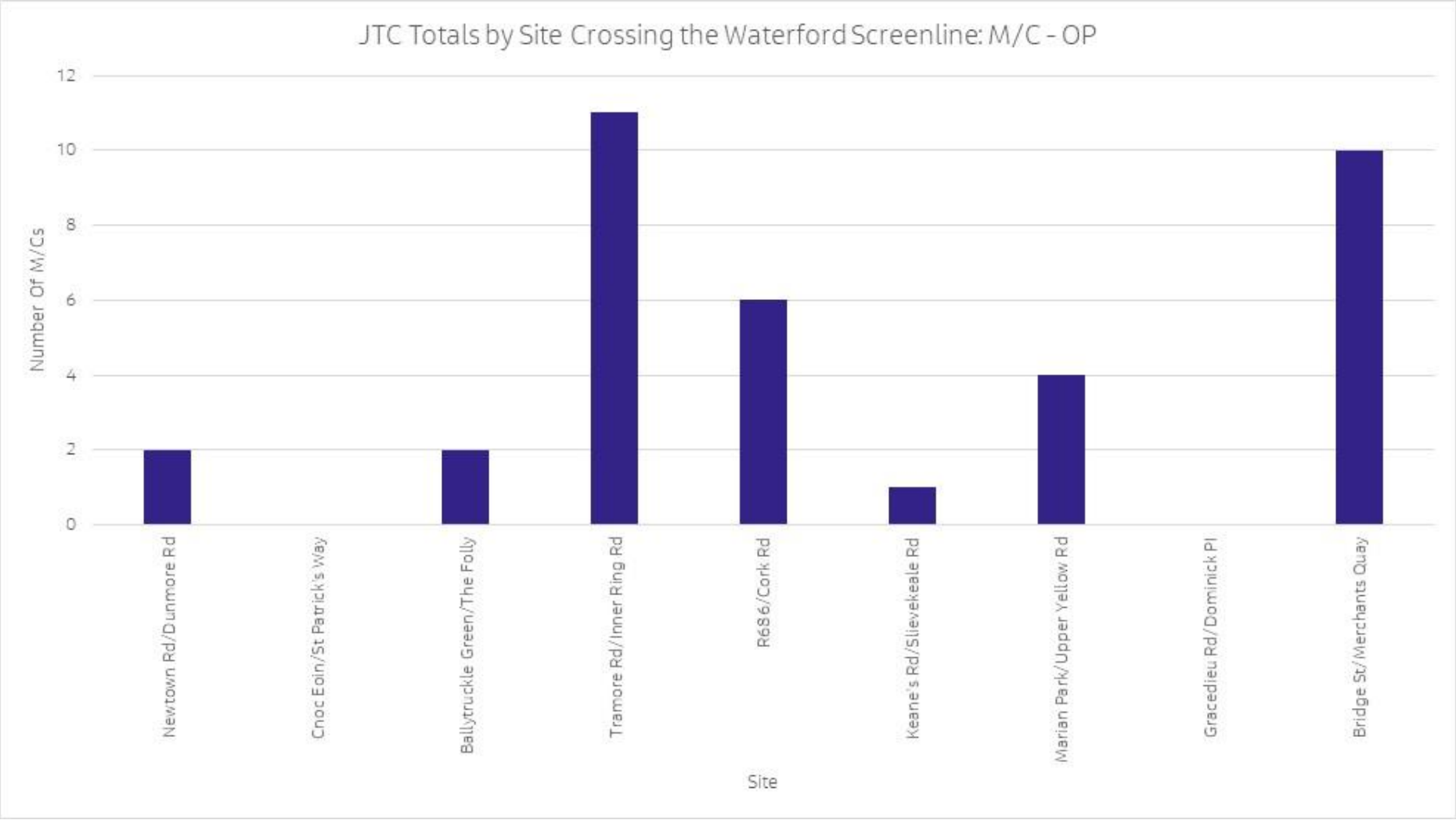

Figure 0-25:Number of Motorcycle Journeys for JTC Surveys for OP per Site

Pedal Cycle Movements by Site and Period

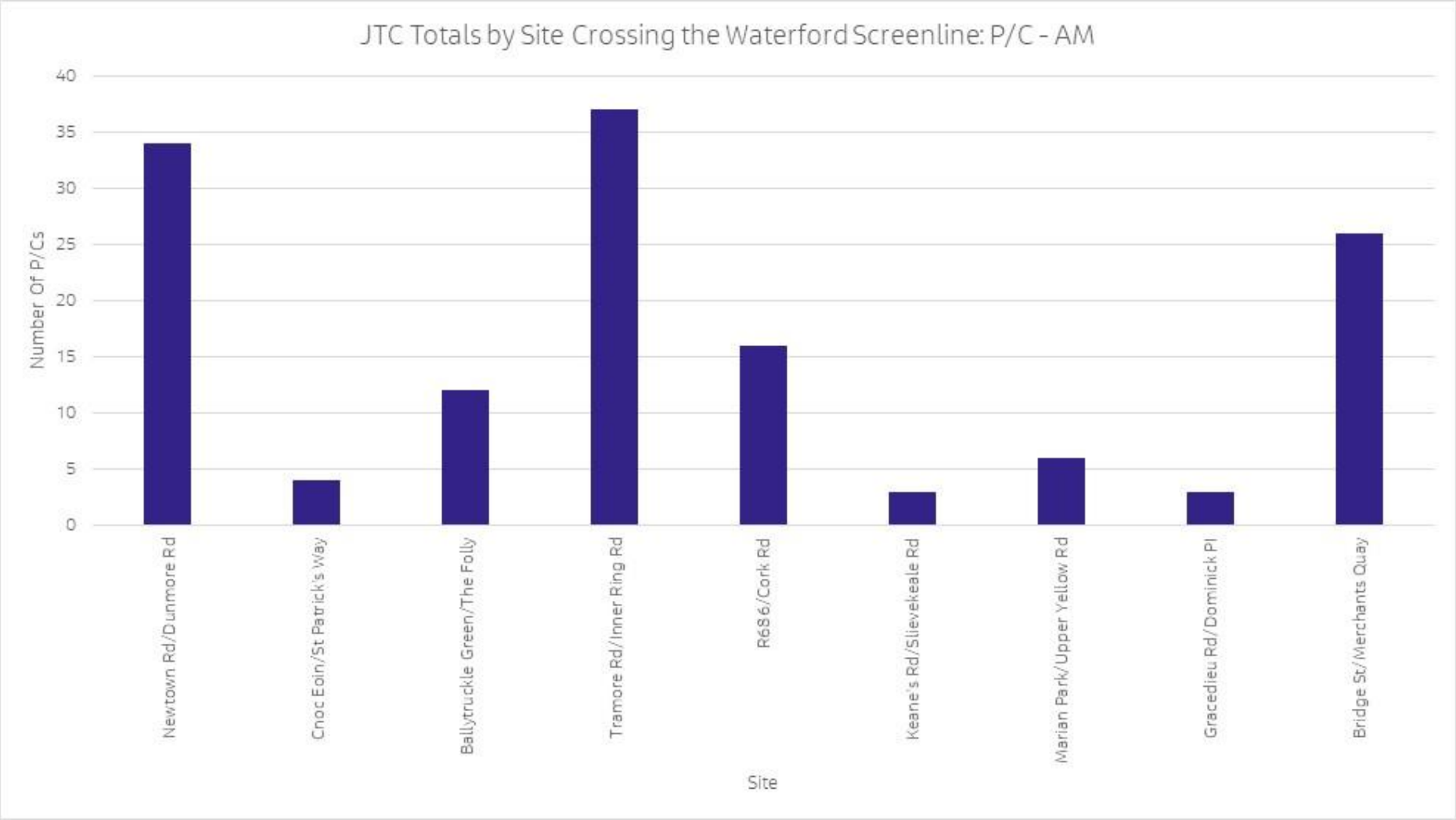

Figure 0-26:Number of Pedal Cycle Journeys for JTC Surveys for AM per Site

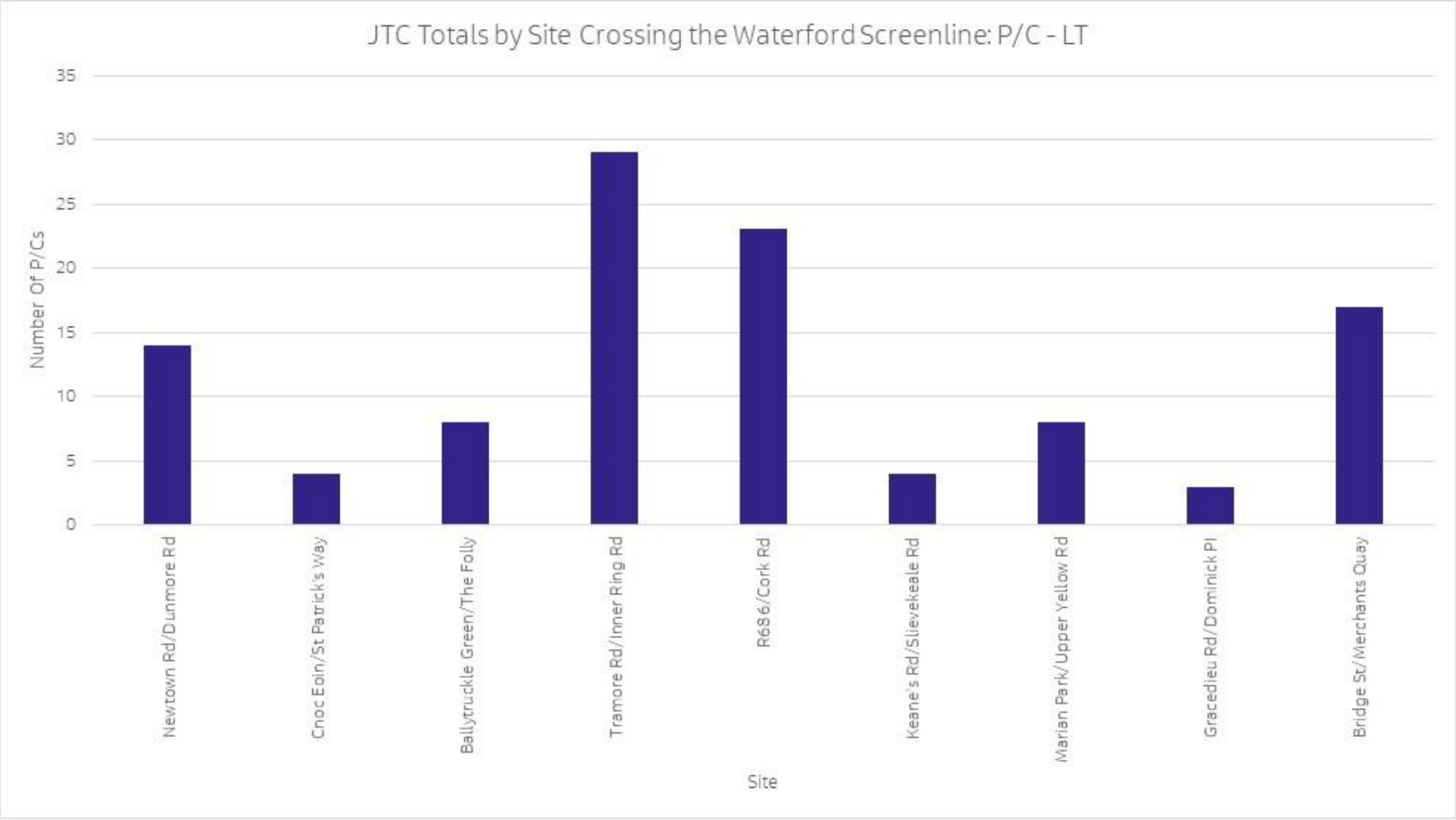

Figure 0-27:Number of Pedal Cycle Journeys for JTC Surveys for LT per Site

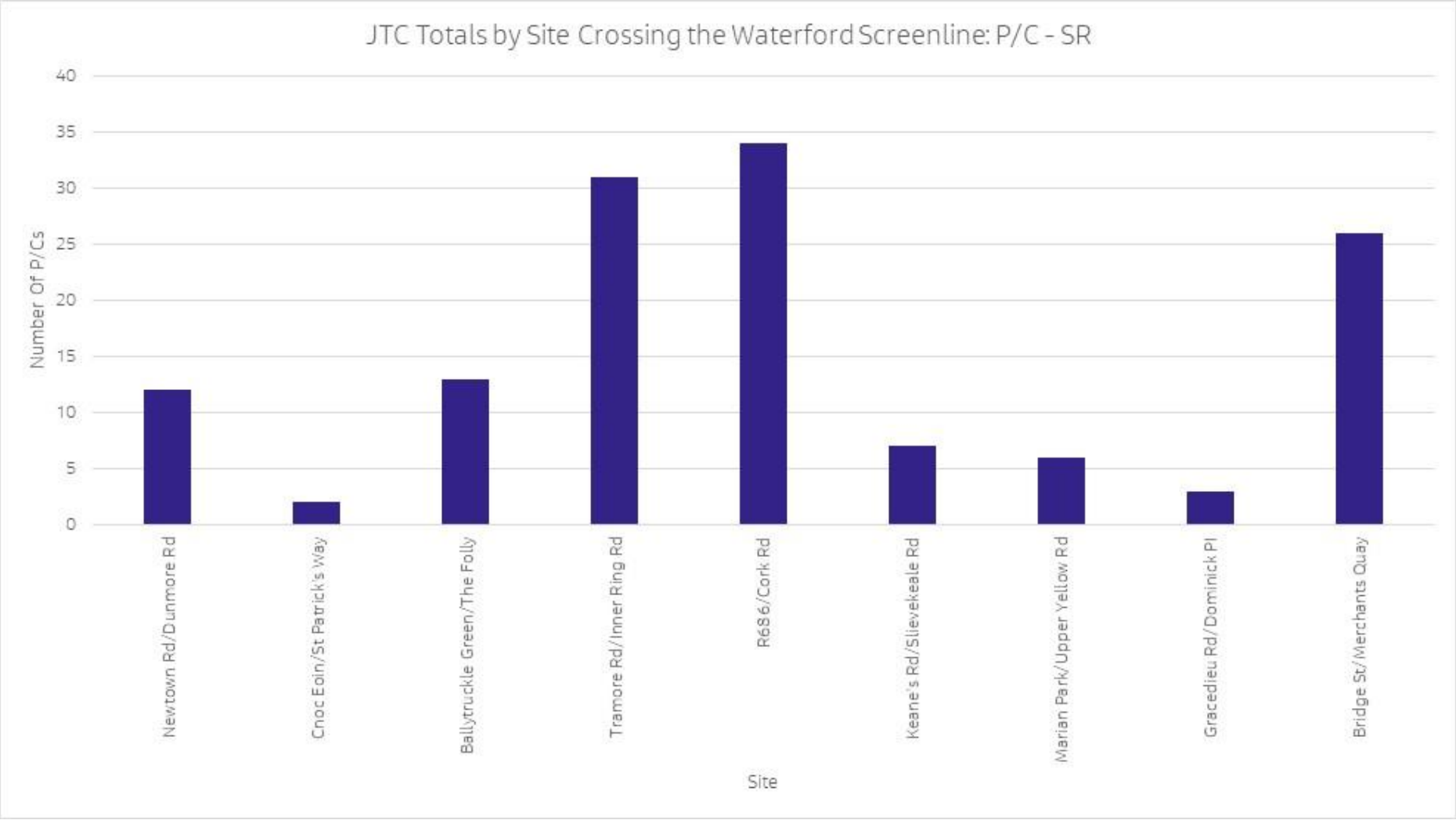

Figure 0-28:Number of Pedal Cycle Journeys for JTC Surveys for SR per Site

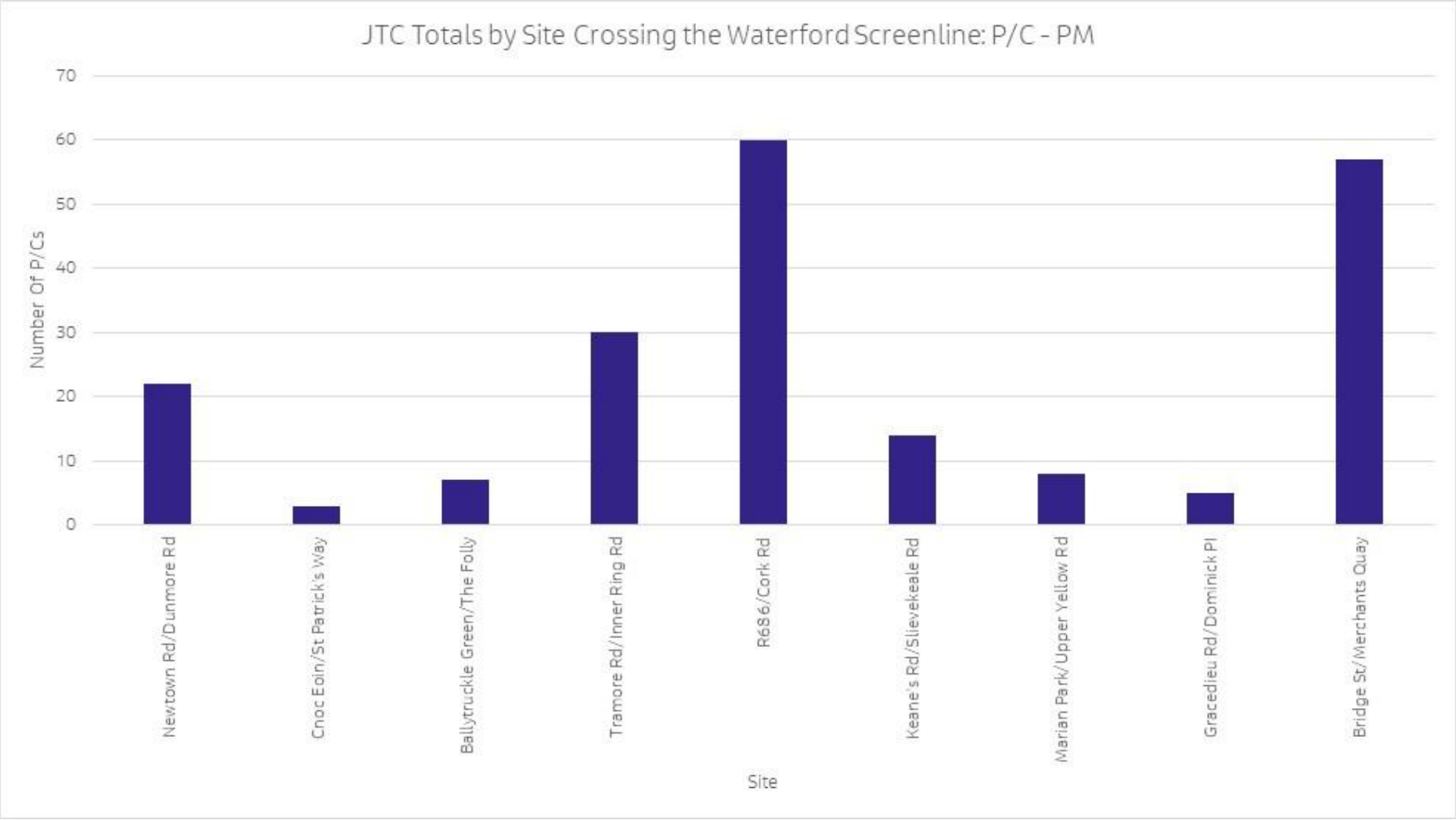

Figure 0-29:Number of Pedal Cycle Journeys for JTC Surveys for PM per Site

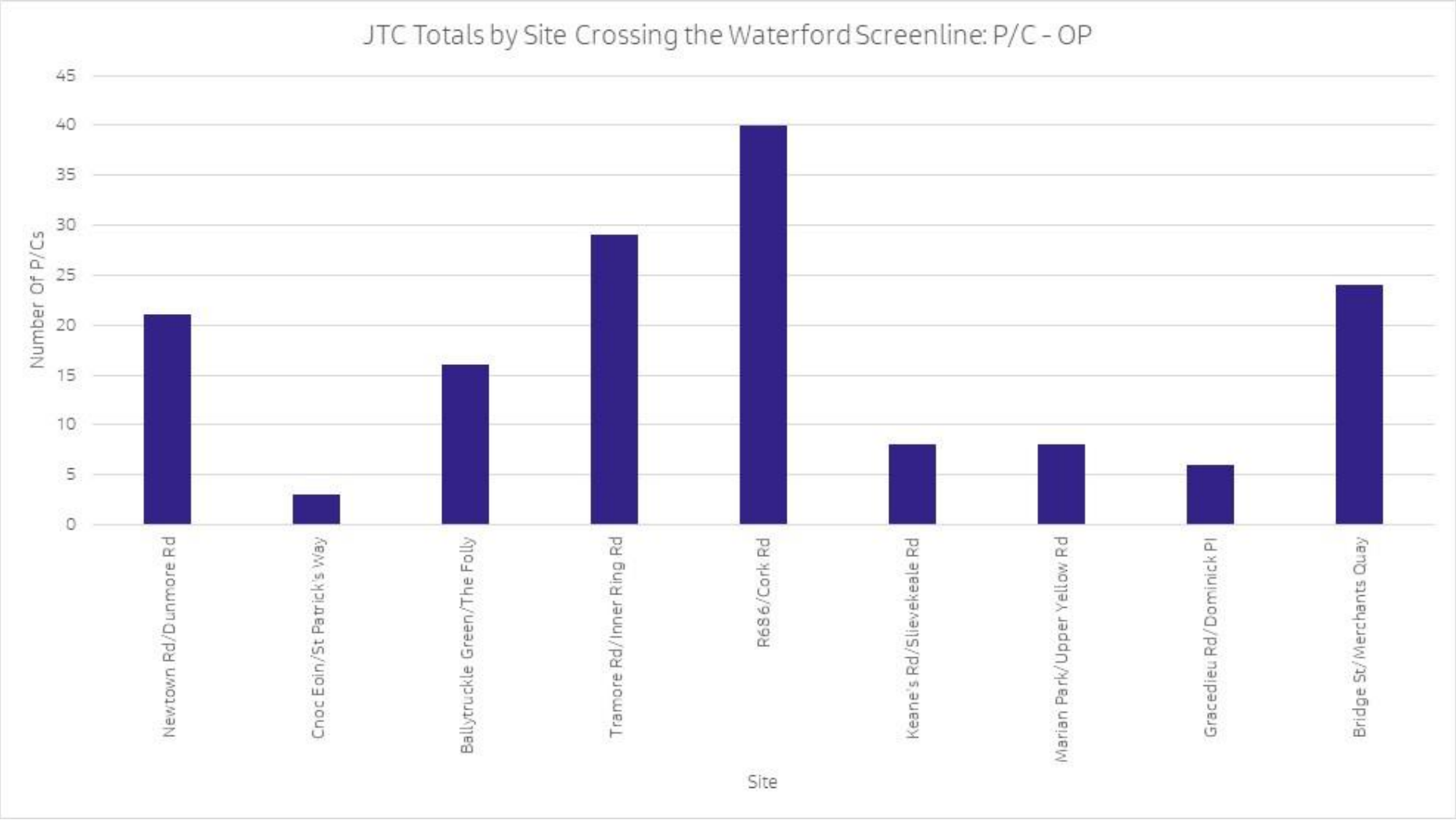

Figure 0-30:Number of Pedal Cycle Journeys for JTC Surveys for OP per Site

Taxi Movements by Site and Period

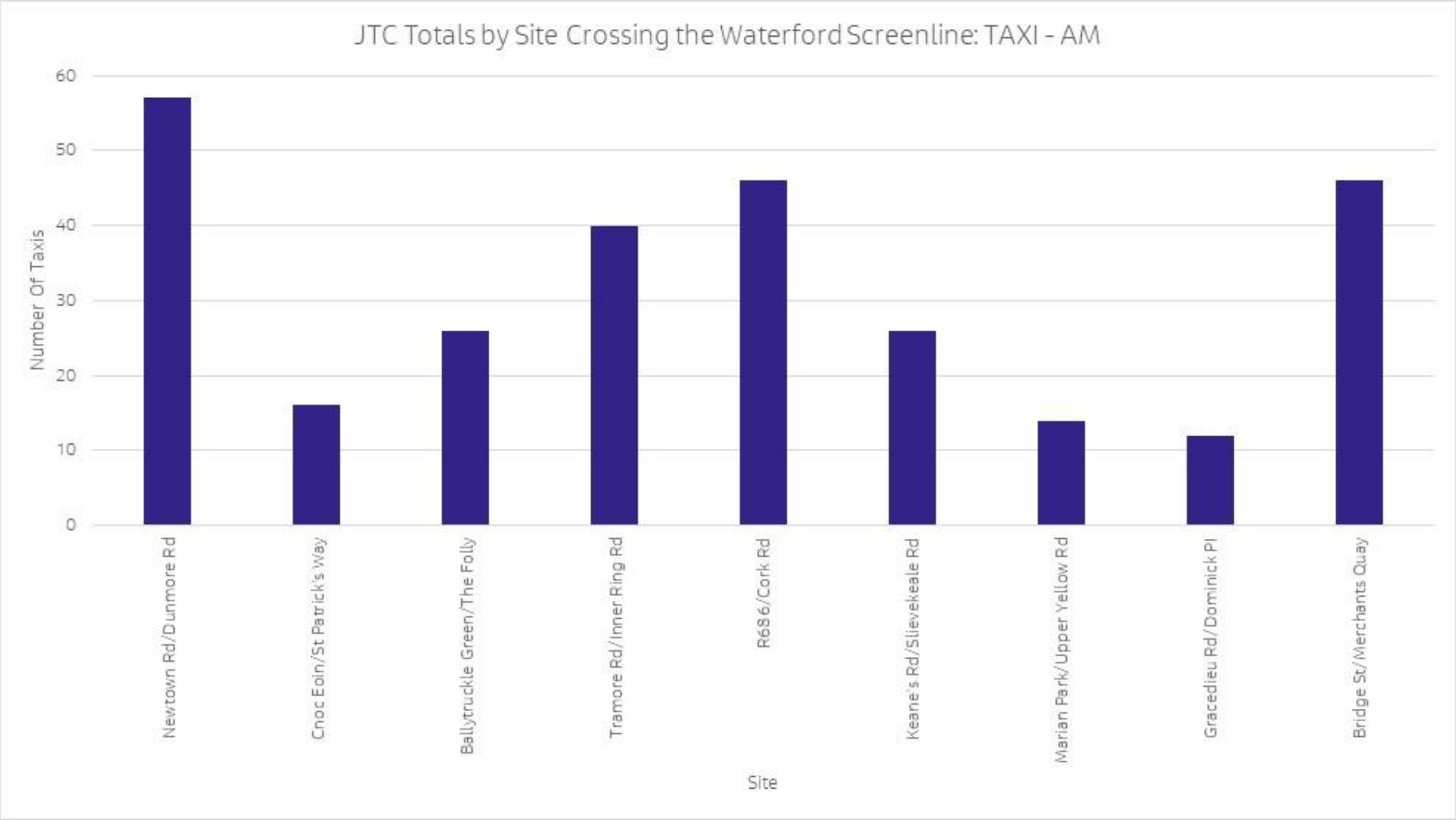

Figure 0-31:Number of Taxi Journeys for JTC Surveys for AM per Site

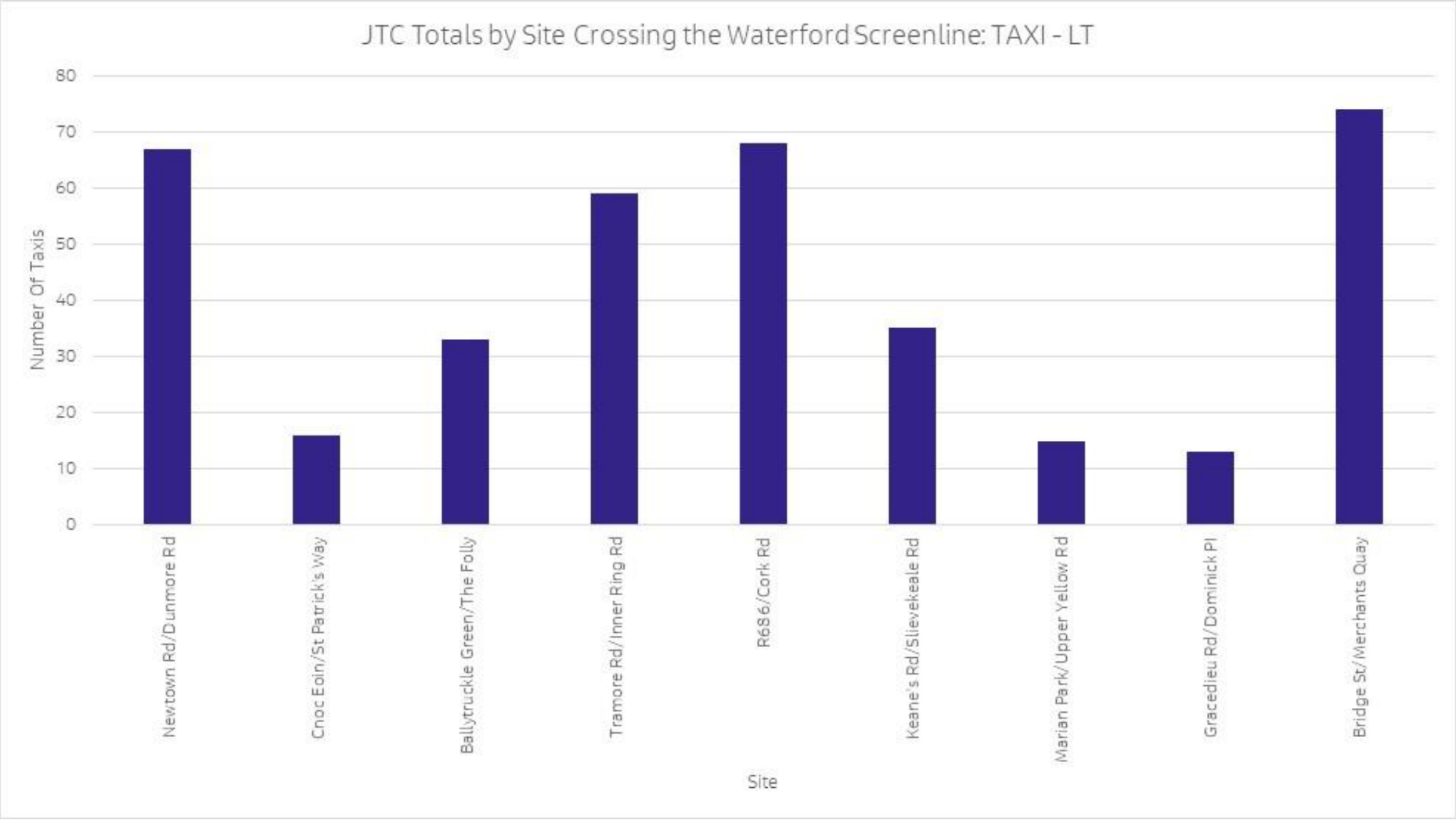

Figure 0-32:Number of Taxi Journeys for JTC Surveys for LT per Site

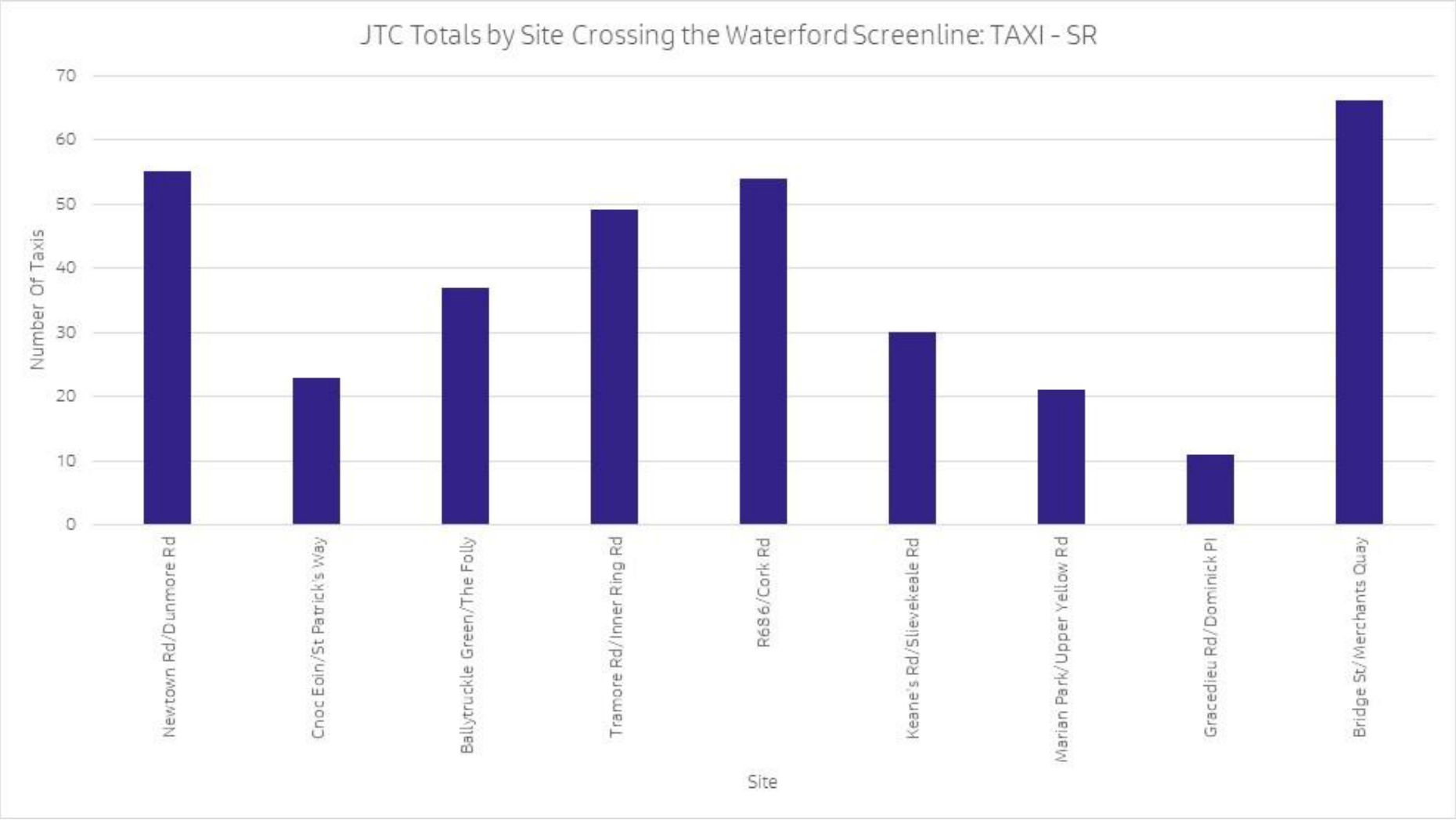

Figure 0-33:Number of Taxi Journeys for JTC Surveys for SR per Site

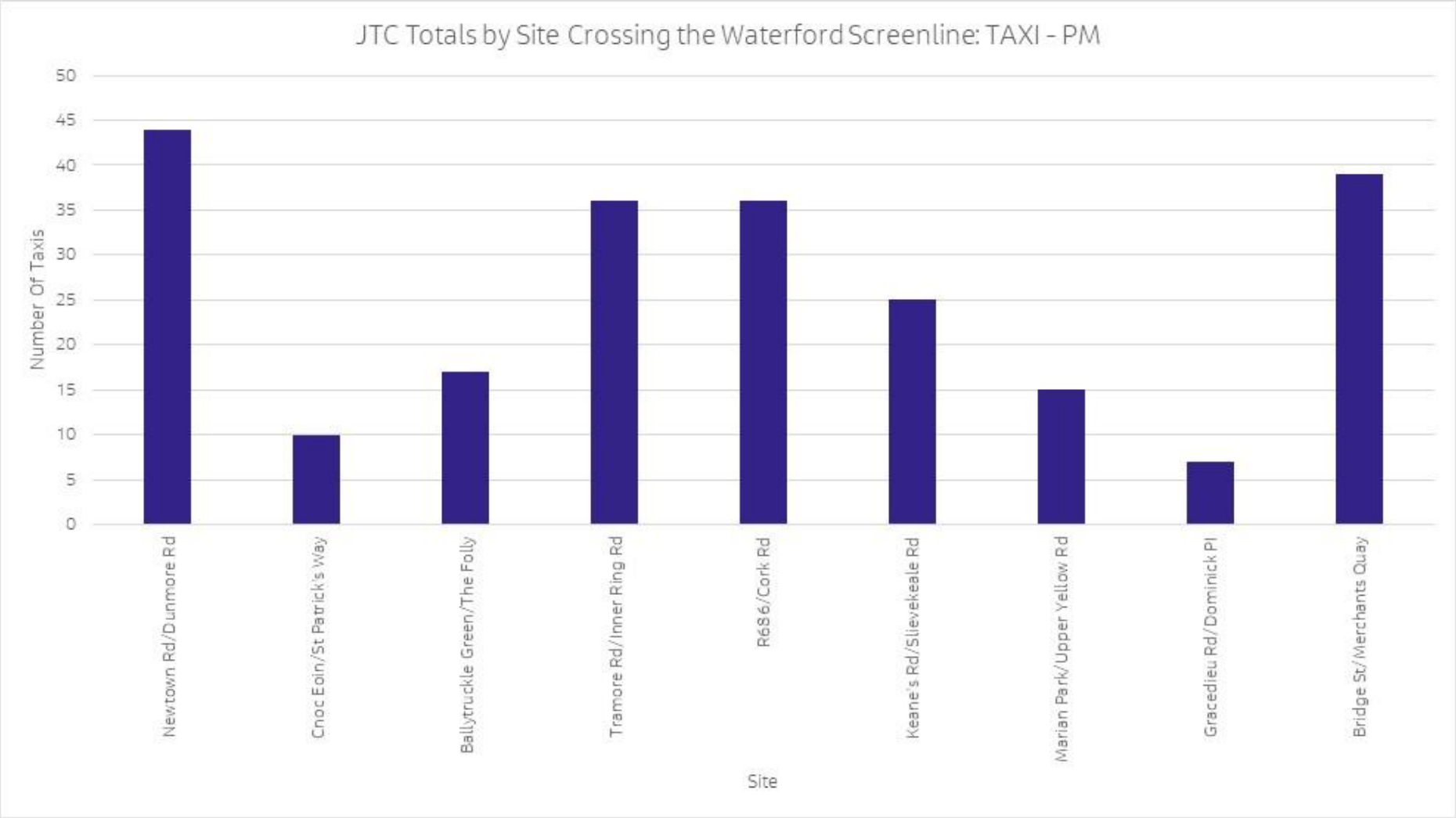

Figure 0-34:Number of Taxi Journeys for JTC Surveys for PM per Site

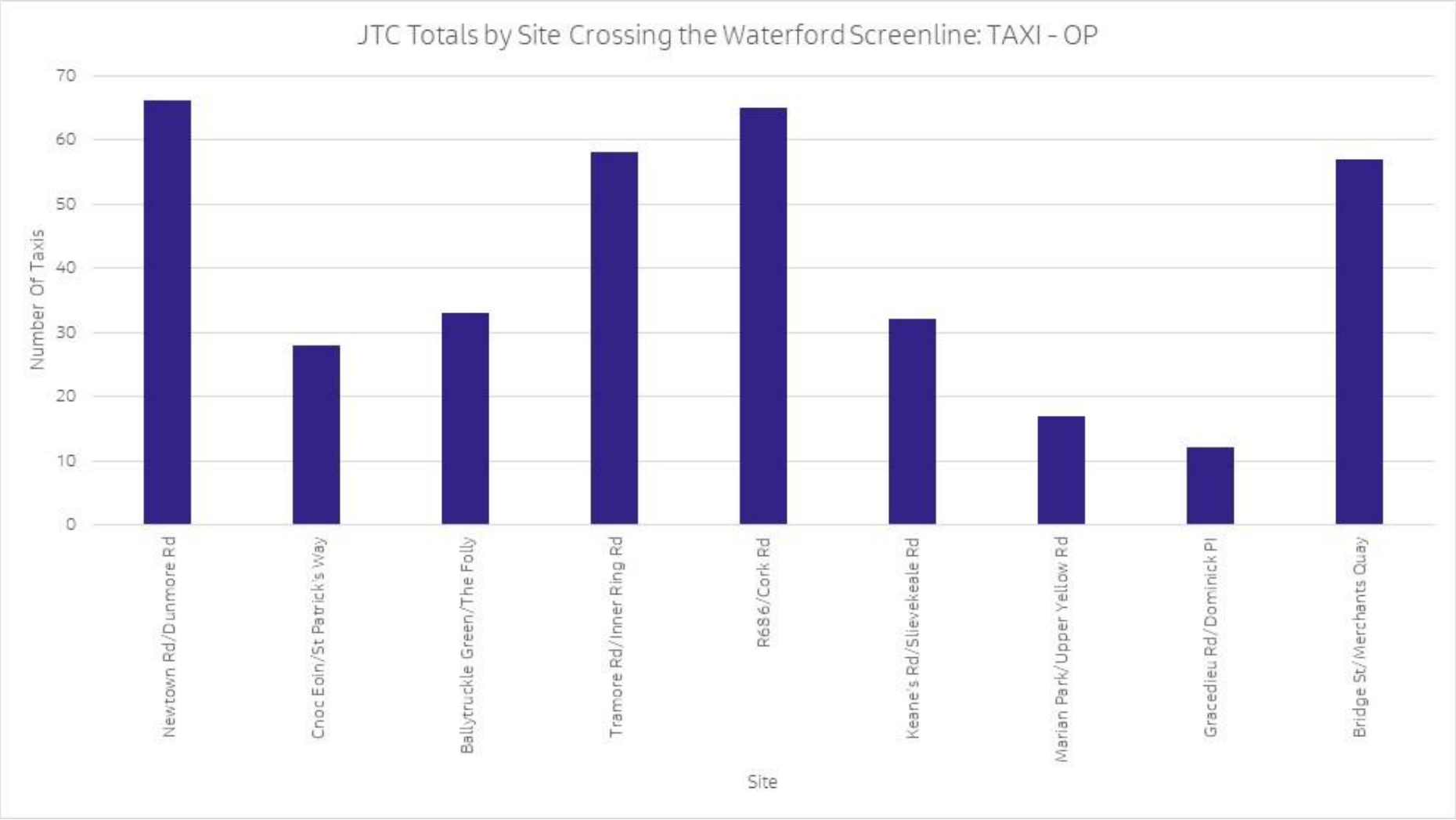

Figure 0-35:Number of Taxi Journeys for JTC Surveys for OP per Site

Bus Movements by Site and Period

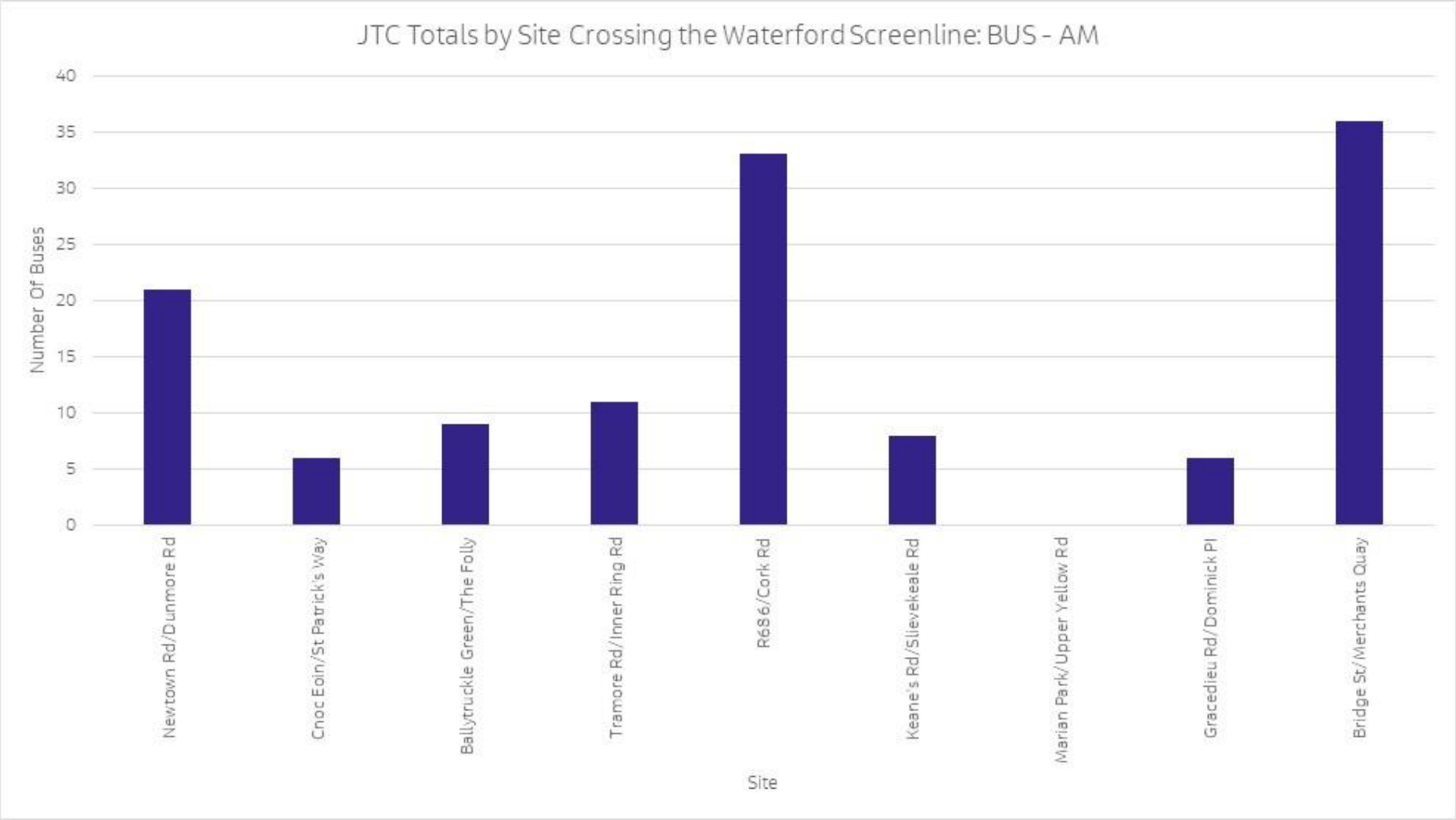

Figure 0-36:Number of Bus Journeys for JTC Surveys for AM per Site

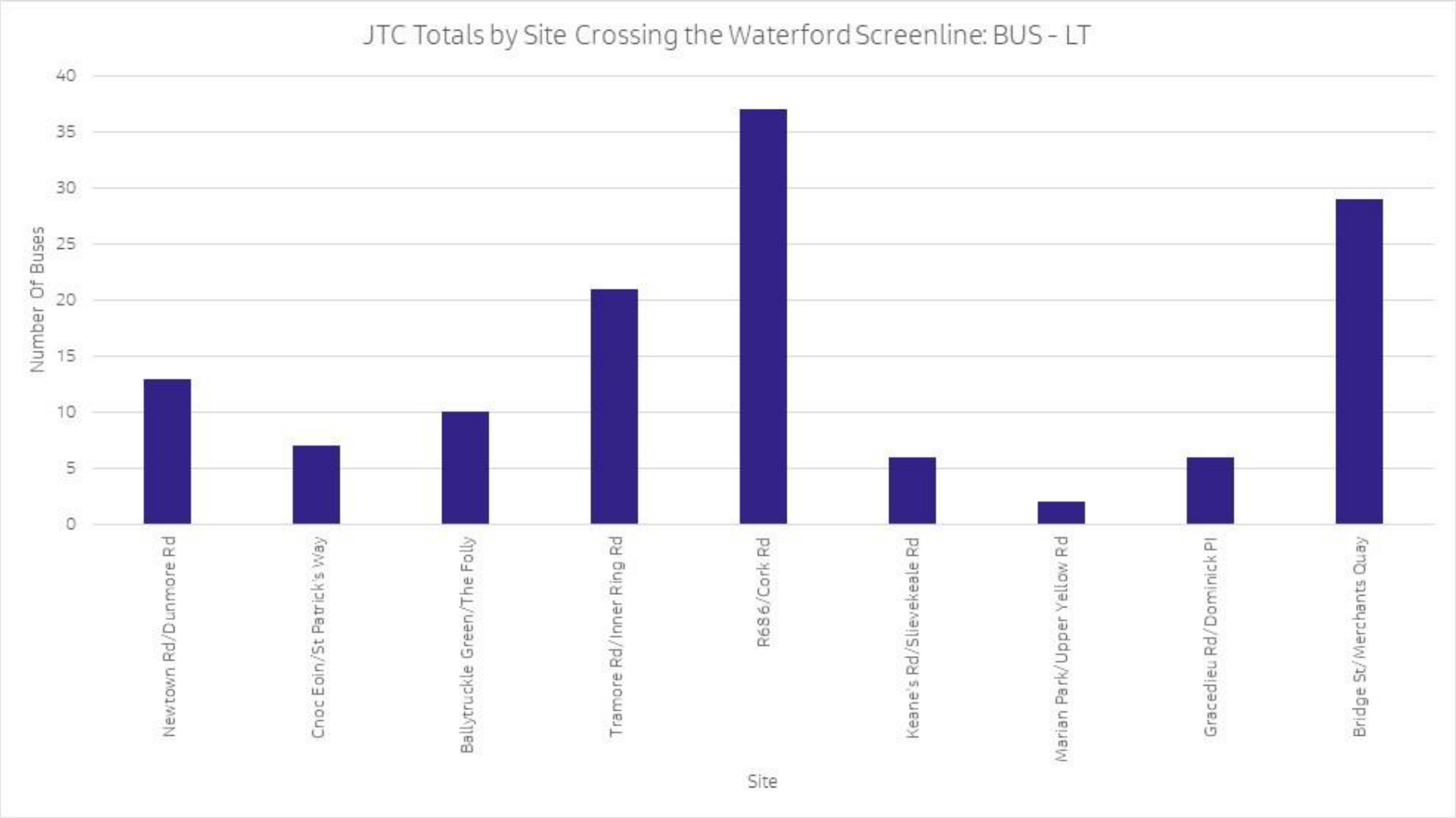

Figure 0-37:Number of Bus Journeys for JTC Surveys for LT per Site

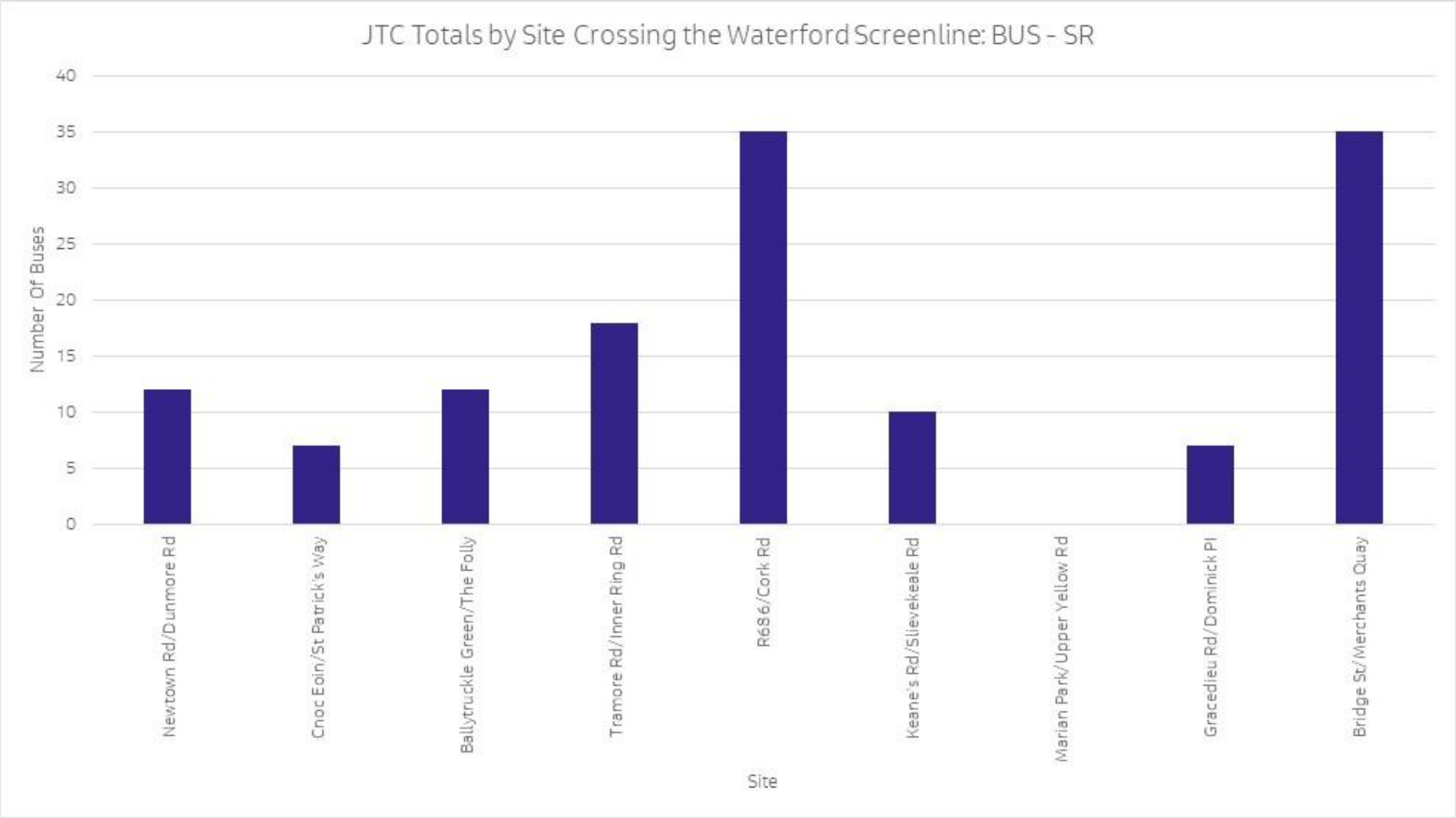

Figure 0-38:Number of Bus Journeys for JTC Surveys for SR per Site

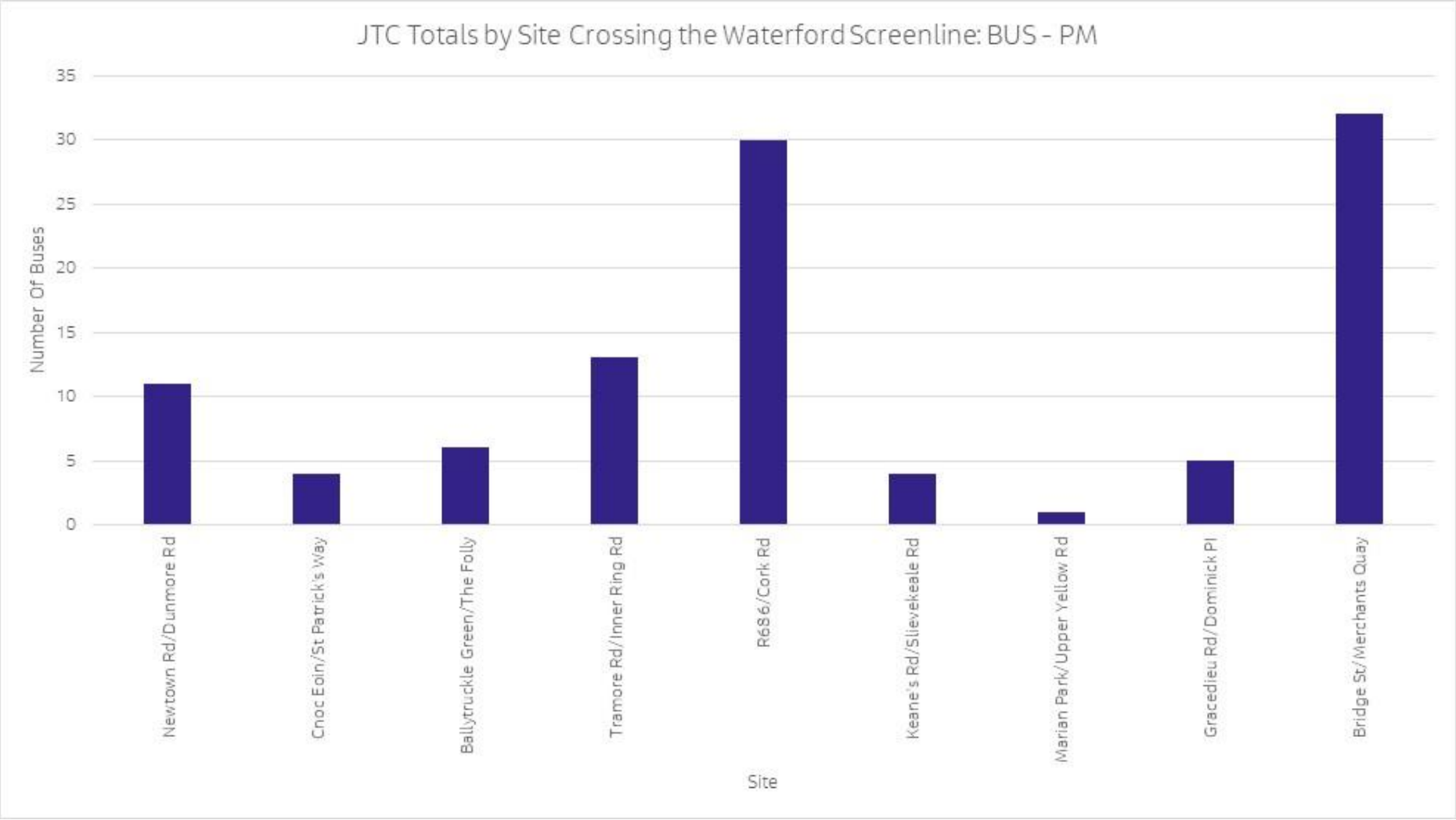

Figure 0-39:Number of Bus Journeys for JTC Surveys for PM per Site

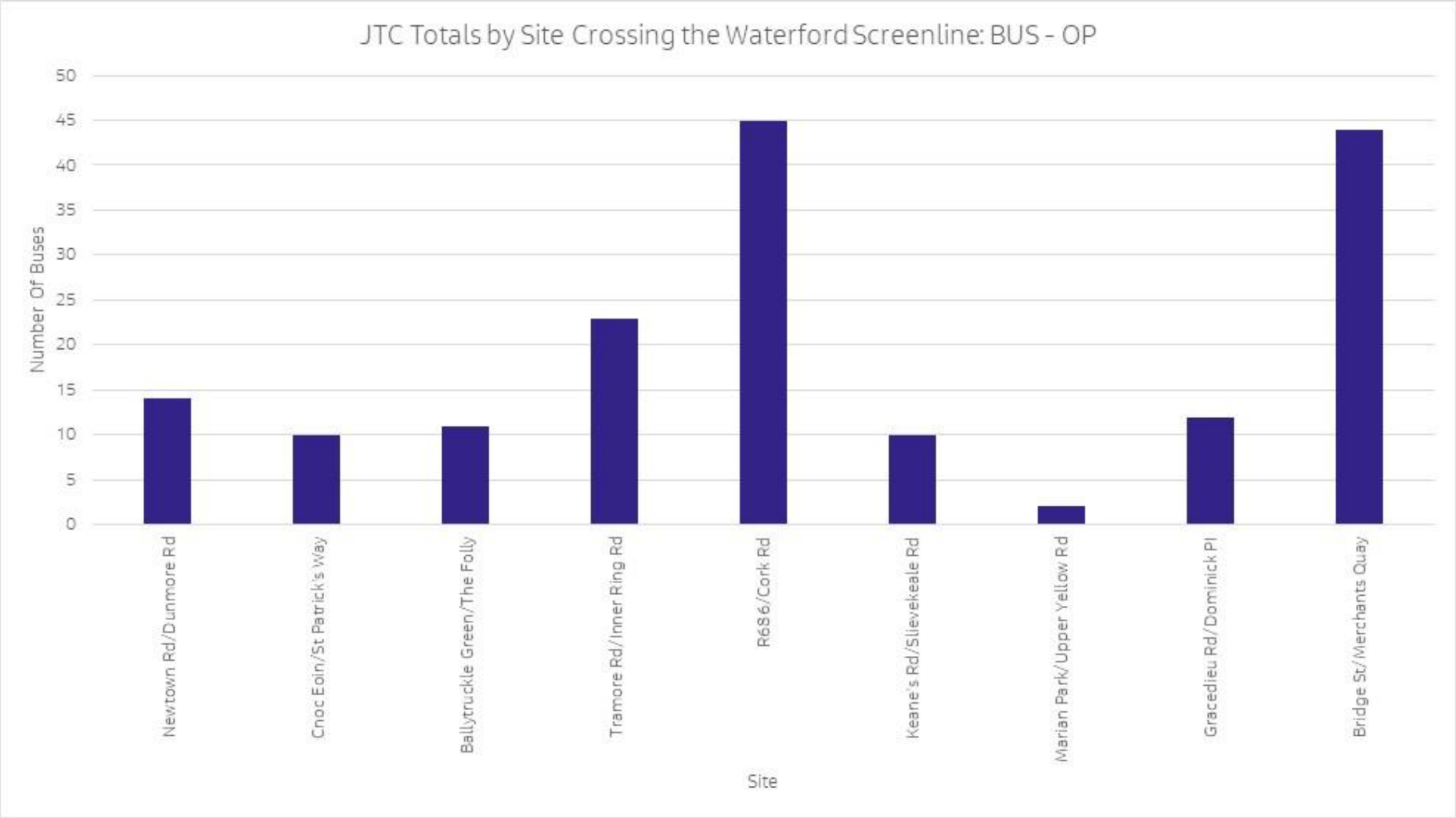

Figure 0-40:Number of Bus Journeys for JTC Surveys for OP per Site

Pedestrian Movements by Site and Period

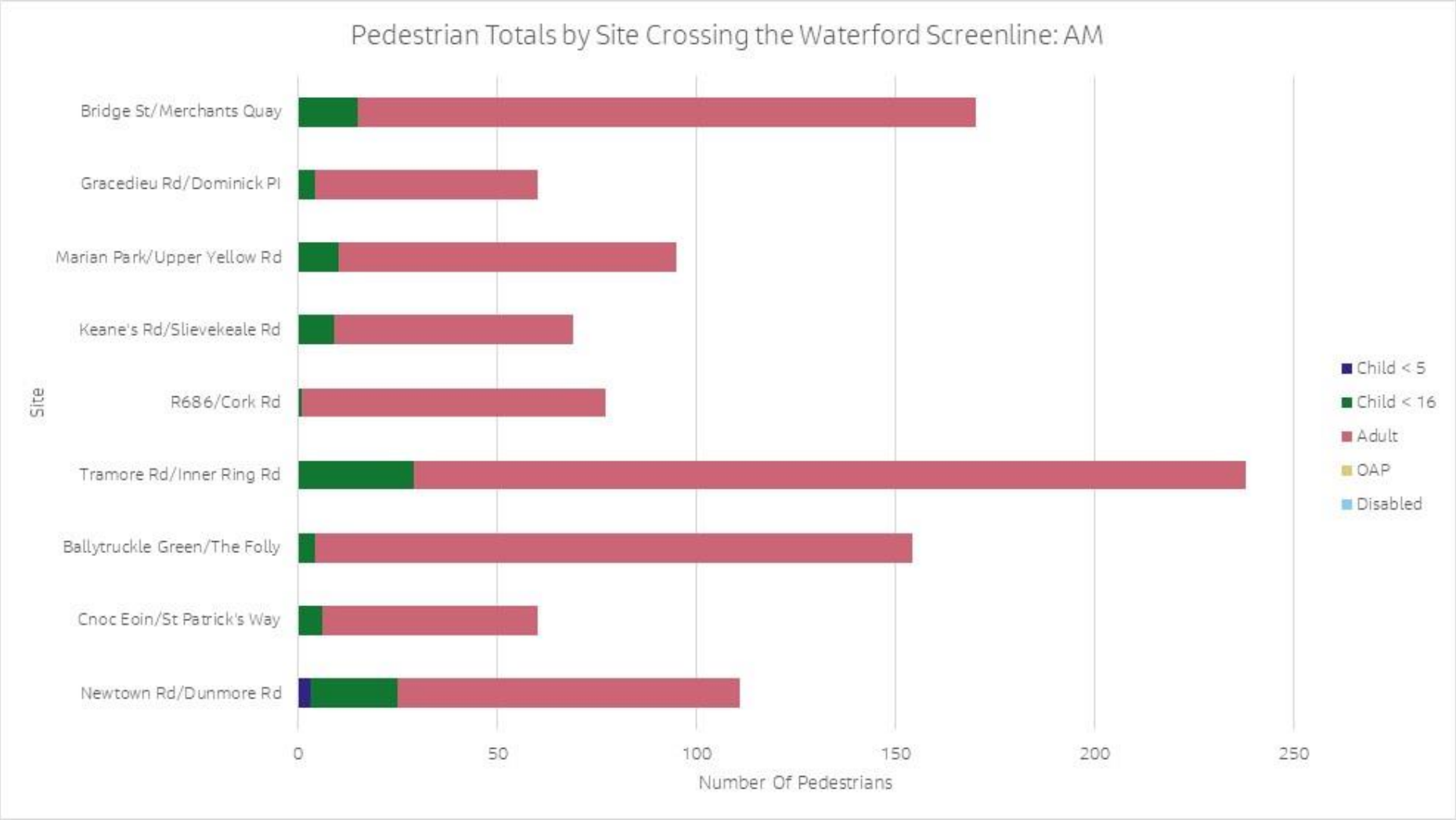

Figure 0-41:Number of Pedestrian Journeys for Ped Surveys for AM per Site

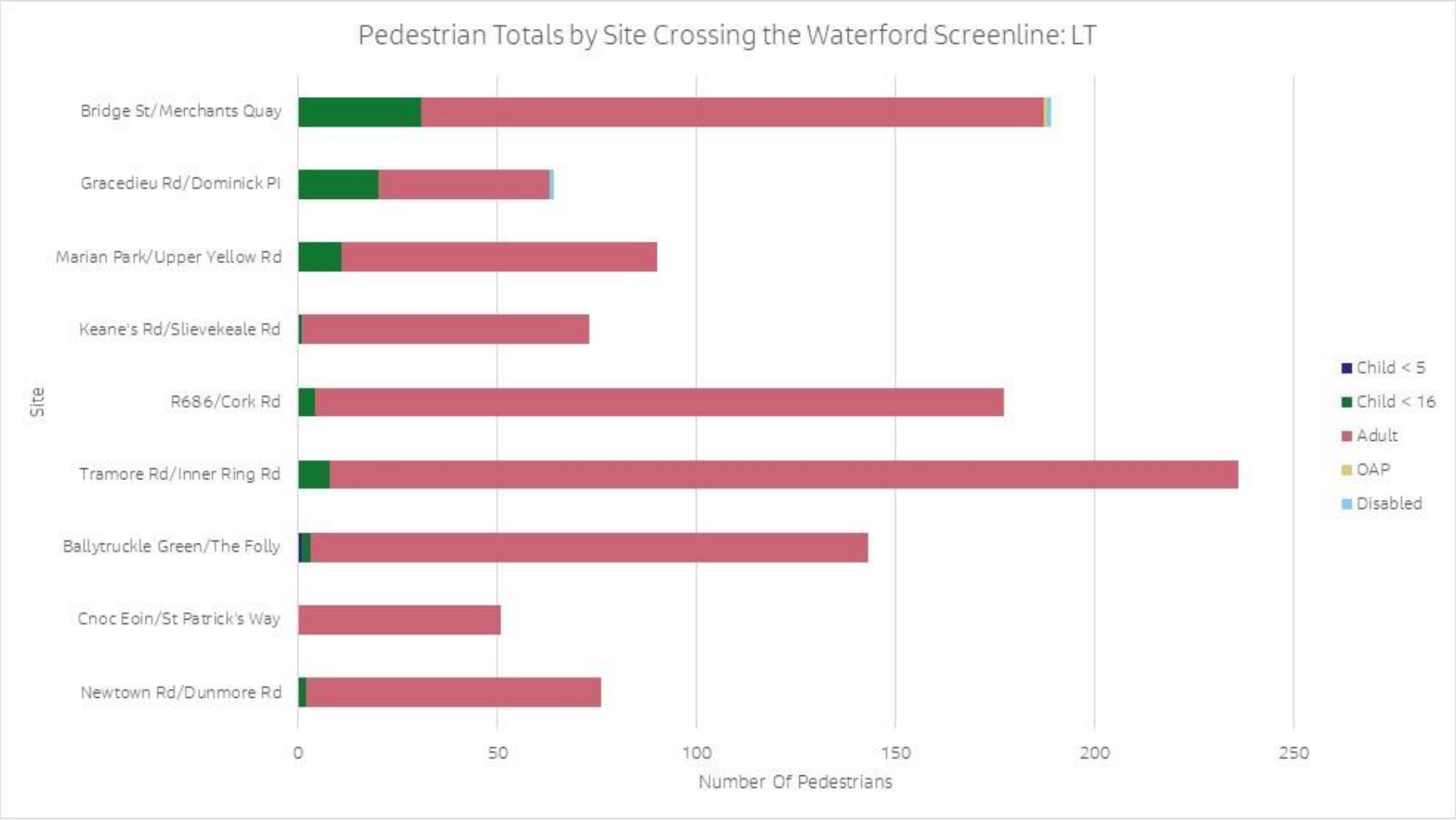

Figure 0-42:Number of Pedestrian Journeys for Ped Surveys for LT per Site

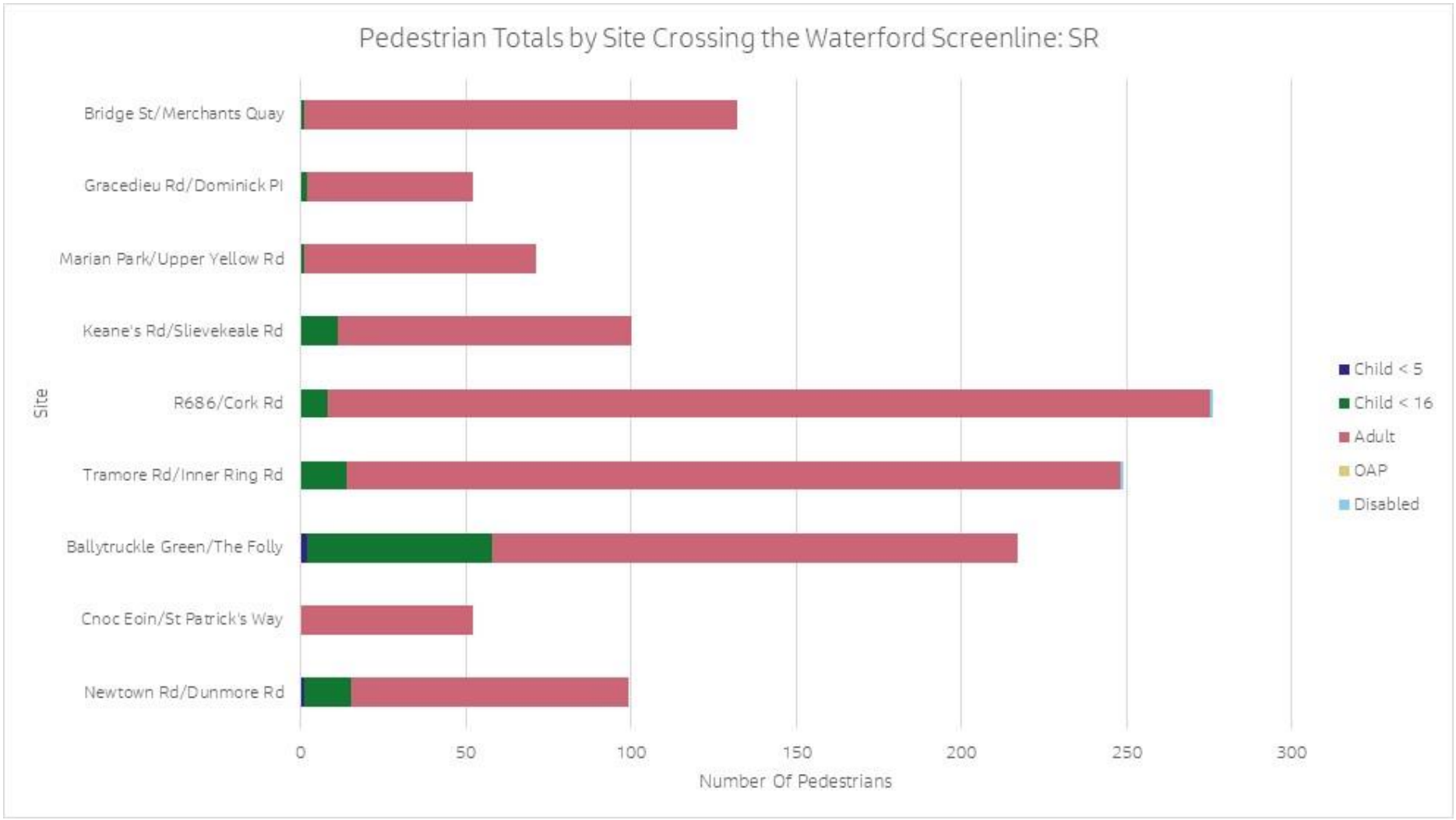

Figure 0-43:Number of Pedestrian Journeys for Ped Surveys for SR per Site

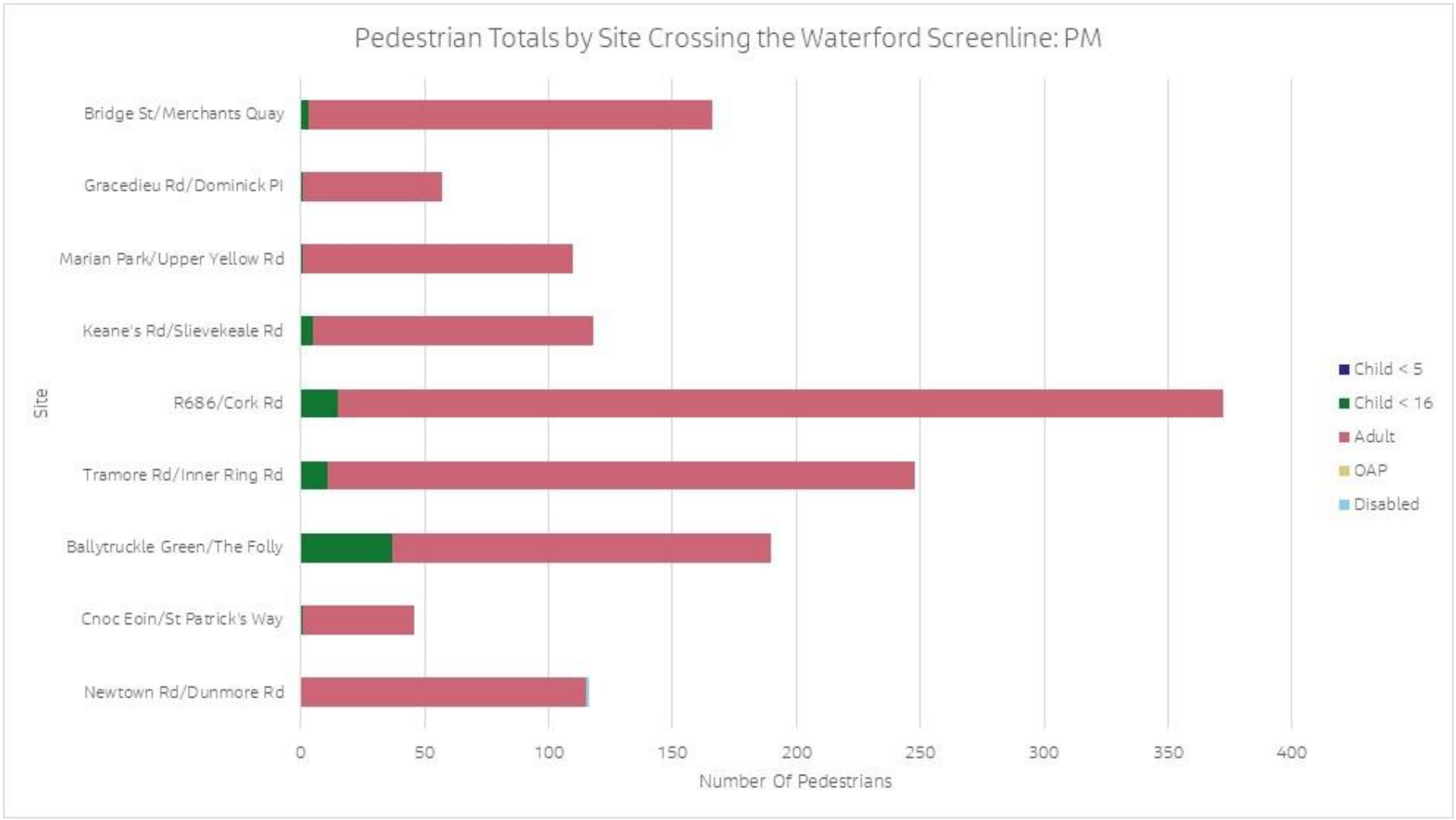

Figure 0-44:Number of Pedestrian Journeys for Ped Surveys for PM per Site

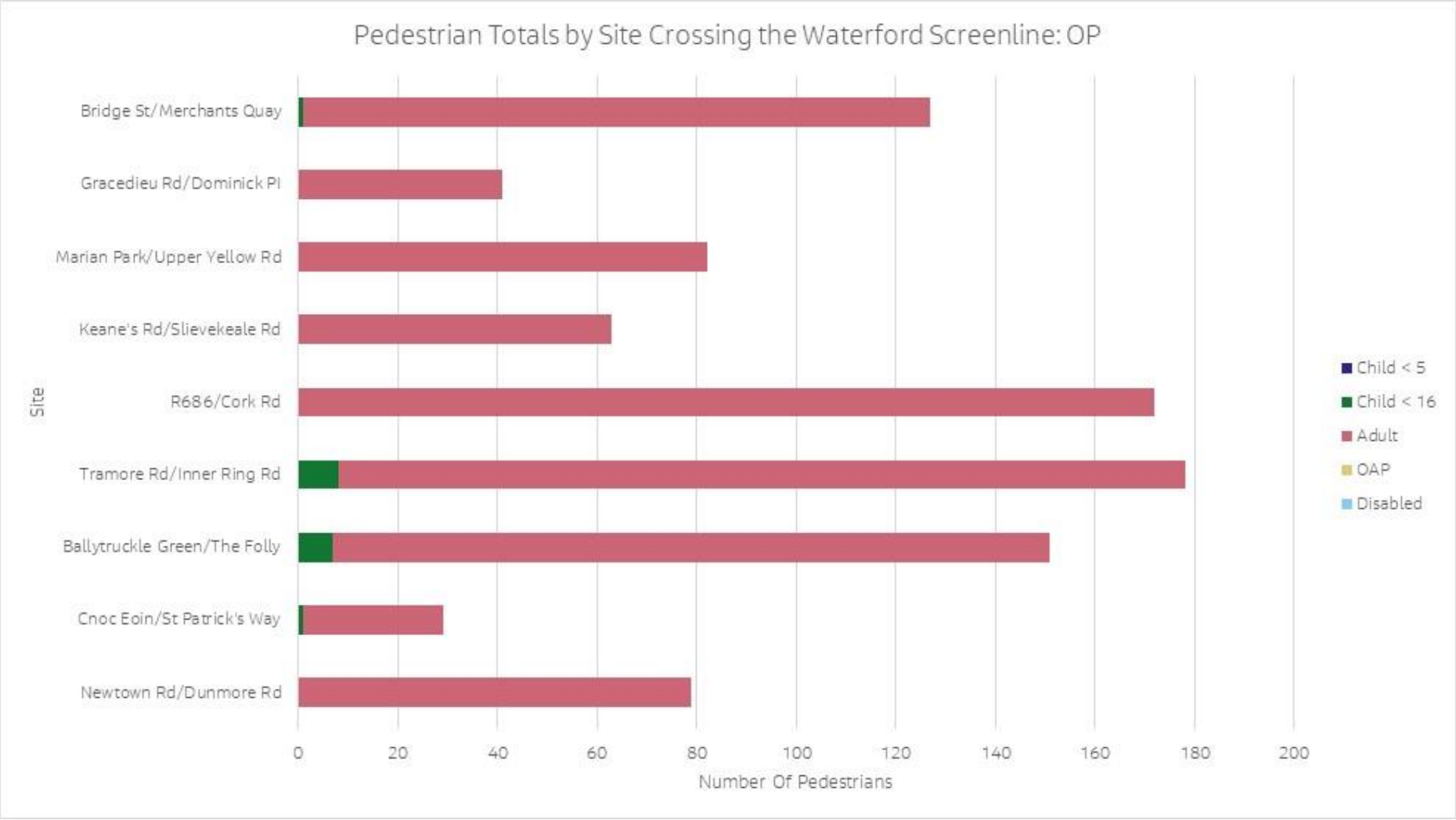

Figure 0-45:Number of Pedestrian Journeys for Ped Surveys for OP per Site

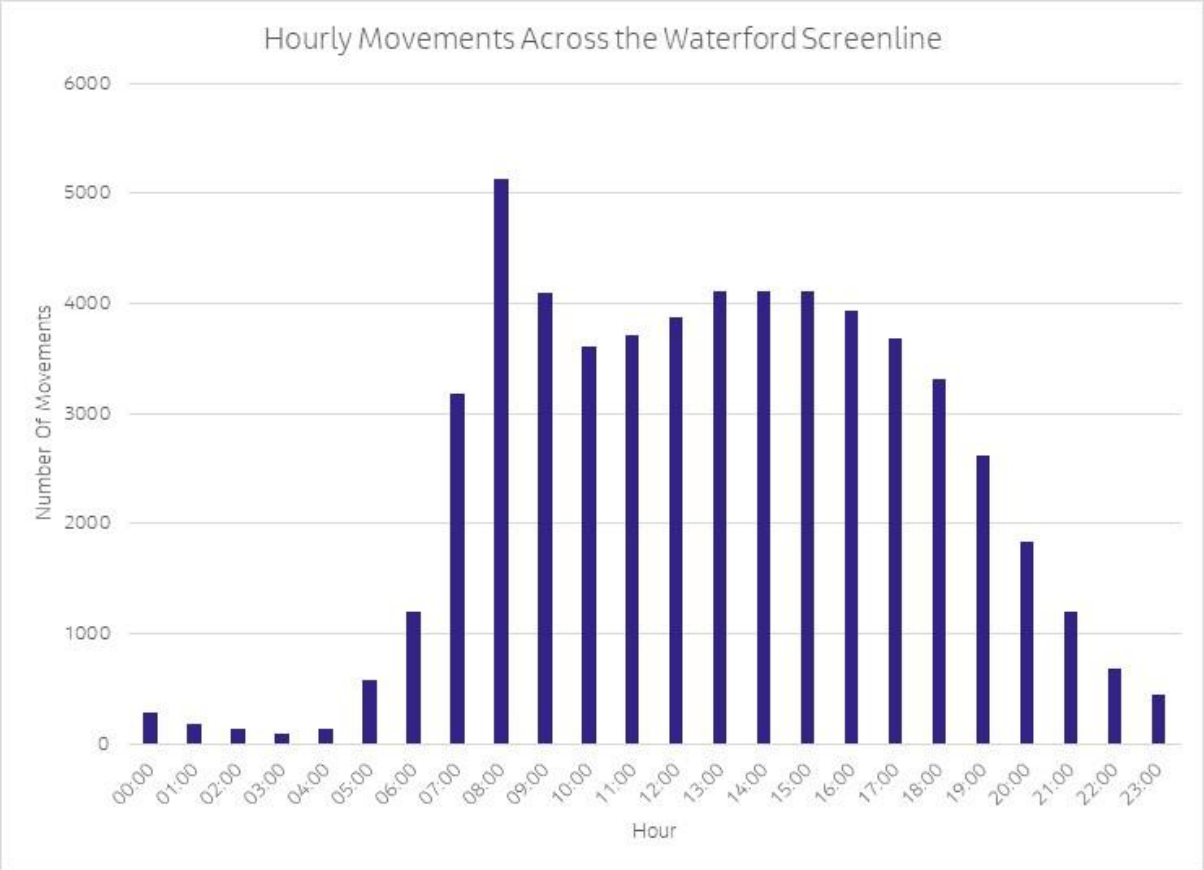

Figure 0-46:Daily Movements by Hour

Total Movements by Time Period

Table 0-1:AM Period Total Movements - Waterford Cordon

Mode	Trips	% Trips
P/C	141	1%
Pedestrian	1,034	4%
Bus	1,597	6%
Rail	65	0%
Car	21,931	87%
Taxi	425	2%

Table 0-2:LT Period Total Movements - Waterford Cordon

Mode	Trips	% Trips
P/C	110	1%
Pedestrian	1,099	4%
Bus	1,681	6%
Rail	87	0%
Car	19,693	87%
Taxi	569	2%

Table 0-3:SR Period Total Movements - Waterford Cordon

Mode	Trips	% Trips
P/C	134	1%
Pedestrian	1,248	4%
Bus	1,538	6%
Rail	81	0%
Car	22,211	87%
Taxi	519	2%

Table 0-4:PM Period Total Movements - Waterford Cordon

Mode	Trips	% Trips
P/C	206	1%
Pedestrian	1,423	4%
Bus	1,288	6%
Rail	92	0%
Car	21,871	87%
Taxi	343	2%

Appendix B - Additional Bus Stop Survey Data

Bus Stop Flow Data

Figure 0-1:Total Buses per Time Period - Waterford

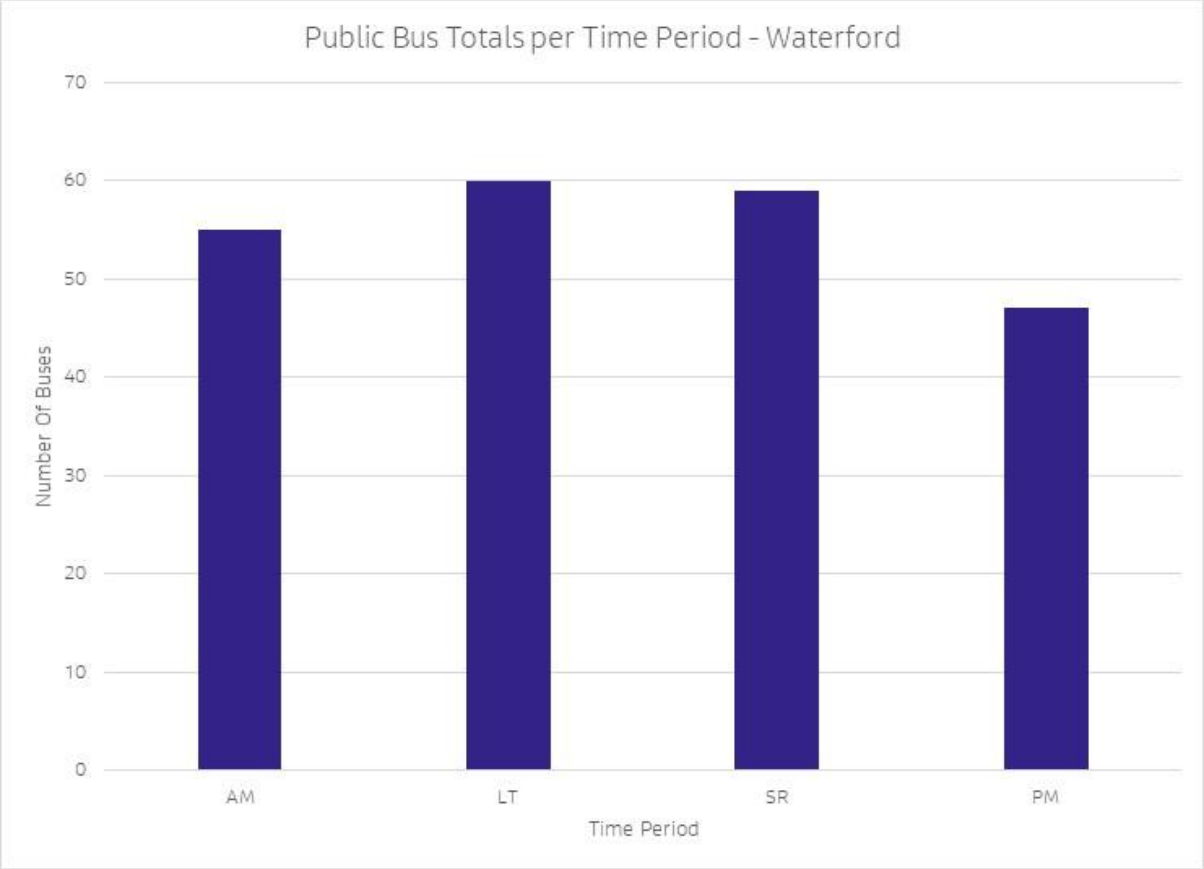

Figure 0-2:Public Buses Total per Time Period - Waterford

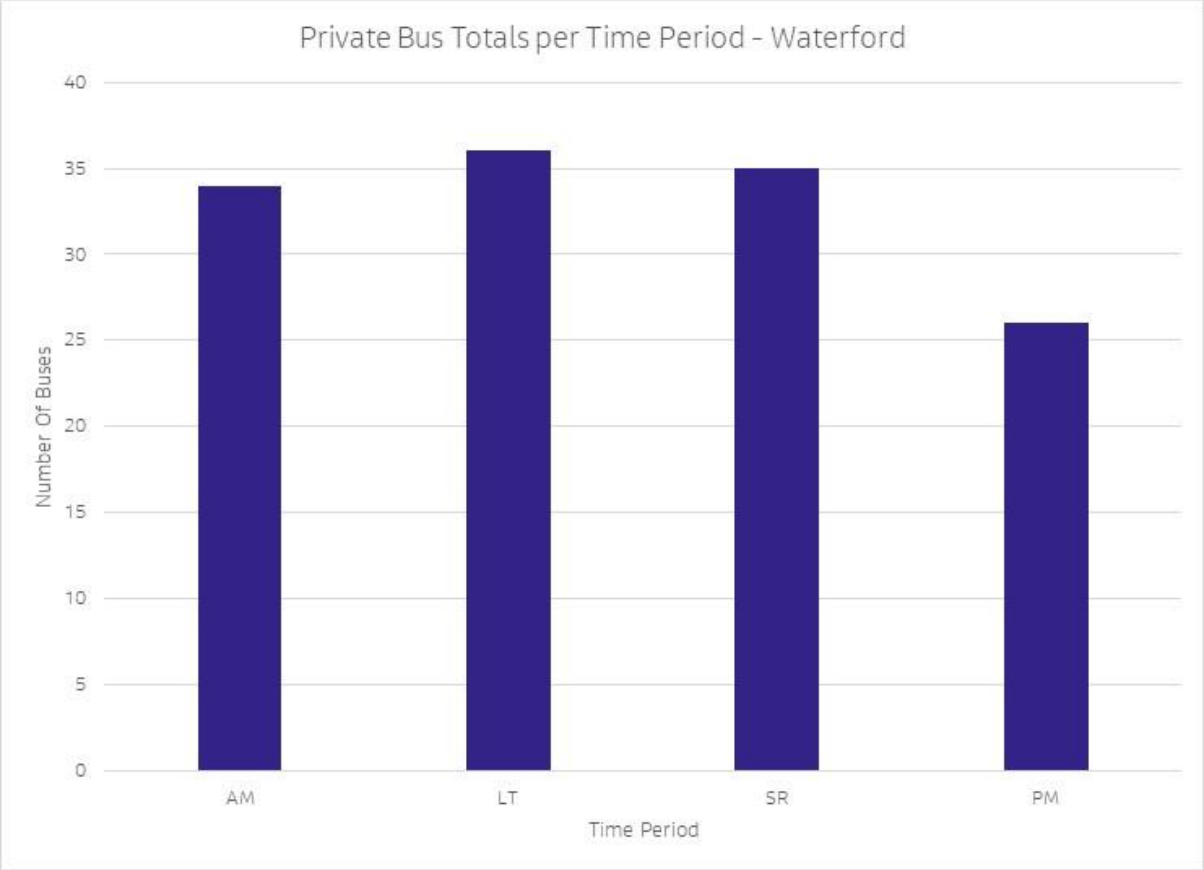

Figure 0-3:Private Buses Total per Time Period - Waterford

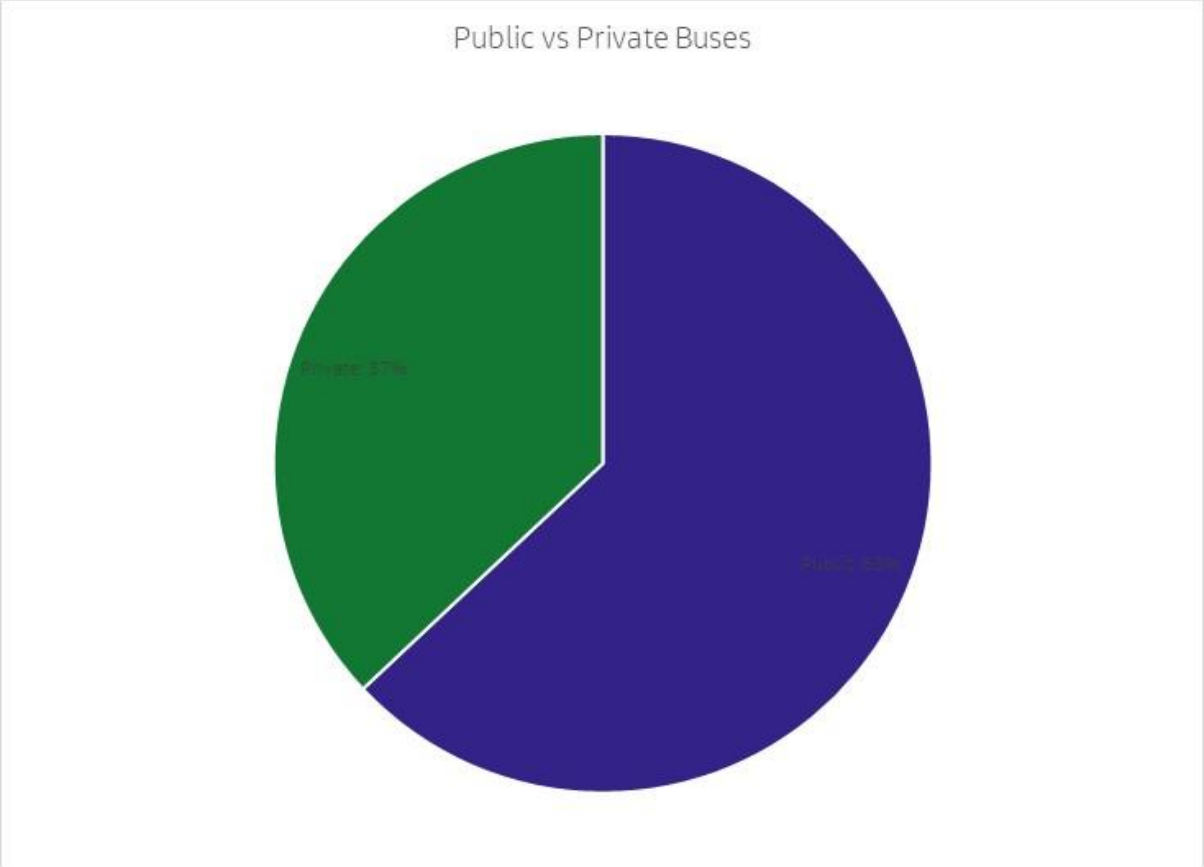

Figure 0-4:Private Buses vs Public Buses - Waterford

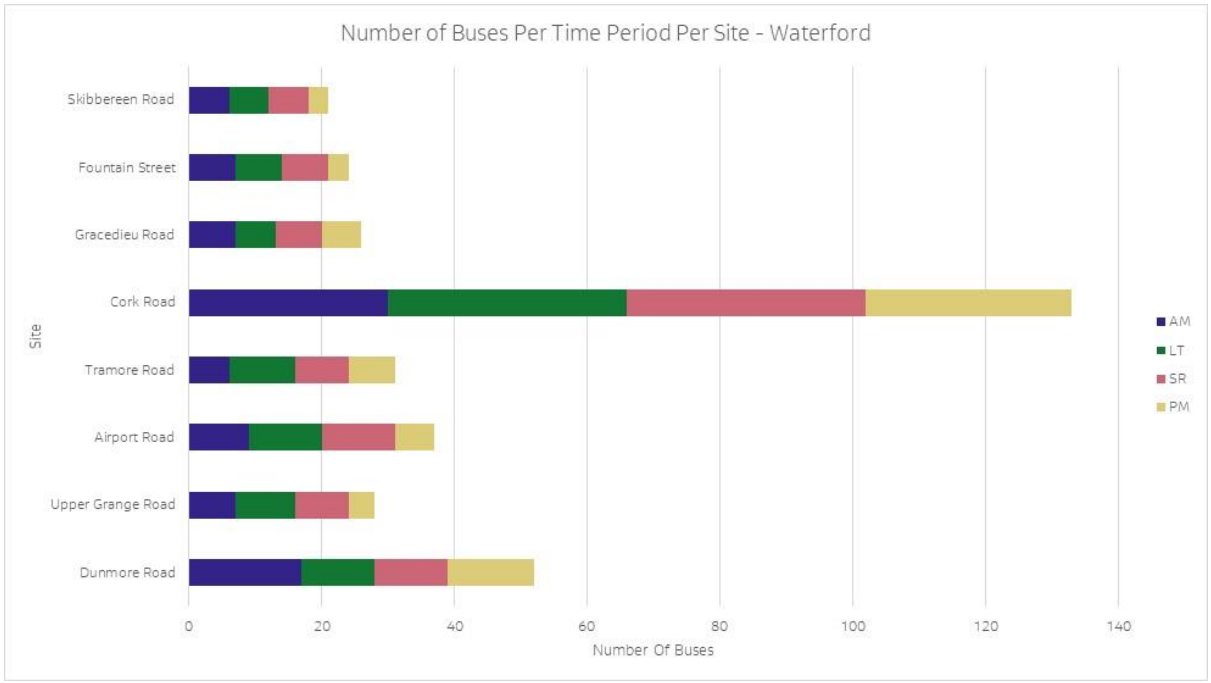

Figure 0-5:Number of Buses per Time Period Per Site - Waterford

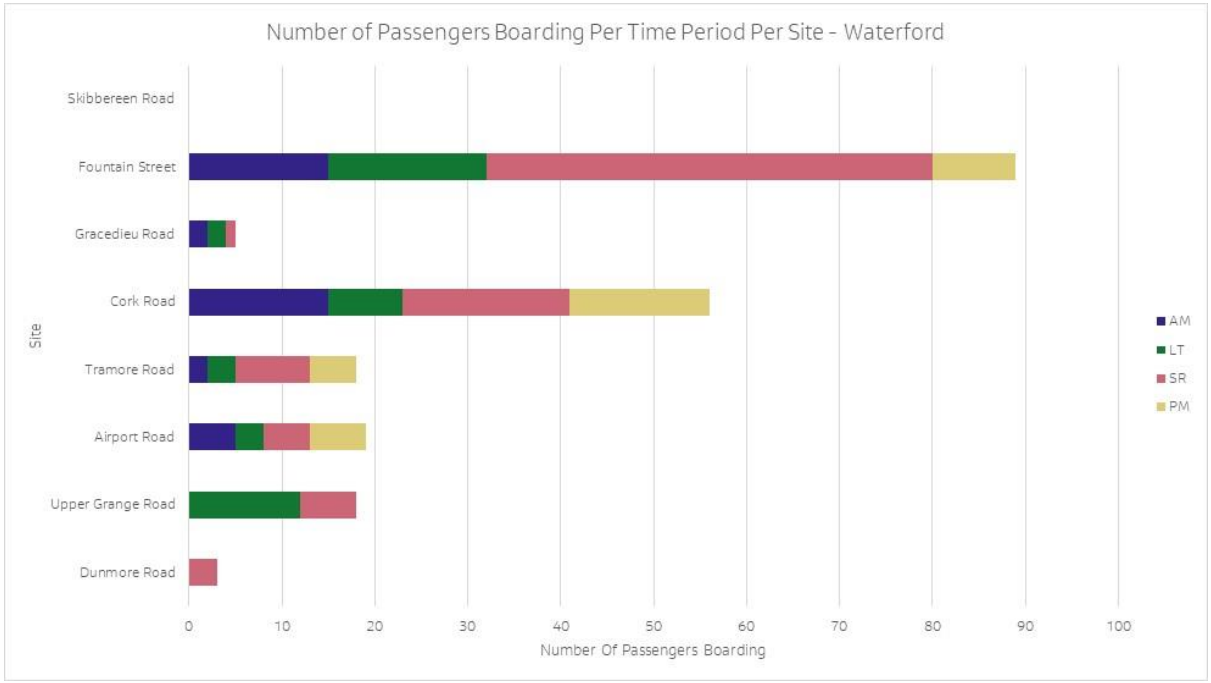

Figure 0-6:Number of Passengers Boarding per Time Period Per Site - Waterford

Bus Occupancy Methodology

The bus passenger trip numbers used throughout this report were calculated from the bus occupancy values via the following methodology.

First the average number of passengers for each bus type was calculated. These are standard industry bus occupancy values and are shown in the table below.

Table 0-1:Average number of passengers per bus type

Average Occupancy of a Bus per Bus Type				
Double Decker	**Single Decker**	**Single Coach**	**Double Coach**	**Mini Bus**
94	37	55	79	16

Then, working back from the average number of passengers per bus type, a value was calculated which corresponds with each occupancy percentage that was recorded in the bus surveys. This was calculated by taking the maximum passenger numbers per bus type, dividing the value by 100 and multiplying by the occupancy value.

Table 0-2:Occupancy Per Bus Type

Occupancy %	Double Decker Passenger Number	Single Decker Passenger Number	Single Coach Passenger Number	Double Coach Passenger Number	Mini Bus Passenger Number
0	0	0	0	0	0
5	5	2	3	4	1
10	9	4	6	8	2
15	14	6	8	12	2
20	19	7	11	16	3
25	24	9	14	20	4
30	28	11	17	24	5
35	33	13	19	28	6
40	38	15	22	32	6
45	42	17	25	36	7
50	47	19	28	40	8
55	52	20	30	43	9
60	56	22	33	47	10

65	61	24	36	51	10
70	66	26	39	55	11
75	71	28	41	59	12
80	75	30	44	63	13
85	80	31	47	67	14
90	85	33	50	71	14
95	89	35	52	75	15
100	94	37	55	79	16

Then, using the above table, the average number of passengers per bus type and occupancy range was calculated. The below table defines the ranges and the average passenger number for each range. The passenger numbers from the above table for each range are added together and the average calculated.

Table 0-3:Average passengers per range

Average number of passengers per range					
Range	**Double Decker**	**Single Decker**	**Single Coach**	**Double Coach**	**Mini Bus**
0-24%	9	4	6	8	2
25-50%	33	13	19	28	6
51-74%	38	15	22	32	6
75-99%	61	24	36	51	10
100%	94	37	55	79	16

The same process was then carried out to calculate the lower and upper passenger bounds of each bus type. These upper and lower bounds, along with the average passenger numbers can be seen in the below tables.

Table 0-4:Lower bound of passengers by range

Lower Bound of passengers per range					
Lower	**Double Decker**	**Single Decker**	**Single Coach**	**Double Coach**	**Mini Bus**
0-24%	0	0	0	0	0
25-50%	5	2	3	4	1
51-74%	28	11	17	24	5
75-99%	52	20	30	43	9

100%	75	30	44	63	13

Table 0-5:Upper bound of passengers by range

Upper Bound of passengers per range					
Upper	**Double Decker**	**Single Decker**	**Single Coach**	**Double Coach**	**Mini Bus**
0-24%	19	7	11	16	3
25-49%	42	17	25	36	7
50-74%	66	26	39	55	11
75-99%	89	35	52	75	15
100%	94	37	55	79	16

Bus Passenger Trips

The following graphs indicate how many passengers crossed each cordon on a bus during each time period at each site. The data in this section was taken from the Bus Occupancy surveys, where average bus occupancy values have been used to calculate the average number of passengers on board each bus.

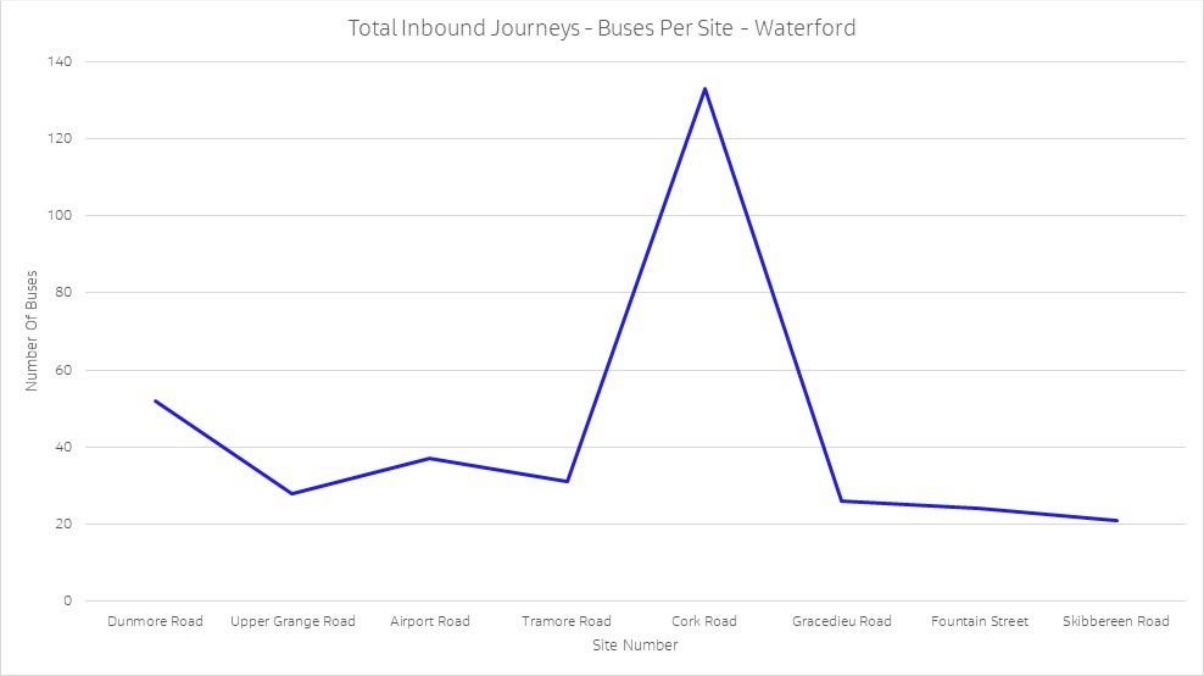

Figure 0-7:Total Inbound Journeys – Buses Per Site - Waterford

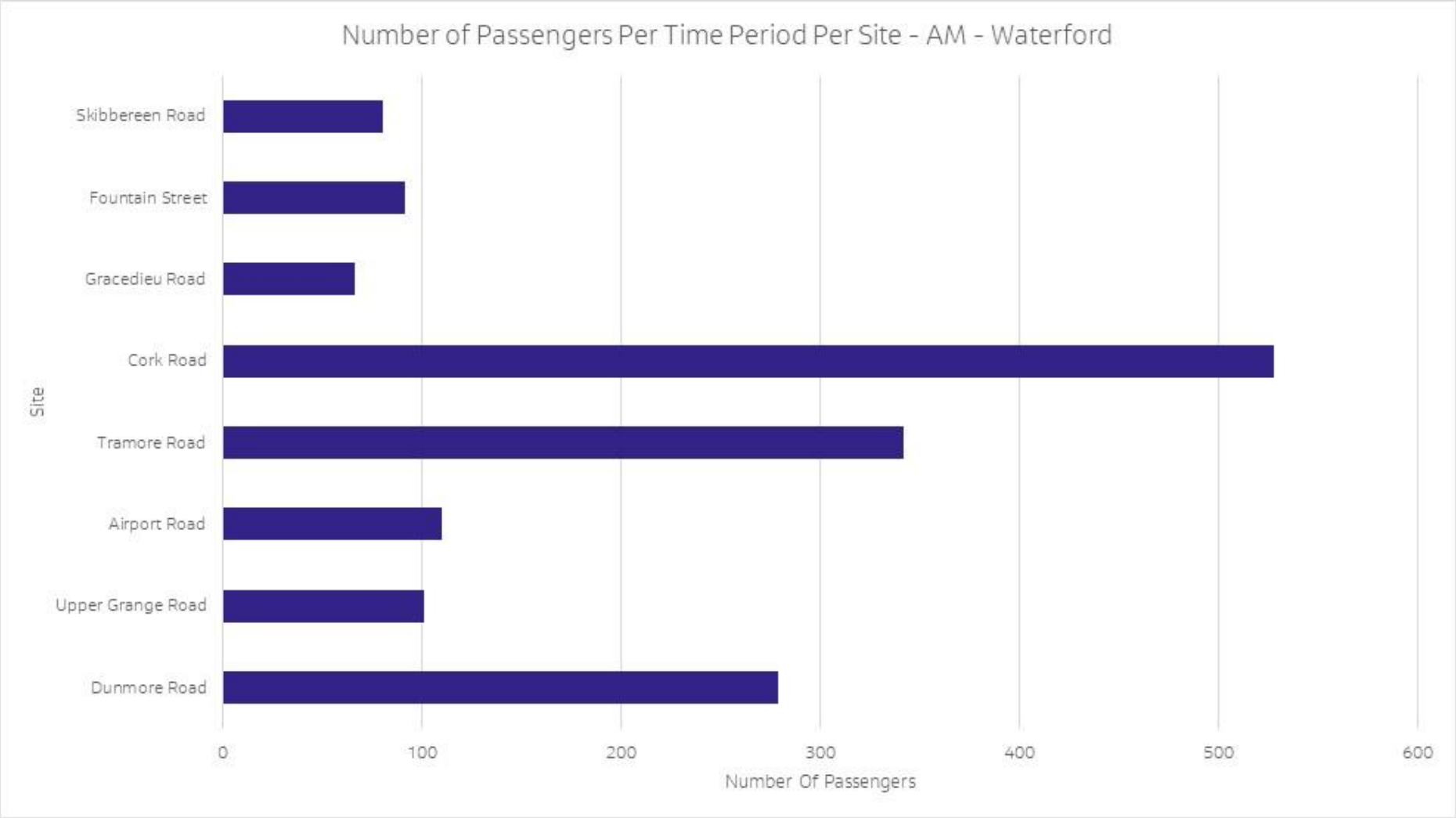

Figure 0-8:Bus Passengers - AM - Waterford

Figure 0-9:Bus Passengers - LT - Waterford

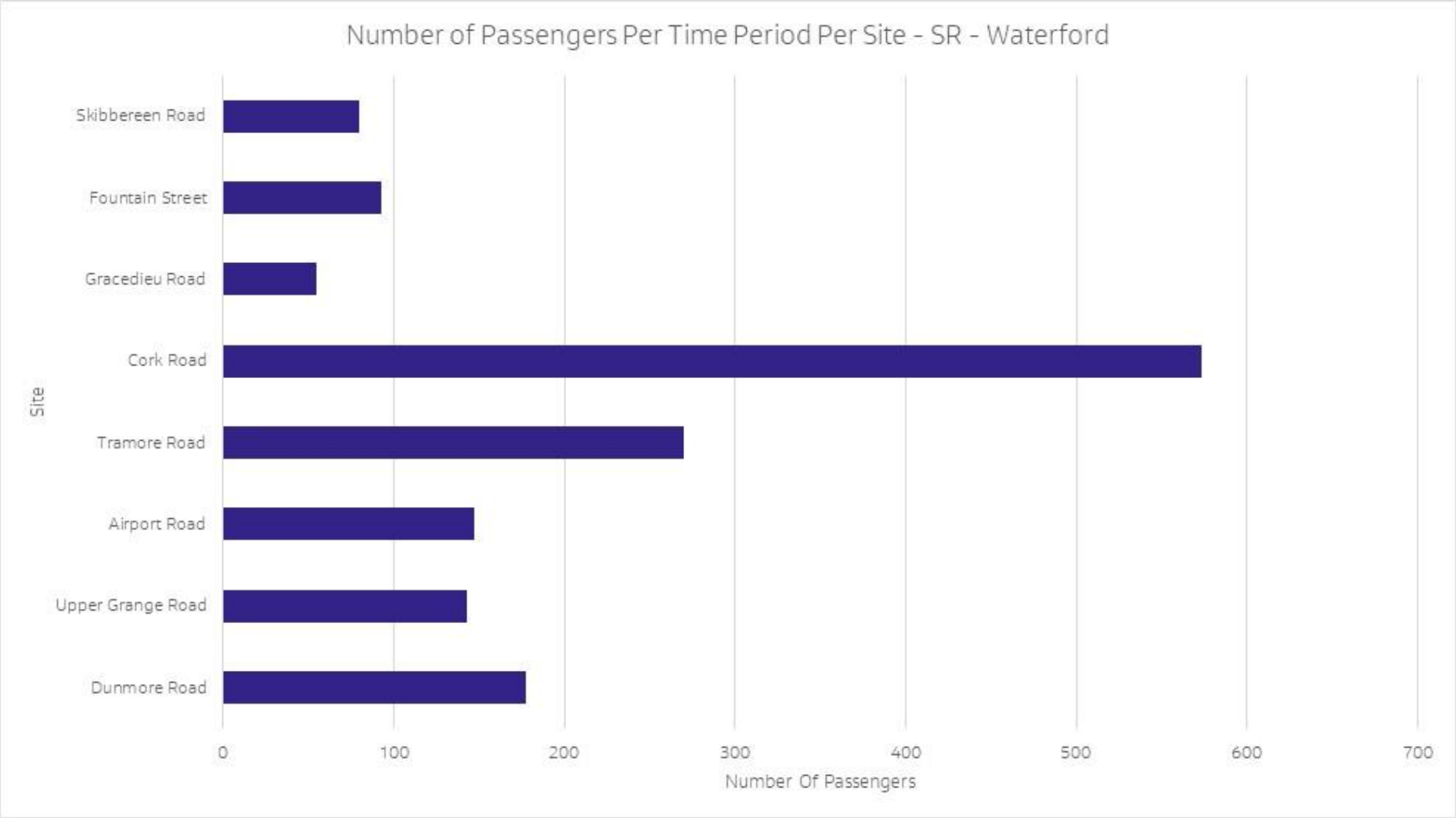

Figure 0-10:Bus Passengers - SR - Waterford

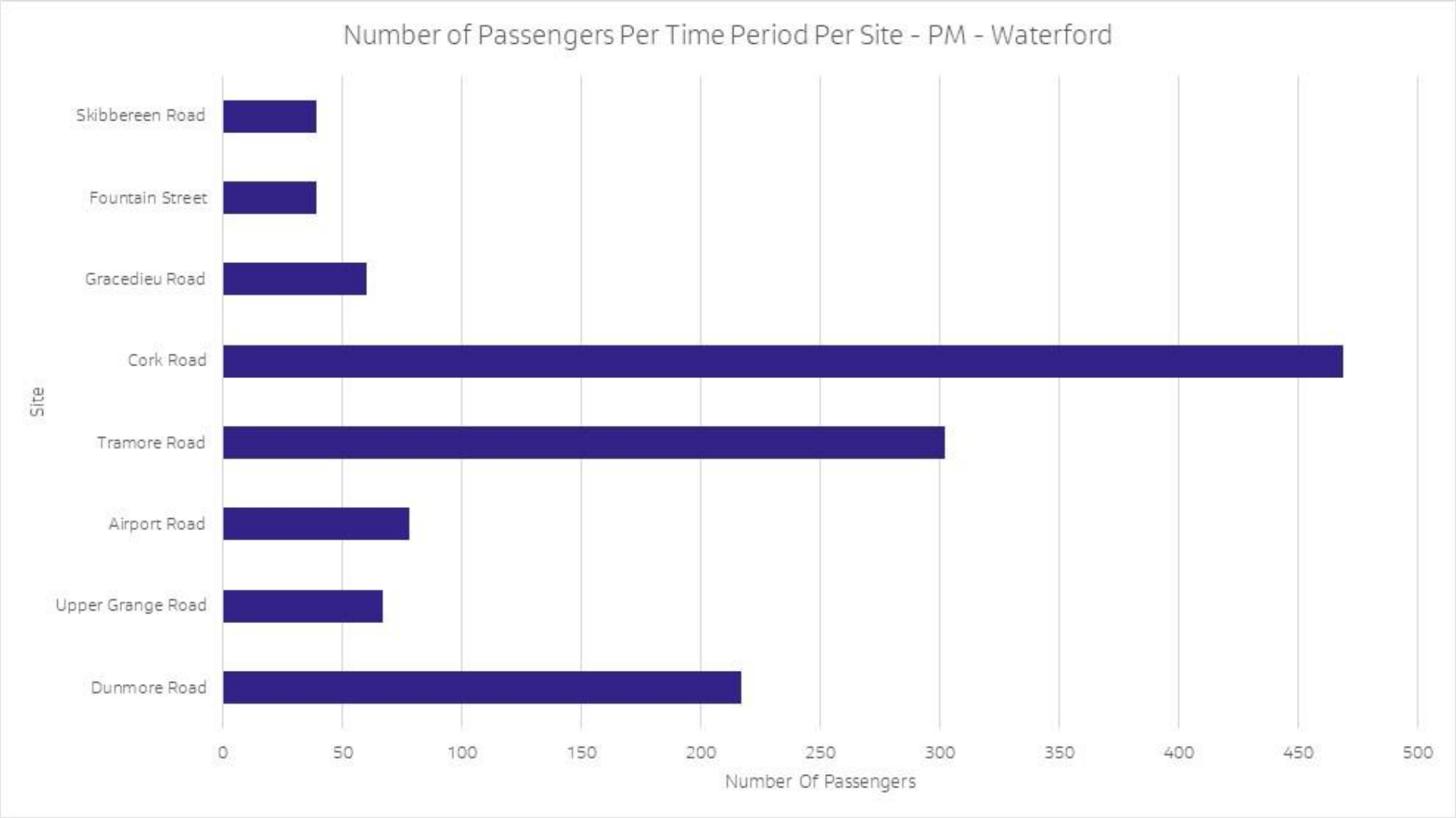

Figure 0-11:Bus Passengers - PM - Waterford

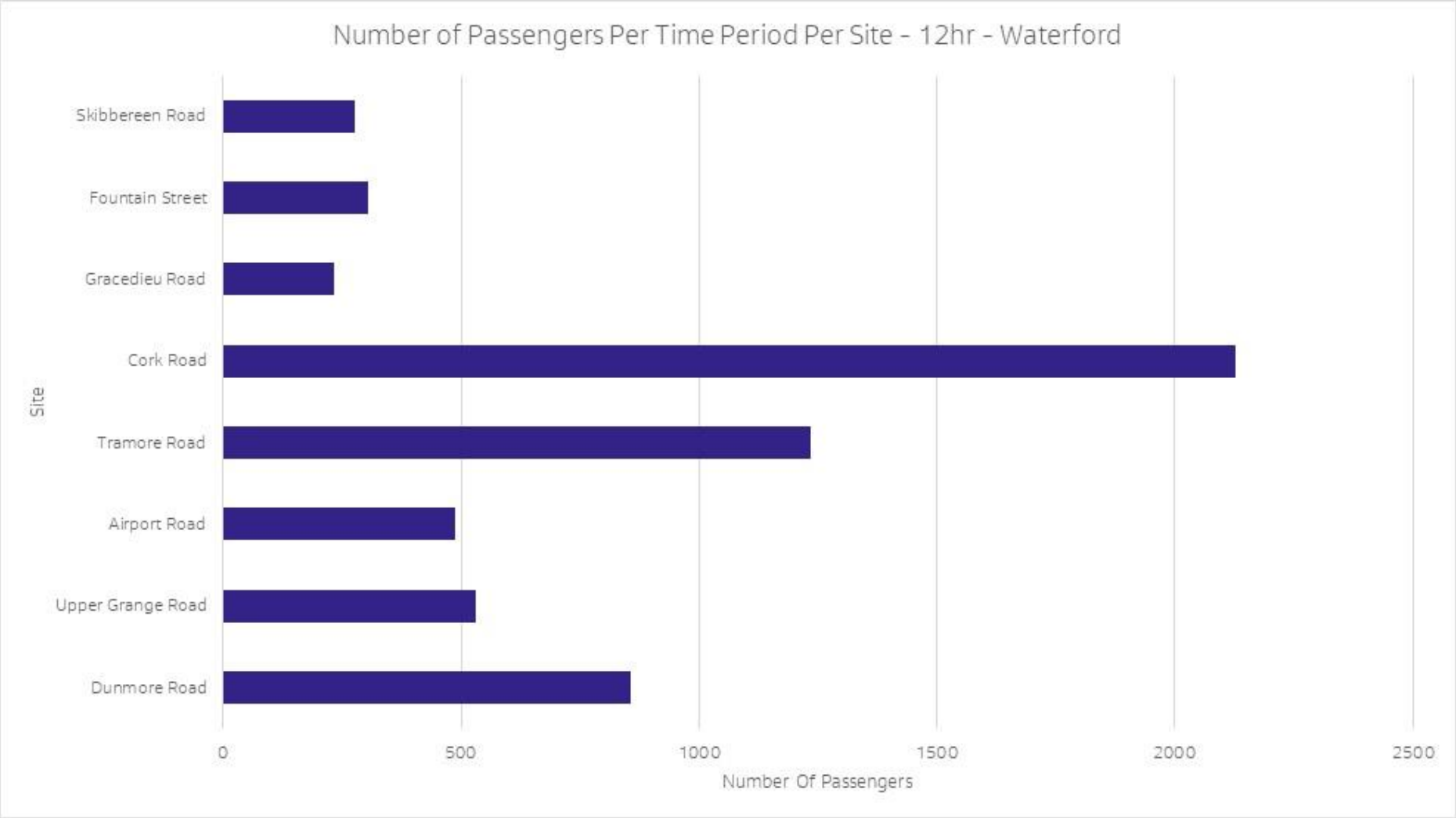

Figure 0-12:Bus Passengers - 12hr - Waterford

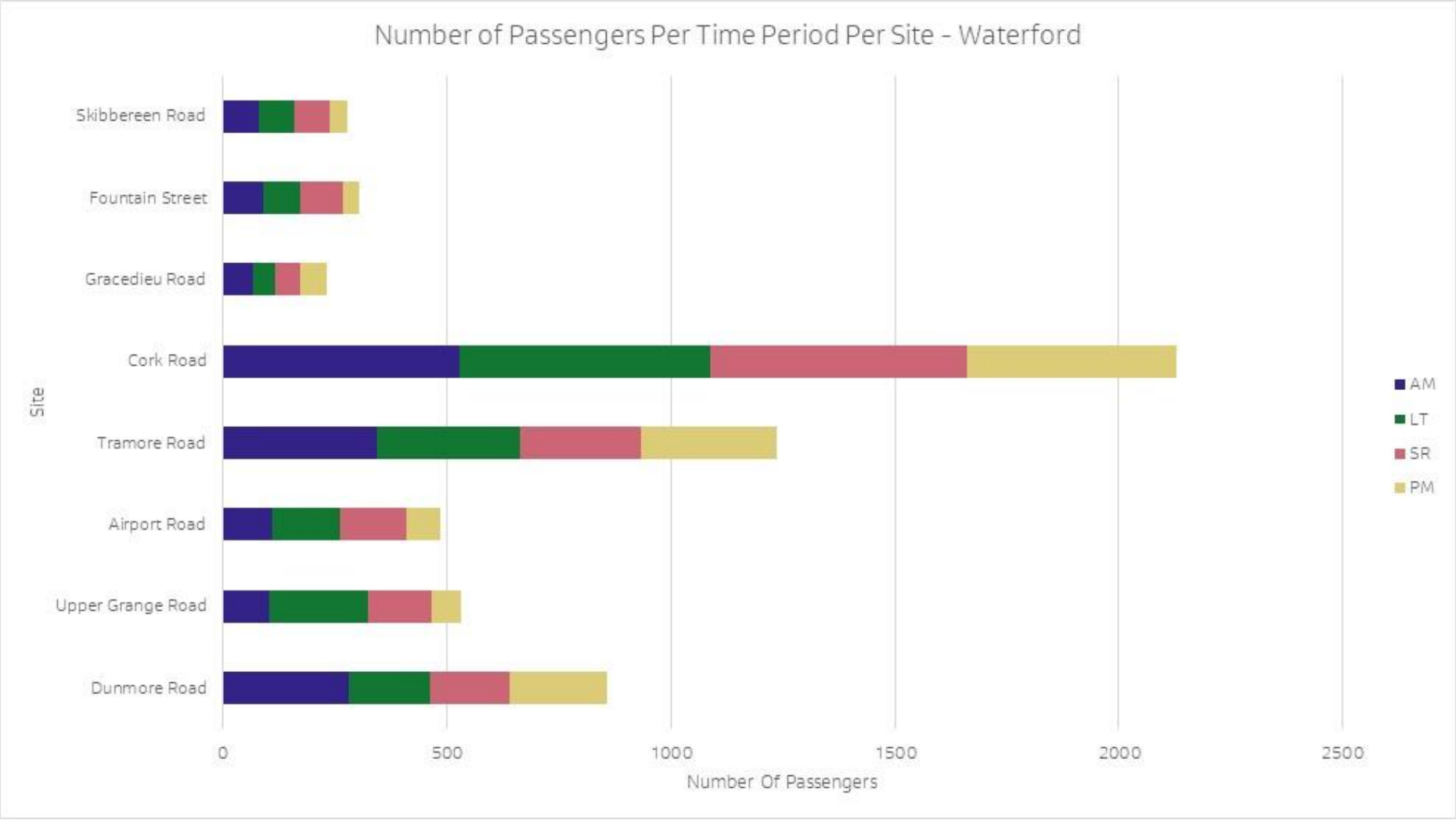

Figure 0-13:Total Passenger Trips Per Site Per Time Period - Waterford

A. Appendix C - Heavy Rail Data

The heavy rail passenger numbers are taken from the Annual Rail Census, carried out by Iarnród Éireann. The Passenger numbers from these services were taken from the following stations, where the train crossed the Waterford City Cordon, or the first station that the train stopped at, after crossing the Cordon.

- Waterford Plunkett Train Station

Table A-1:Rail Passengers per Time Period

All Rail Trips Inbound Across Cordon	Trips
AM	65
LT	87
SR	81
PM	92
12hr	325

Table A-2:Rail Passengers by Origin

Origin	AM	LT	SR	PM	12hr
Heuston	65	62	81	92	300
Limerick Junction	0	25	0	0	25