

Yellow lines at bus stops

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Research conducted by MVA

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1 Introduction

1.1 Overview

- 1.1.1 It is vital to passenger safety, assistance for the mobility impaired and bus operations, that a bus can stop close to the kerb at bus stops. This can be hindered by passengers waiting to board at the edge of the footway. To reduce the number of passengers who behave in this matter, yellow lines were installed parallel to the kerb at stops along Route 149.
- 1.1.2 MVA was commissioned to observe passenger behaviour at three selected bus stops along the route and collect observations during peak times of activity. Our methodology, key findings and recommendations are presented here.

1.2 Background

- 1.2.1 Route 149 operates between Edmonton and London Bridge, with major stops in Tottenham, Stamford Hill, Dalston, and Shoreditch. It is scheduled to run at headways of 6 minutes during the week, 8 minutes during the evenings, and 8 minutes on Sundays. The service is delivered by 'bendy' or articulated buses, with capacity for approximately 95 passengers. It should be noted that a 'bendy' bus allows for boarding and alighting at each door, thus alleviating the rush to board at the front door on conventional buses.
- 1.2.2 Route 149 is part of the bus priority programme and, therefore, subject to the design and implementation of intensive bus priority measures, including the installation of the yellow lines.

2 Methodology

2.1 Site Inspection

2.1.1 The first task was to select three sites for data collection. The following characteristics were considered at each site:

- General arrangement of the bus stop and street furniture;
- Footway widths and obstructions;
- Current passenger volumes (general observation);
- Review of the general behaviour of people in and around the bus stops; and
- Review any passenger information about yellow lines.

2.1.2 In selecting stops for data collection, it was important to consider: diversity in stop configuration, surrounding environment and observed passenger volumes. It can generally be observed that it is easier to assess a person's awareness and behaviour by examining pedestrians on a constrained footway space. In a less constrained environment, people are more likely to stand arbitrarily, whereas, when confronted with a narrow footway, especially one with high levels of activity, (eg in front of stores or near station accesses), people are more likely to make a conscious decision as to where they stand.

2.1.3 Based on field observation and information, the following stops (summarised in Table 2.1) were recommended for survey collection:

- Tottenham Swan – Northbound (Figure 2.1);
- Bruce Grove Station/High Road – Northbound (Figure 2.2); and
- Dalston Junction – Southbound (Figure 2.3).

Table 2.1 Selected stop characteristics

	General configuration	Footway widths	Footway configuration & constraints
Tottenham Swan	Front facing shelter	Wide	Footway behind shelter, adjacent to greenspace
Bruce Grove/High Road	Front-facing shelter	Narrow	Footway between shelter and roadway, proximity to rail station and store entrances
Dalston Junction	Back-facing shelter	Narrow	Footway between shelter and store entrances



Figure 2.1 – Tottenham Swan (NB)



Figure 2.2 – Bruce Grove Station (NB)



Figure 2.3 – Dalston Junction (SB)

2.2 Survey Periods and Data Collection

- 2.2.1 Passengers behave differently depending on the footway environment, time of day, and when waiting, queuing, and boarding a bus. Surveys were conducted when passenger volumes were the greatest, during commuting periods and school travel periods.
- 2.2.2 Manual counts were conducted on the 15 January 2009 (Thursday) and the 17 January 2009 (Saturday). Weather on both days was partly cloudy and dry.
- 2.2.3 Data was collected between:
- 07:30 and 09:30 on a weekday (AM peak);
 - 17:00 and 19:00 on a weekday (PM peak); and
 - 11:00 and 13:00 on a Saturday.
- 2.2.4 To ensure consistency in data collection, feature points were identified during the site inspection to estimate the point when the driver evaluates the bus's spatial requirements in pulling up to the kerb, such that if passengers are waiting at the edge of the footway, the bus cannot stop close to the kerb.
- 2.2.5 Information was collected for all buses that serve the stops to increase the number of data points. The other buses serving the corridor include routes 67, 76, 241, 243, 259, 279, 348, 349, and 476. The unique boarding/alighting characteristic of a 'bendy' bus which operates the 149 route was also considered.
- 2.2.6 For each bus, the following information was collected:
- Time of arrival;
 - Numbers of people standing behind the yellow line and the numbers of those standing between the yellow line and kerb when the bus crosses the feature point;
 - Numbers of passengers boarding each bus including those who boarded the bus without waiting; and
 - Time, duration and type of any unusual event that affects passenger or bus driver behaviour (eg road sweeping, illegal loading, breakdowns, etc.) It is likely that these periods will be omitted from the analysis.

3 Survey analysis and key findings

3.1 Overview

- 3.1.1 The focus of our analysis not only investigated overall passenger behaviour volumes, but also the number of arrivals that were impeded by passengers waiting in front of the yellow line. As the bus's ability to pull up to the kerb properly can be hindered by even one person standing too close the carriage way, these instances were investigated in greater detail.
- 3.1.2 Our analysis also assessed factors that may influence a passenger's behaviour at the stop, such as:
- Impact of waiting passenger volumes;
 - Impact of multiple buses dwelling at the stop; and
 - Impact of bus headway.
- 3.1.3 The data sheets are included in Appendix A.

3.2 Overall Stop Behaviour

- 3.2.1 On nearly 91% of passengers waited behind the yellow line, with less than ten percent waiting in front of the yellow line. The highest proportion of **People In Front of Yellow Line** (PIFOYL) occurred at Dalston Junction, where approximately 1 out of every 5 passengers wait for the bus in front of the yellow line. Both Tottenham Swan and Bruce Grove average about 6% of passengers waiting in front of the yellow line. The average information for each stop by period is summarised in Table 3.1.

Table 3.1 Percentage of PIFOYL compared to all passengers waiting on footway

	AM	PM	SAT
Tottenham Swan	5.8%	6.3%	7.4%
Bruce Grove	6.4%	6.6%	4.6%
Dalston Junction	8.6%	21.2%	35.8%

- 3.2.2 This high propensity at Dalston Junction may be because of the back-facing shelter configuration and the high levels of activity surrounding the station. The waiting area outside the shelter is utilised by a pedestrians using the high street shops. This may explain why the proportion is significantly higher in the afternoon and on Saturday when more through pedestrians may be using the footway and passengers elect to wait between the yellow line and the carriageway.
- 3.2.3 Bruce Grove station has similar high street/retail environment, however because of the front-facing configuration, more people tend to wait in the shelter rather than along the shared footway (approximately 30-40% of passengers wait in the shelter at Bruce Grove, versus 20-30% waiting in the shelter at Dalston Junction). This may be because people tend to prefer front-facing shelters as they can see if their desired bus is approaching.

3 Survey analysis and key findings

3.2.4 When focusing in on only those waiting behind and in front of the yellow line not including those in the shelter, the average percentage of those waiting in front of the yellow line increases to 15.7%, with notable increases occurring at Tottenham Swan which previously had the highest rate (average 60% of passengers waiting in the shelter).

Table 3.2 Percentage of PIFOYL compared to number of waiting passengers, not in shelter

	AM	PM	SAT
Tottenham Swan	14.6%	16.3%	18.1%
Bruce Grove	9.0%	11.8%	4.6%
Dalston Junction	9.8%	26.8%	40.2%

3.2.5 The daily distribution of waiting passenger location on the footway is presented in Figures 3.1-3.3.

Tottenham Swan

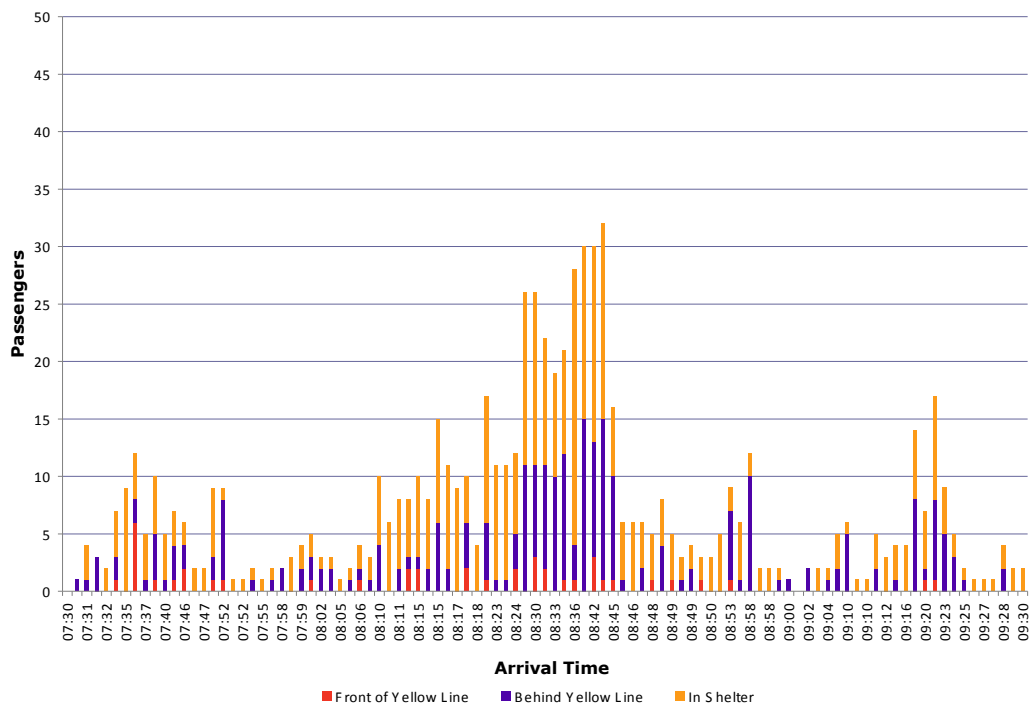


Figure 3.1: Tottenham Swan - AM

3 Survey analysis and key findings

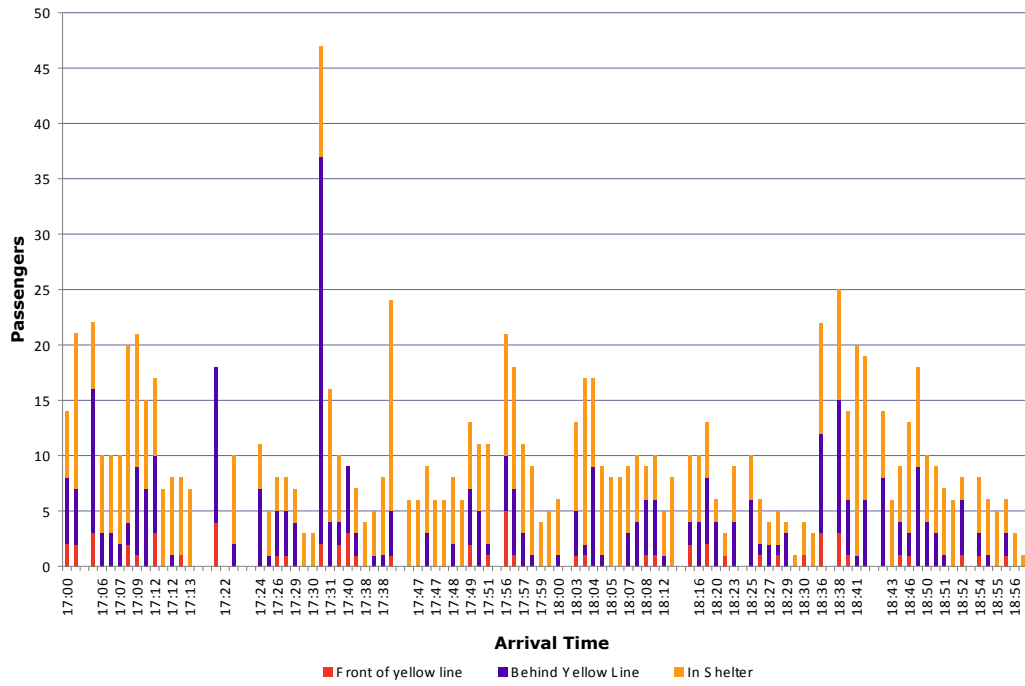


Figure 3.2 Tottenham Swan – PM

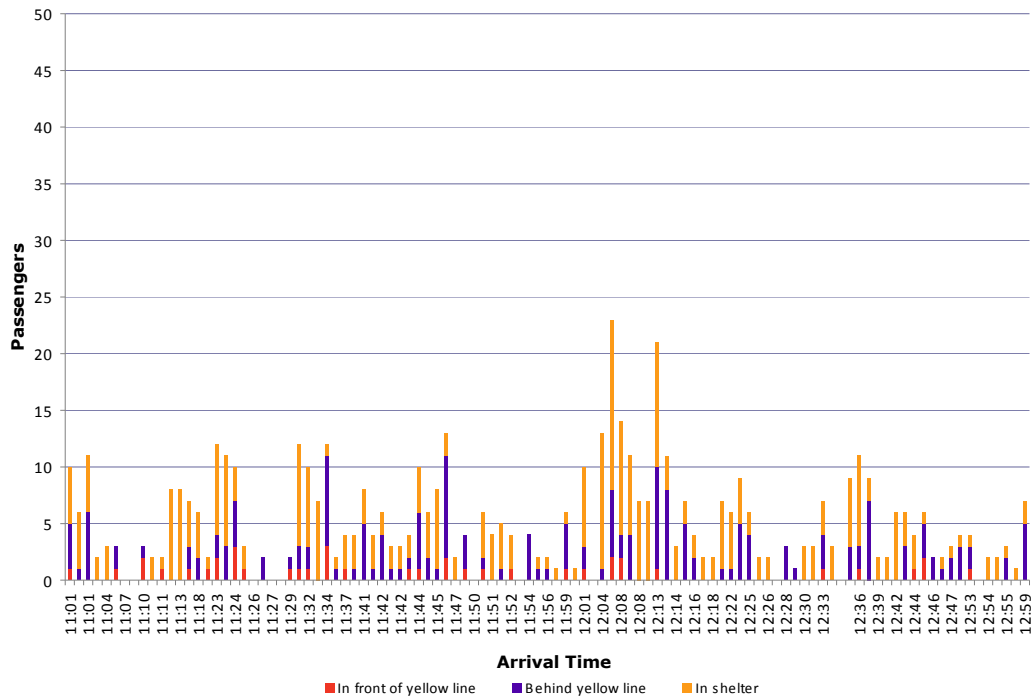


Figure 3.3 Tottenham Swan – Saturday

Bruce Grove Station

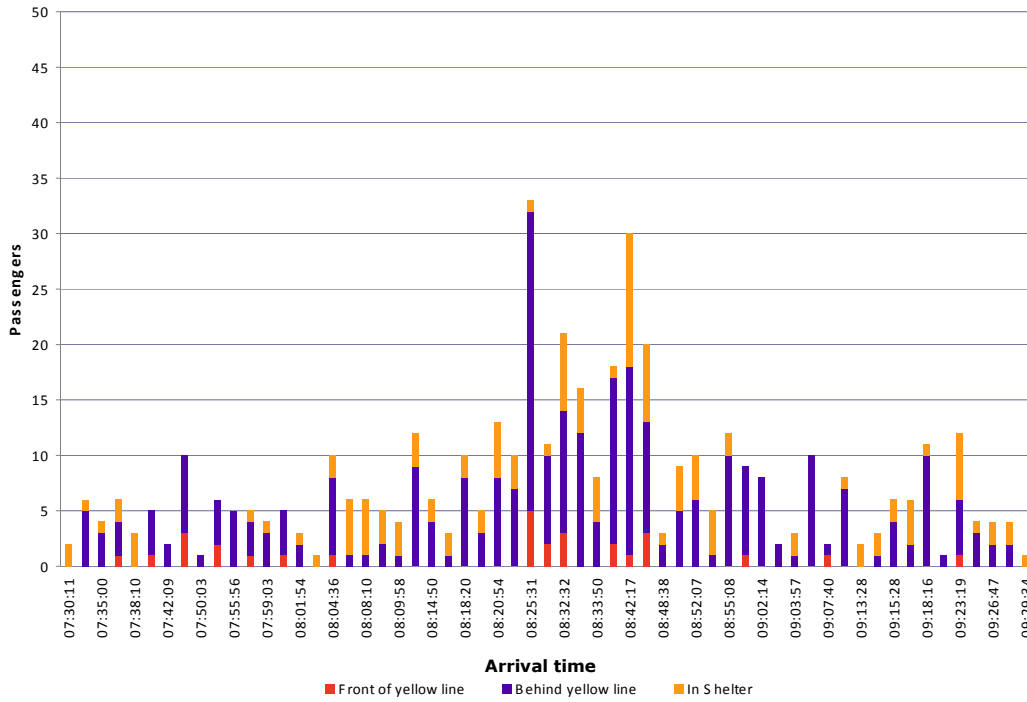


Figure 3.4 Bruce Grove Station - AM

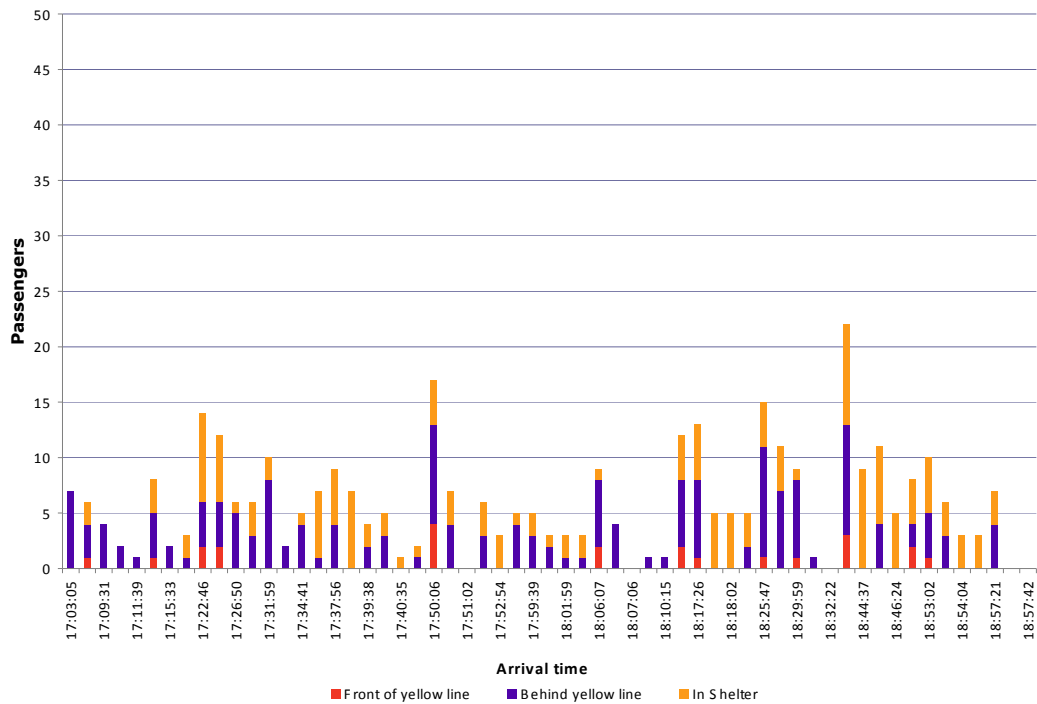


Figure 3.5 Bruce Grove Station - PM

3 Survey analysis and key findings

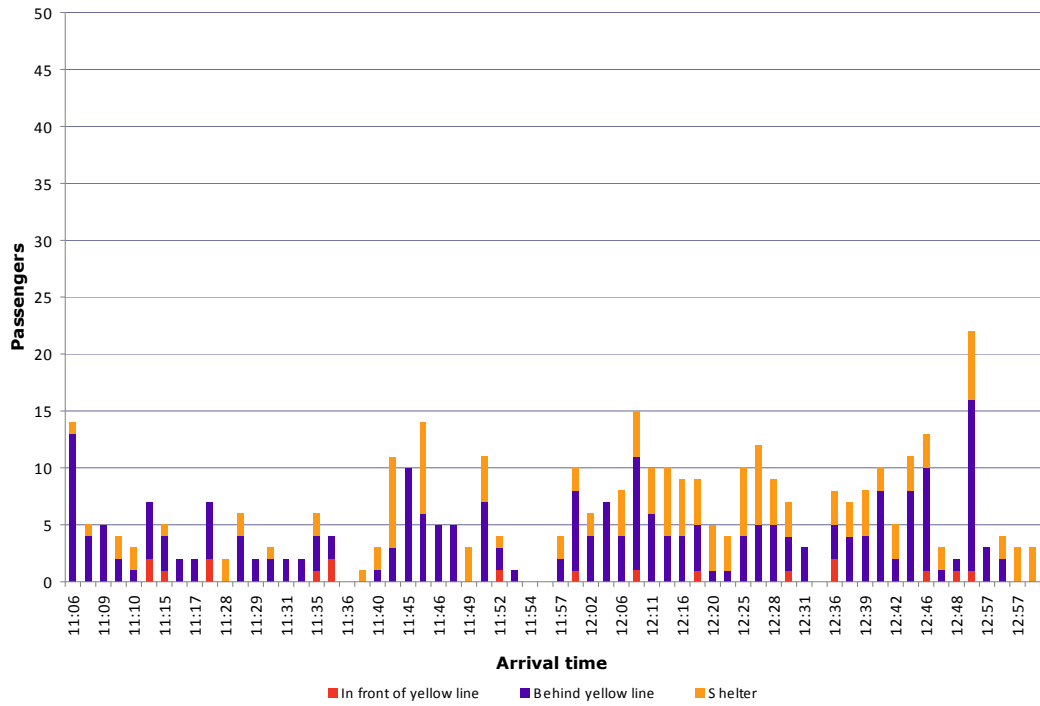


Figure 3.6 Bruce Grove Station – Saturday

Dalston Junction

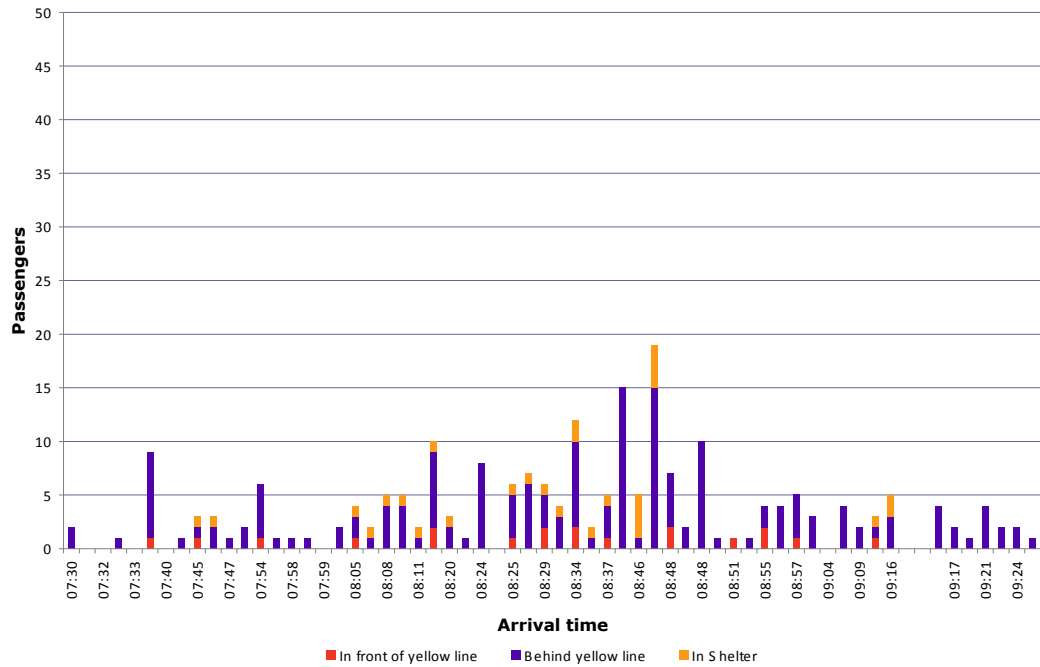


Figure 3.7 Dalston Junction – AM

3 Survey analysis and key findings

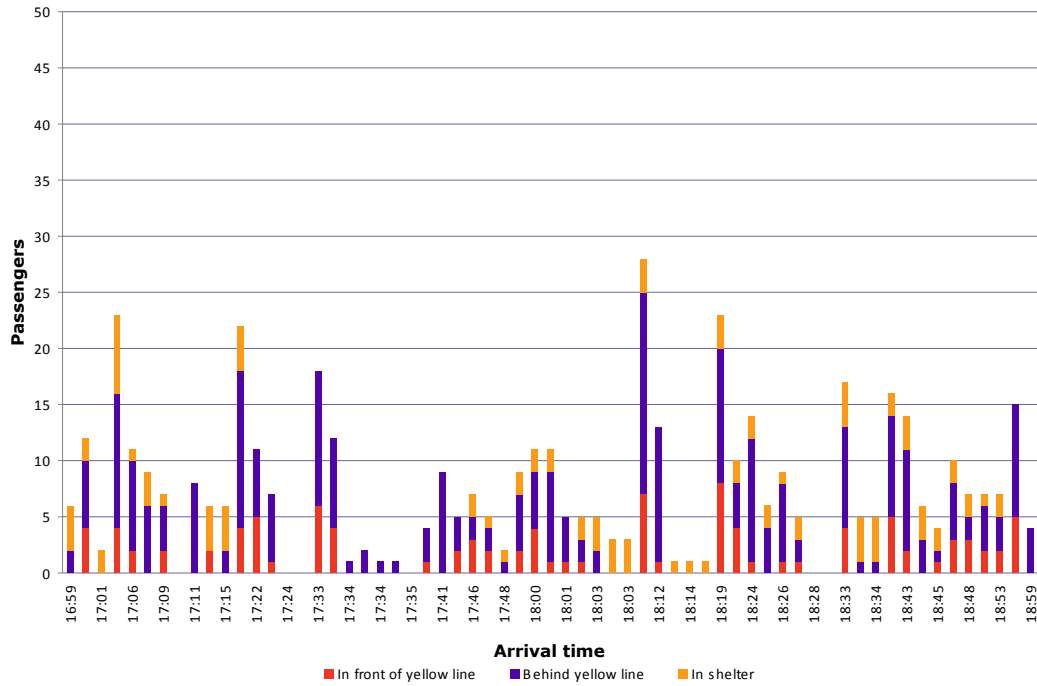


Figure 3.8 Dalston Junction – PM

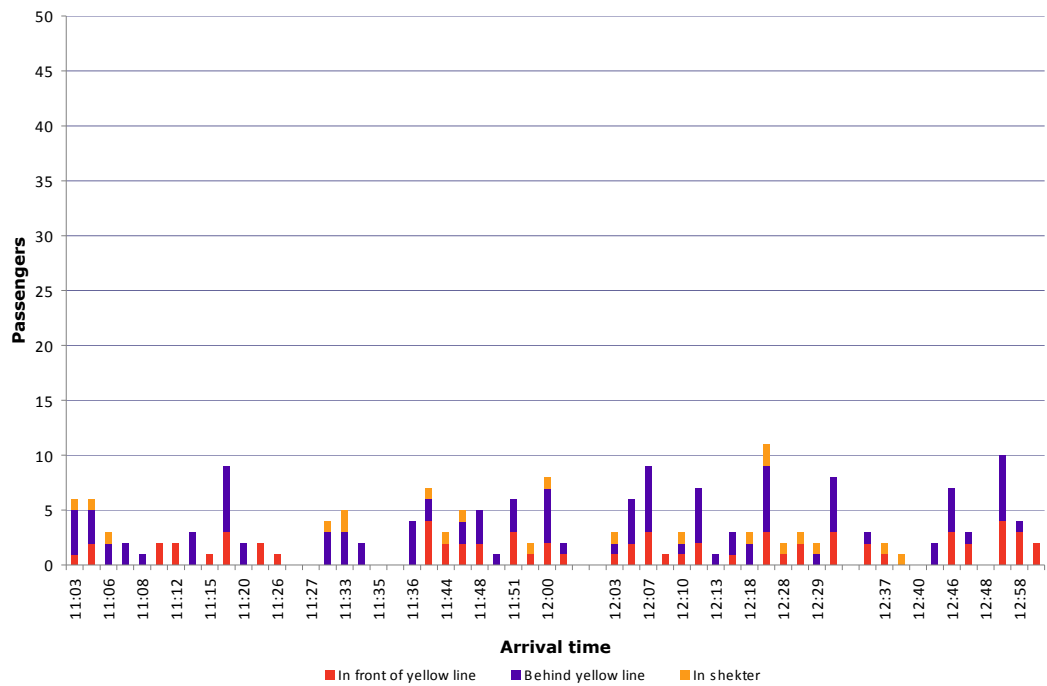


Figure 3.9 Dalston Junction – Saturday

3.2.6 Although the numbers of passengers in front of the line are relatively small, the proportion of bus arrivals where one or more passengers is in front of the line is 31%. The highest

3 Survey analysis and key findings

proportion of arrivals where one or more person is waiting in front of the yellow line is one or more is at Dalston Junction.

3.2.7 The number and percentage of arrivals where this is the case is presented in Table 3.3.

Table 3.3 Number & Proportion of arrivals where one or more passengers are waiting in front of the yellow line

	AM		PM		SAT		Overall	
	# of arrivals	% of arrivals	# of arrivals	% of arrivals	# of arrivals	% of arrivals	# of arrivals	% of arrivals
Tottenham Swan	27	27.3%	37	38.1%	30	30.0%	94	31.8%
Bruce Grove	16	27.1%	13	22.0%	14	21.9%	43	23.6%
Dalston Junction	14	23.0%	35	56.5%	34	60.7%	83	46.4%

3.2.8 When examining Route 149 in particular, the number of arrivals when more than one person is waiting in front of the yellow line is in line or below the averages calculated, notably at Dalston Junction where on the average is 10% less than when calculating for all buses overall average (Table 3.4). This is most likely due to the boarding configuration of Route 149, which allows for boarding at multiple doors and, therefore, passengers do not queue aggressively or wait at the traditional front door position.

Table 3.4 Route 149 Proportion of arrivals where one or more passengers are waiting in front of the yellow line

	AM	PM	SAT	Total
Tottenham Swan	29.4%	23.5%	40.0%	31.5%
Bruce Grove	30.8%	27.8%	26.3%	28.0%
Dalston Junction	4.8%	57.9%	55.6%	37.9%

3.3 Waiting Passenger Volumes

3.3.1 When the volume of waiting passengers increases, it was observed that, due to footway capacity constraints, passengers may move to the area in front of the yellow line. The average number of passengers waiting when, one or more persons disobeys the yellow line relative to the average number of passengers when no one disobeys the yellow line, is summarised in Table 3.5.

Table 3.5 Average number of passengers waiting when no passengers are waiting in front of the yellow line (PIFOYL = 0) and when one or more passengers are waiting in front of the yellow line (PIFOYL ≥ 1)

	AM		PM		SAT	
	PIFOYL= 0	PIFOYL ≥ 1	PIFOYL= 0	PIFOYL ≥ 1	PIFOYL= 0	PIFOYL ≥ 1
Tottenham Swan	5.15	12.85	7.95	13.84	4.33	7.97
Bruce Grove	5.74	12.69	4.24	11.92	5.40	8.50
Dalston Junction	3.00	5.79	3.22	11.14	1.64	4.53

3.3.2 It is clear from these results that: passengers are more likely to stand in front of the yellow line when the number of passengers on the footway is great. A similar trend occurs on Route 149 when its results are isolated from other route data.

Table 3.6 Route 149 Average number of passengers waiting when no passengers are waiting in front of the yellow line (PIFOYL = 0) and when one or more passengers are waiting in front of the yellow line (PIFOYL ≥ 1)

	AM		PM		SAT	
	PIFOYL= 0	PIFOYL ≥ 1	PIFOYL= 0	PIFOYL ≥ 1	PIFOYL= 0	PIFOYL ≥ 1
Tottenham Swan	4.8	13.0	8.3	11.5	4.6	8.3
Bruce Grove	8.1	5.5	4.3	13.2	7.2	10.0
Dalston Junction	3.3	9.0	3.8	12.4	1.8	4.5

3.3.3 Another clear trend is that, generally, groups of two people wait in front of the yellow line. This may be because once a fellow passenger decides to step in front of the yellow line, another passenger follows suit to also examine conditions or if a desired bus is coming. The average number of PIFOYL when at least one passenger is in front of the yellow line is summarised in Table 3.7.

Table 3.7 Average number of passengers in front of the yellow line, when at least one person is waiting in front of the yellow line

	AM	PM	SAT
Tottenham Swan	1.56	1.68	1.33
Bruce Grove	1.81	1.77	1.29
Dalston Junction	1.36	2.89	2.00

3.4 Multiple buses dwelling

3.4.1 The presence of another bus at the stop may affect the location of waiting passengers, as those on the footway may move in front of the yellow line, because their view is obstructed by the current dwelling bus or passengers or they may perceive that there is a lower risk in approaching the carriageway.

3.4.2 The number of arrivals and percentage of arrivals where multiple buses are dwelling is presented in Table 3.8.

Table 3.8 Number and Percentage of arrivals when multiple buses were dwelling

	AM		PM		SAT	
	# of arrivals	% of arrivals	# of arrivals	% of arrivals	# of arrivals	% of arrivals
Tottenham Swan	19	19.2%	30	30.9%	27	27.0%
Bruce Grove	10	16.9%	15	25.4%	14	21.9%
Dalston Junction	13	21.3%	21	33.9%	9	16.1%

3.4.3 Of those occurrences where multiple buses arrive, the number of arrivals where a passenger is between the yellow line and the roadway, is generally small. If multiple buses arrive and the yellow line was disobeyed, the average number of people in front of the line is presented in Table 3.9 below.

Table 3.9 Percentage of arrivals when multiple buses are dwelling and average number of passengers in front of the yellow line

	AM		PM		SAT	
	% of arrivals	# disobeying	% of arrivals	# disobeying	% of arrivals	# disobeying
Tottenham Swan	15.8% (3)	2	16.7% (5)	1.00	7.4% (2)	1.5
Bruce Grove	0.00%	0	0.00%	0.00	7.1% (1)	1
Dalston Junction	0.00%	0	28.6% (6)	2.17	44.4% (4)	1.5

3.4.4 In 13% of cases when multiple buses were dwelling at the stop, passengers did stand in front of the yellow line. This rate is slightly higher than the average for all cases. However the sample size for multiple buses dwelling is not significant.

3.5 Headway between buses

3.5.1 The headway, or time between arrivals along the same route was calculated.

3.5.2 The average headway was calculated for those arrivals when a passenger was in front of the yellow line (Table 3.10). The average headway when passengers situated themselves between the line and roadway is approximately 9 minutes.

Table 3.10 Average headway when one or passengers waited in front of the yellow line

	AM	PM	SAT	TOTAL
Tottenham Swan	00:10:41	00:08:33	00:07:41	00:08:58
Bruce Grove	00:09:37	00:11:04	00:07:29	00:09:20
Dalston Junction	00:07:26	00:08:32	00:08:51	00:08:15
All stop average	00:09:15	00:09:23	00:08:00	00:08:51

3 Survey analysis and key findings

3.5.3 The proportion of those PIFOYL were then reviewed for occurrences with headways less and more than 9 minutes. This information is summarised in Table 3.11 below, including the average number of PIFOYL.

Table 3.11 Proportion of arrivals disobeying with headway greater than or less than 9 minutes

Frequency	Tottenham Swan		Bruce Grove		Dalston Junction	
	<9 minutes	>9 minutes	<9 minutes	>9 minutes	<9 minutes	>9 minutes
AM # arrivals	11	46	37	22	44	18
% of arrivals disobeying	21.0%	46.5%	21.6%	36.4%	25.0%	16.7%
avg # disobeying	1.88	2.00	1.73	1.73	1.36	1.36
PM # arrivals	45	14	37	22	38	24
% of arrivals disobeying	26.4%	46.4%	16.2%	31.8%	52.7%	63.0%
avg # disobeying	1.75	1.75	1.60	1.60	2.72	2.75
SAT # arrivals	42	10	43	21	31	25
% of arrivals disobeying	16.7%	42.0%	18.6%	28.6%	51.6%	72.0%
avg # disobeying	1.15	1.17	1.36	1.36	2.00	1.71

3.5.4 As anticipated, the proportion of arrivals with passengers in front of the yellow line increases when headway is greater than 9 minutes.

4 Conclusions and Recommendations

4.1 Conclusions

- 4.1.1 Less than 10% of passengers waiting at stops stand in front of the yellow line (stop by stop information summarised in Table 3.1). This percentage increases when examining those passengers not in the shelter area, increasing the average to nearly 16% (stop by stop information summarised in Table 3.2).
- 4.1.2 The stop that experiences the greatest number of passengers disobeying the yellow line is at Dalston Junction, which is a highly constrained site and during the afternoon and weekends high pedestrian volumes lead to an increased number of passengers waiting in front of the yellow line.
- 4.1.3 Although the high street is similar at Bruce Grove Station, the configuration of a forward facing shelter with the footway between the shelter and the stop, results in passengers standing adjacent to the shelter away from the carriageway to allow footway pedestrians through.
- 4.1.4 The footway width available at Tottenham Swan is more variable, with a high propensity for passengers to use the shelter. However, as there is no footway capacity constraint, depending on time of day, passengers stand more randomly to wait for the bus.
- 4.1.5 Overall, in conditions where: the total passengers waiting time increases, multiple buses are dwelling and/or headways are extensive, passengers tend to be more aggressive and approach the edge of the carriageway. The boarding and alighting characteristic of Route 149 buses causes a slight reduction in this behaviour.
- 4.1.6 Although each stop varies in configuration and surrounding activity, nearly 30% of arrivals across all stops were impeded by passengers waiting too close to the carriageway (stop by stop information summarised in Table 3.3).

4.2 Recommendations

- 4.2.1 To promote the understanding of the yellow line and discourage the action of standing near to the kerb, information explaining the purpose and benefits of remaining behind the yellow line should be provided at bus stop locations. The current survey results should be supplemented with surveys of those stops where information is available and similar stops where yellow lines are not used.
- 4.2.2 Additionally, if the yellow line programme is to be implemented on a greater scale, more 'before' data should be gathered in order to provide a basis for comparison when trying to detect shifts in passenger behaviour. If no 'before' data is available, then comparable site locations with similar surrounding land uses and configurations should be collected.

It would be useful to conduct on board bus interviews to assess if passengers were aware or even realised the yellow line prior to boarding and if they feel that their behaviour would change in the future.