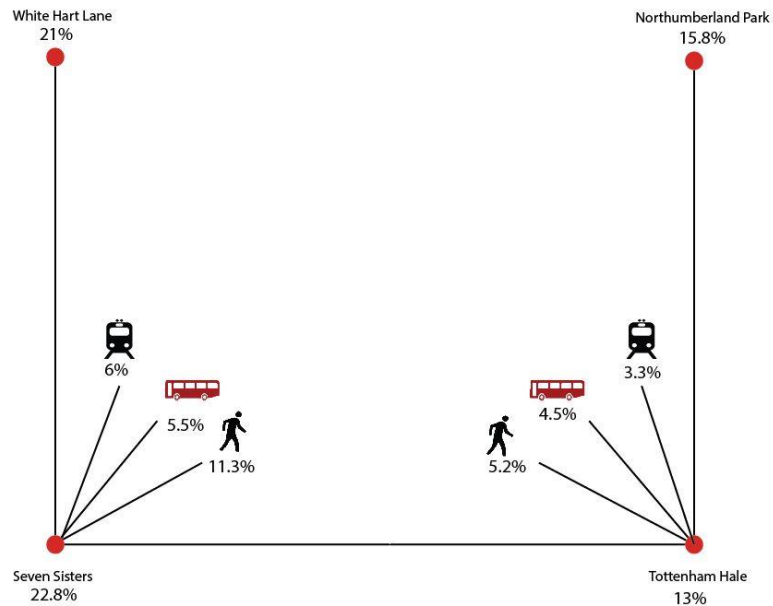


THFC New Stadium Rail Capacity Analysis

Contents

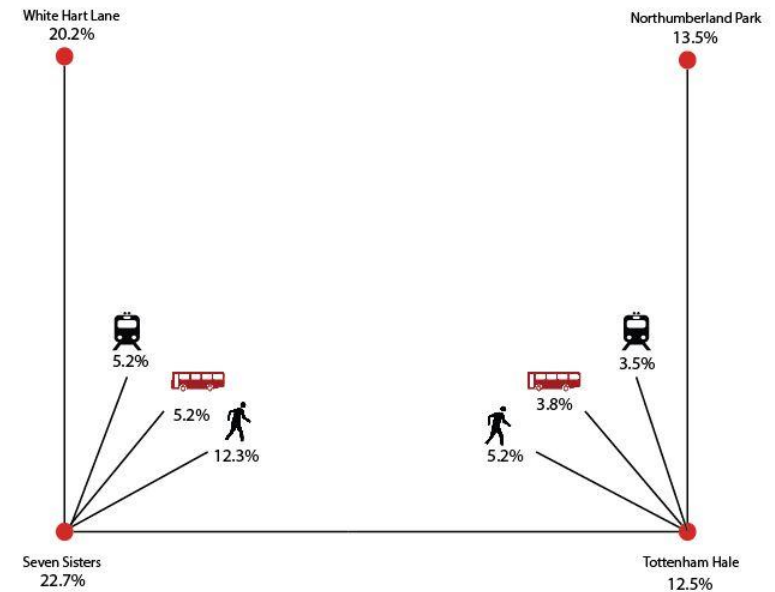
⚡ Midweek Scenario

- Pre-match Northumberland Park
- Post-Match Northumberland Park
- Pre-match White Hart Lane
- Post-match White Hart Lane



⚡ Weekend Scenario

- Pre-match Northumberland Park
- Post-Match Northumberland Park
- Pre-match White Hart Lane
- Post-match White Hart Lane



Assessment of Rail Capacity

- ✧ This document contains the outcome of an assessment of National Rail service and station capacity at Northumberland Park and White Hart Lane in the light of anticipated demand associated with an expanded Tottenham Hotspur Stadium.
- ✧ Two Match day scenarios are considered:
 - ✧ Midweek: 20:00 kick off, 21:50 final whistle
 - ✧ Weekend: 15:00 kick off, 16:50 final whistle
- ✧ Spectator demand forecasts have been generated by Tim Spencer & Co, using information from existing spectator surveys and analysis of THFC's database of Season Ticket Holders and those on the Waiting List.
- ✧ Assumptions used to generate the forecasts of Spectator demand at Transport Nodes are listed in a Data Book
- ✧ Spreadsheet models of demand and capacity have been constructed to assess the performance of different parts of the network and infrastructure
- ✧ The following pages summarise the performance throughout the pre- and post-match period for both the Midweek and Weekend scenarios
- ✧ Background loading on services and at the stations is included in the assessment. 8% growth has been applied to observed background figures on the White Hart Lane route and 22% growth applied to the Northumberland Park route to represent conditions in 2021.
- ✧ Station capacities are calculated according to SPSG's Special Events guidance, recognising that the Network Rail guidance rates are consistent for all infrastructure types other than escalators.

Assessment of Rail Capacity

⌘ For assessment of capacity on the Northumberland Park route, the following assumptions are applied:

- ⌘ Current Matchday Timetable, plus uplift to 4tph on the Stratford-Stansted services
- ⌘ All trains operated as 8-car
- ⌘ Existing Station Layout
- ⌘ Assumed Standardised Capacity of 734, 718, 636ppl/train dependent on rolling stock*
- ⌘ Background Demand patterns from 2013 Abellio
 - ⌘ 22% growth applied to reflect 2021
- ⌘ Weekend background demand derived using relative volumes recorded at different times in previous surveys (2008) applied to 2013 midweek data
- ⌘ Platform Capacity Limited to 700 at Northumberland Park
 - ⌘ Queues held outside the station when this number reached on either Platform

⌘ For assessment of capacity on the White Hart Lane route, the following assumptions are applied:

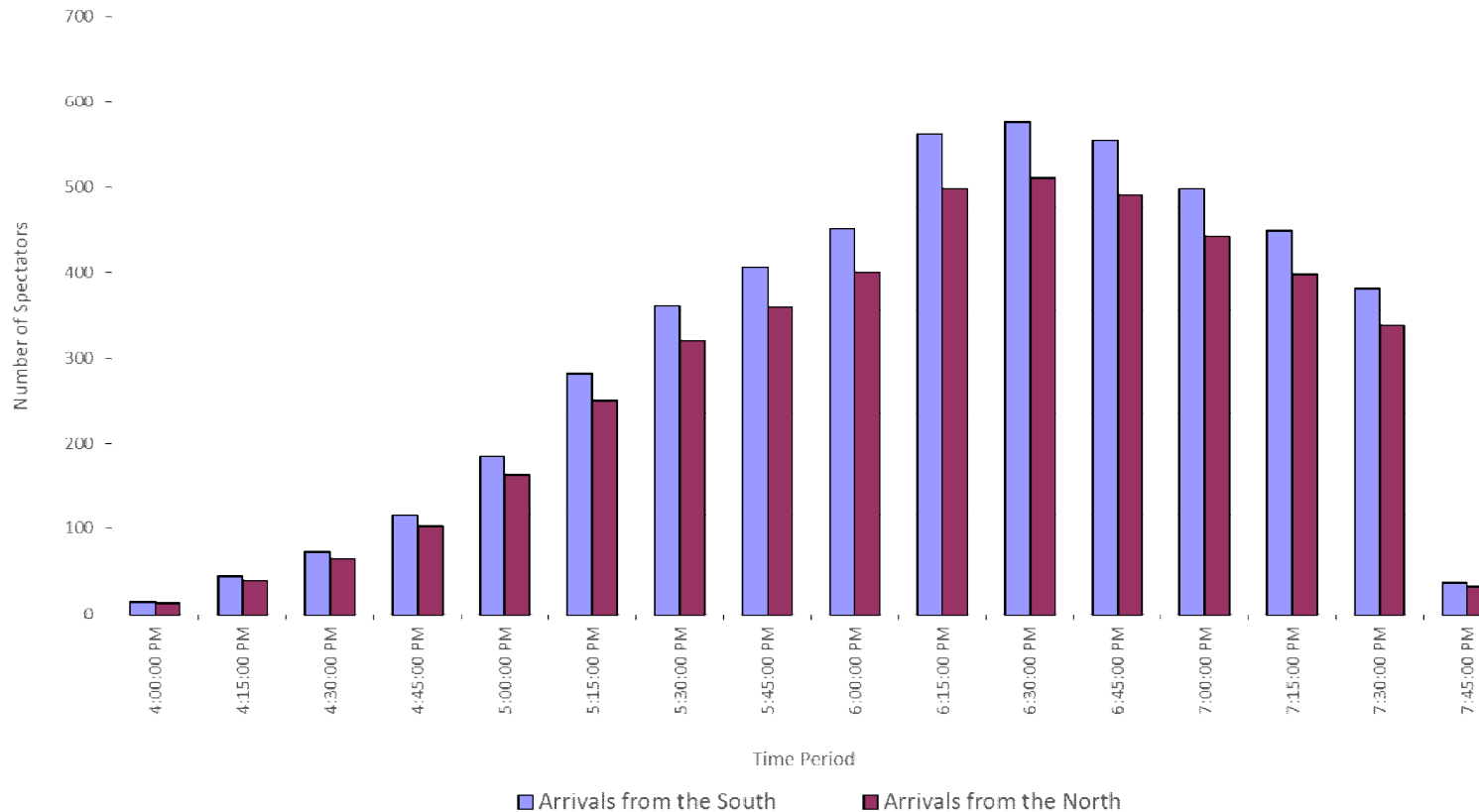
- ⌘ Current Matchday Timetable
- ⌘ All trains operated as 8-car
- ⌘ Existing Station Layouts
- ⌘ Assumed Standardised Capacity of 859ppl/train*
 - ⌘ A sensitivity test has been reported where the busiest 8 trains in the midweek pre-match are able to accommodate 1,020ppl/train
- ⌘ Background Demand patterns from 2013 Abellio
 - ⌘ 8% growth applied for WHL (Railplan 7)
- ⌘ Weekend background demand derived using relative volumes recorded at different times in previous surveys (2008) applied to 2013 midweek data
- ⌘ Platform Capacity Limited to 859 at White Hart Lane
 - ⌘ Queues held outside the station when this number reached



Midweek Matchday Scenario

Pre-Match: Northumberland Park Station

Spectator Arrivals at Northumberland Park during the Pre-Match Period



∆ 9,419 spectators in total (~15% of Spectators)

- 4,427 arriving from the north
- 4,492 arriving from the south (1,961 of these interchange from the Victoria Line at Tottenham Hale)

Pre-Match: Northumberland Park Station

Northbound services

- The section of the route is capacity constrained between 18:00 and 18:30, assuming that the service capacity is limited to 85%.
- If this were the case, there would be some people unable to board the first train at Tottenham Hale and would accumulate on the Platform. All people should be able to board the subsequent service. Platform accumulation at Tottenham Hale at these times are:

• At 18:15 • **186 people**

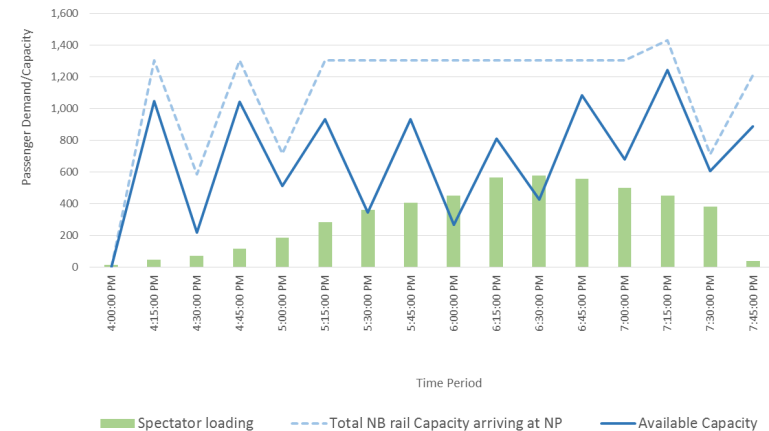
• At 18:30 • **149 people**

- Platform loadings would not exceed desired capacity thresholds

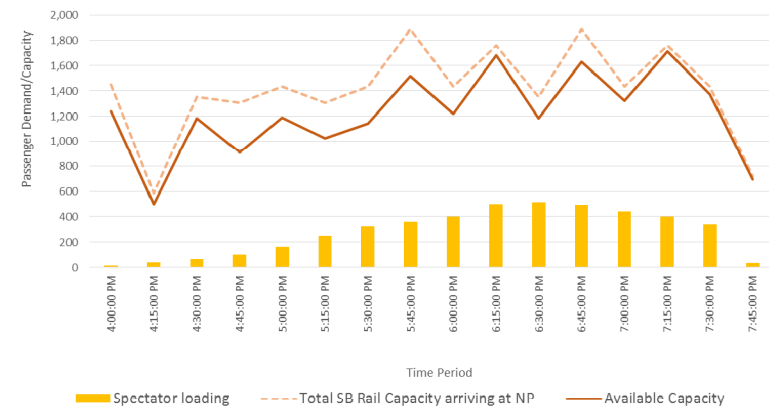
Southbound services

- There are **no** constraints on this route during the pre-match period, assuming 8 car operation is maintained

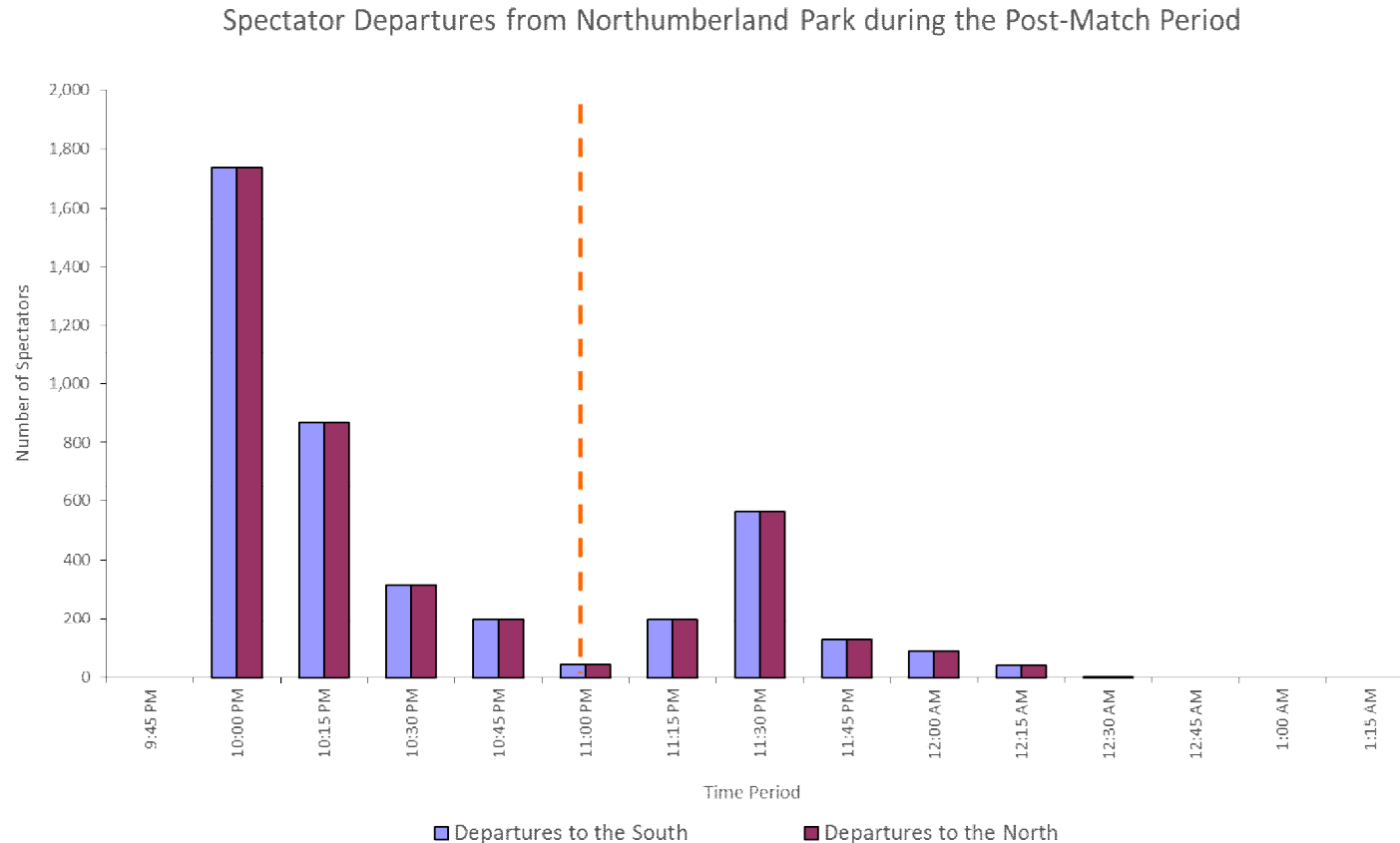
Spectator Demand and Available Rail Capacity NB Tottenham Hale - Northumberland Park Station



Spectator Demand and Available Rail Capacity SB into Northumberland Park Station



Post-Match: Northumberland Park Station



Å 8,374 spectators in total (~14% of Spectators)

- 4,187 heading to the north
- 4,187 heading to the south (1,795 of these interchange onto the Victoria Line at Tottenham Hale)

Post-Match: Northumberland Park Station

⚠ Northbound Platform

- Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 700 people, as this broadly matches the capacity per train.

⚠ Maximum queue length: **463 people**

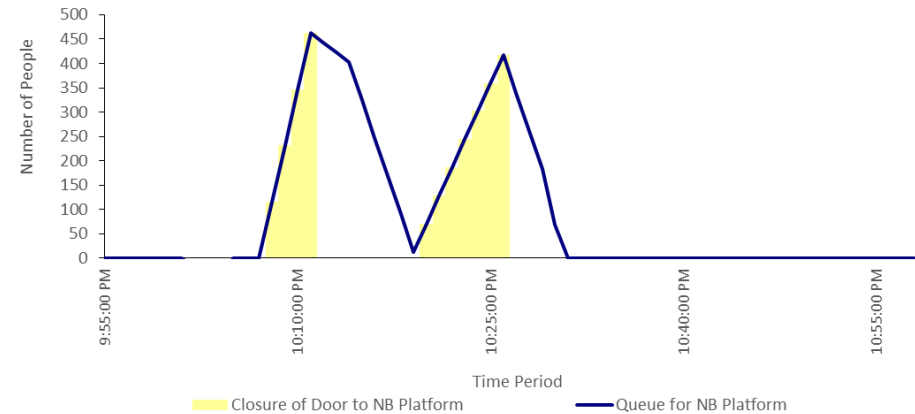
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

⚠ The duration of queuing outside the station would be **23 mins**

⚠ The maximum wait time for any individual would be **19 mins** from arrival to boarding a train

- 37% of spectators would wait for 10 mins or less
- 39% of spectators would be delayed for 11 ÷ 15 mins
- 24% of spectators would be delayed for 16 ÷ 20 mins

Extent of Queuing outside Northumberland Park Station during the Post-Match for NB Services if Platform Capacity Capped at 700 persons



Post-Match: Northumberland Park Station

⚠ Southbound Platform

- Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 700 people, as this broadly matches the capacity per train.

⚠ Maximum queue length: **576 people**

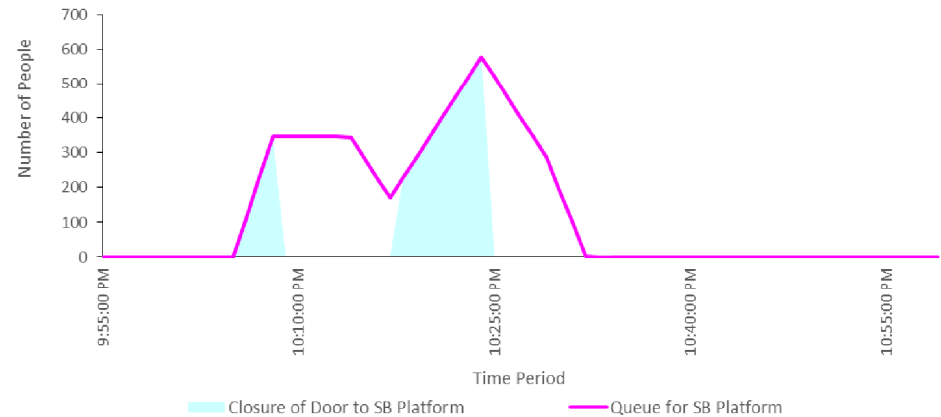
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

⚠ The duration of queuing outside the station would be **27 mins**

⚠ The maximum wait time for any individual would be **16 mins** from arrival to boarding a train

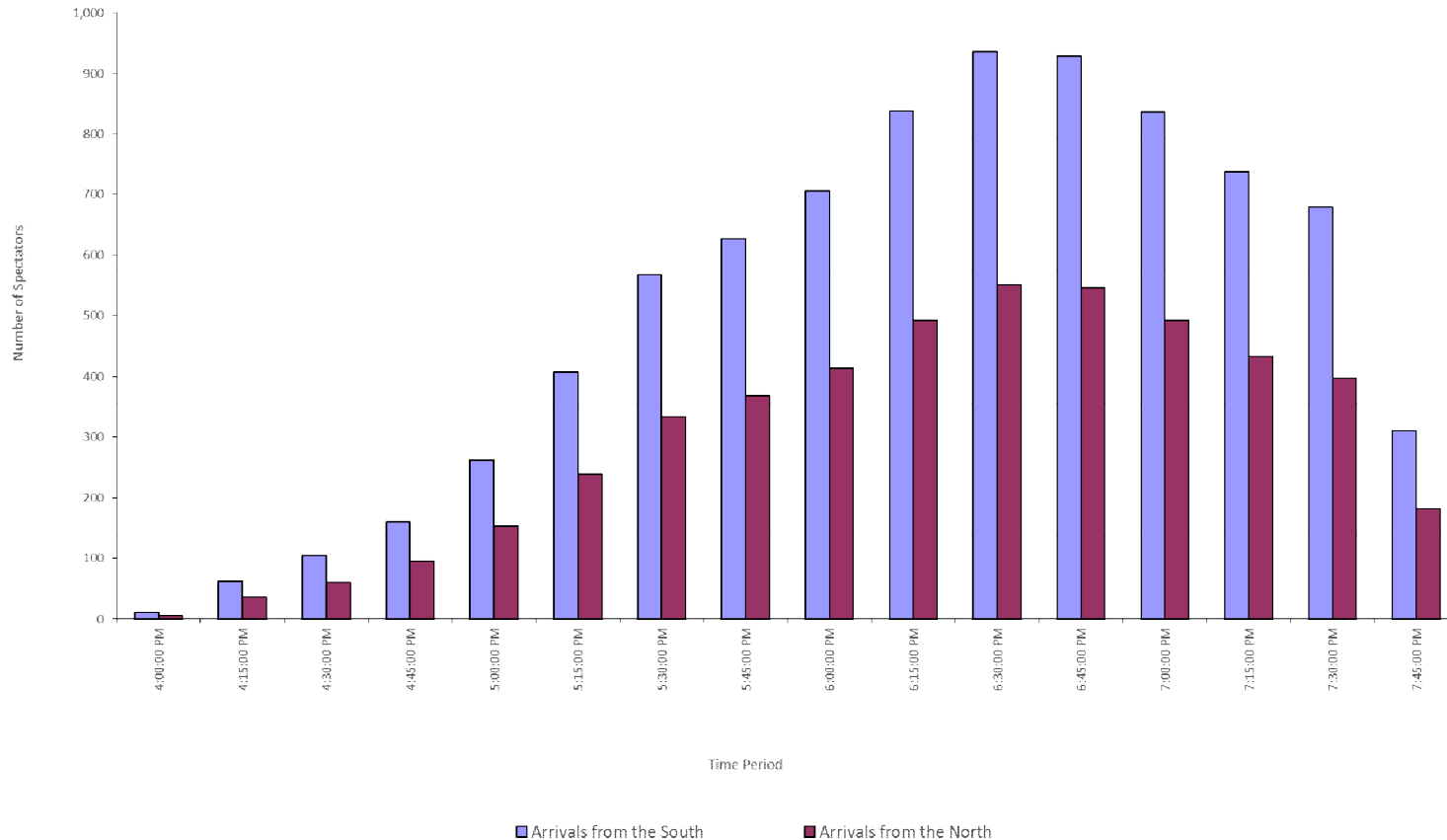
- 58% of spectators would wait for 10 mins or less
- 35% of spectators would be delayed for 11 ÷ 15 mins
- 7% of spectators would be delayed for 16 ÷ 20 mins

Extent of Queuing outside Northumberland Park Station during the Post-Match for SB Services if Platform Capacity Capped at 700 persons



Pre-Match: White Hart Lane Station

Spectator Arrivals at White Hart Lane during the Pre-Match Period

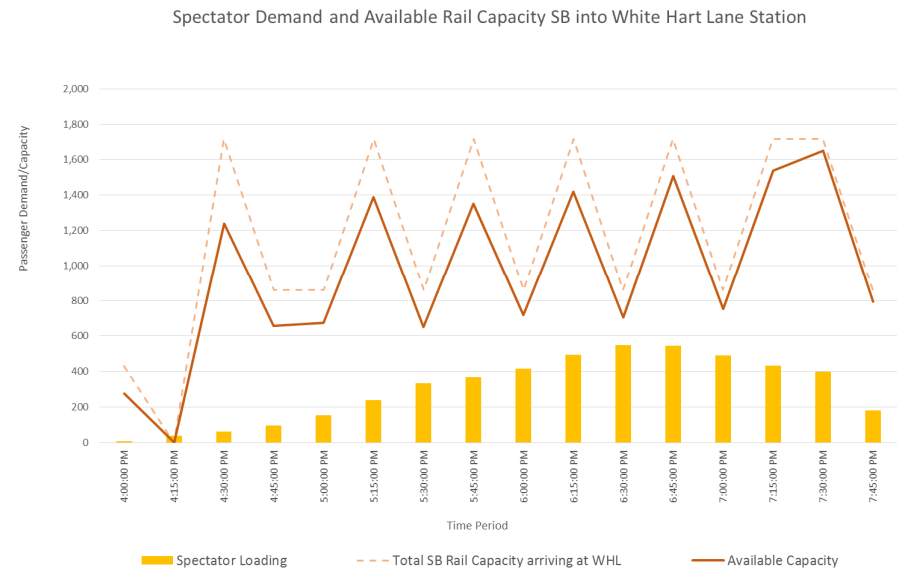


Å 12,975 spectators in total (~21% of Spectators)

- 4,801 arriving from the north
- 8,174 arriving from the south (3,702 of these interchange from the Victoria Line at Seven Sisters)

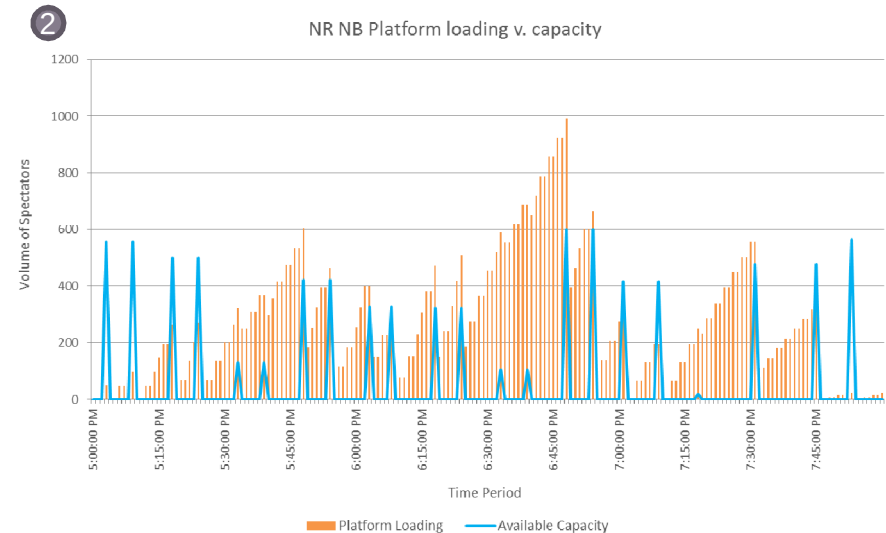
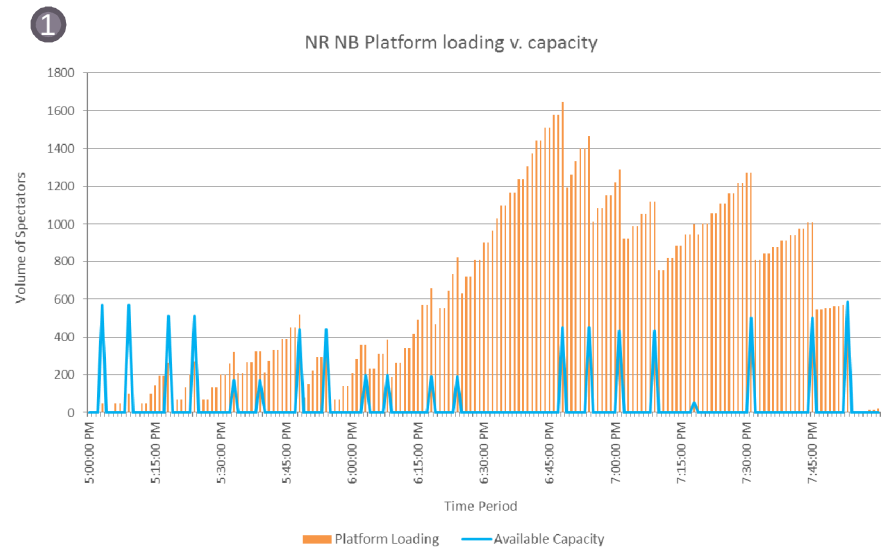
Pre-Match: SB Services to White Hart Lane

- Assuming the use of 8-car Class 378 rolling stock, no capacity constraints are anticipated on southbound services into White Hart Lane.
- The train headway of southbound services is 15 minutes during the pre-match.
- In terms of platform clearance at White Hart Lane station, the principal capacity constraint in the station is the stairs from the platform, at **3m** wide.
- Assuming a flow rate of 43p/m/min (SPSG Special Events), the capacity of the stairs is **129p/min**.
- Even with a fully loaded service, this would allow for clearance of the platform well within the 15 min headway.



Pre-Match: NB Services to White Hart Lane

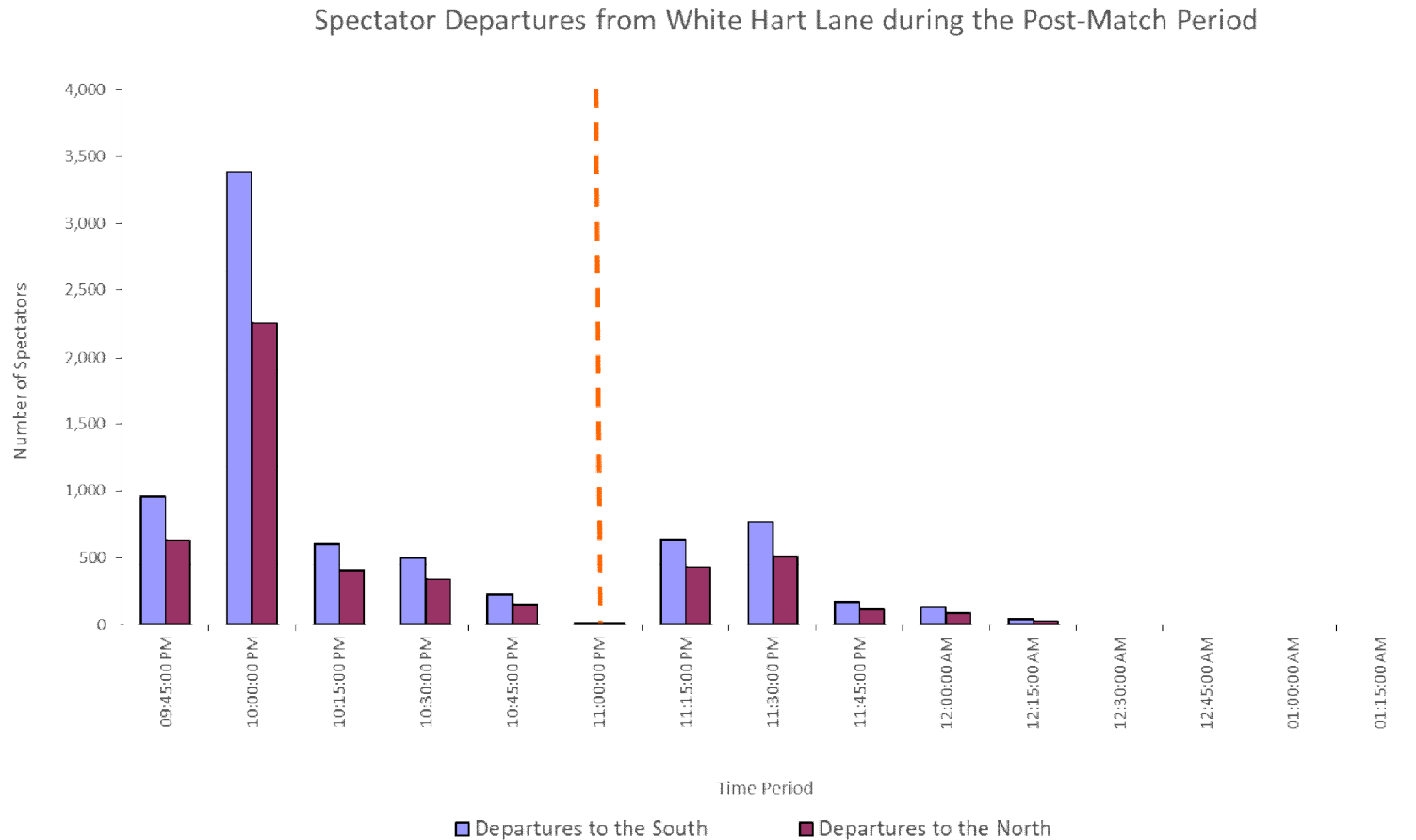
- Å Given that NB trains arriving at Seven Sisters will already be partially loaded with background travellers and Spectators travelling to White Hart Lane from Central London, there will be capacity constraints between 18:15 and 19:30.
- Å As there is a finite train capacity, a potential issue for consideration is the occupancy of the NB National Rail platform during this period.
- Å In the first scenario, where train capacity is assumed to be limited to 859 pax/train (TfL advice that service capacity at 85% of total for events), this implies some trains will have no space for boarders at Seven Sisters. This would result in Platform loadings in excess of 1,500 people, with associated risks to safety and management.
- Å Higher loadings on these services are currently observed, and as discussed at the TfL pre-application meeting in July 2014, it is reasonable to assume that the full capacity will be available during peak times.
- Å In the second scenario, 1,020 pax/train is assumed for eight train services, which suggests that the peak loading of the platform would be between 900 and 1,000 passengers.
- Å Some passengers waiting on this platform would have to wait for two services to pass before being able to board.
- Å Note: In the base case, over 2,000 spectators per match are able to travel via this route, with significantly lower train capacity. If this behaviour were replicated, then platform loading of the levels calculated here are unlikely to occur to the extent shown



Pre-Match: NB Services to White Hart Lane

- ⚠ The minimum train headway of northbound services is **5 minutes** during the pre-match period.
- ⚠ In terms of platform clearance at White Hart Lane station, the principal capacity constraint in the station is the stairs from the platform, at **3m** wide.
- ⚠ Assuming a flow rate of 43p/m/min (SPSG Special Events), the capacity of the stairs is **129p/min**. Therefore the clearance capacity of the platform within the 5 minute headway is **645 people**.
- ⚠ The forecasts indicate that the train with the highest number of THFC spectators expected to alight at White Hart Lane station will have approximately **826 spectators**.
- ⚠ In this instance the platform could clear in approximately **6.5 minutes**.
- ⚠ However, the station is currently undergoing a re-design. It is recommended that this requirement is taken into consideration in the design, i.e. to provide the ability to clear at least **166p/min** from the northbound platform.
- ⚠ *NB. It is likely that the designs will achieve this given current design for evacuation scenarios.*

Post-Match: White Hart Lane Station



∆ 12,395 spectators in total (~20% of Spectators)

- 4,958 heading to the north
- 7,437 heading to the south (4,338 of these interchange onto the Victoria Line at Seven Sisters)

Post-Match: White Hart Lane Station

⚠ Northbound Platform

- Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 859 people, as this matches the capacity per train (assuming that new Class 378 rolling stock is in use).

⚠ Maximum queue length: **833 people**

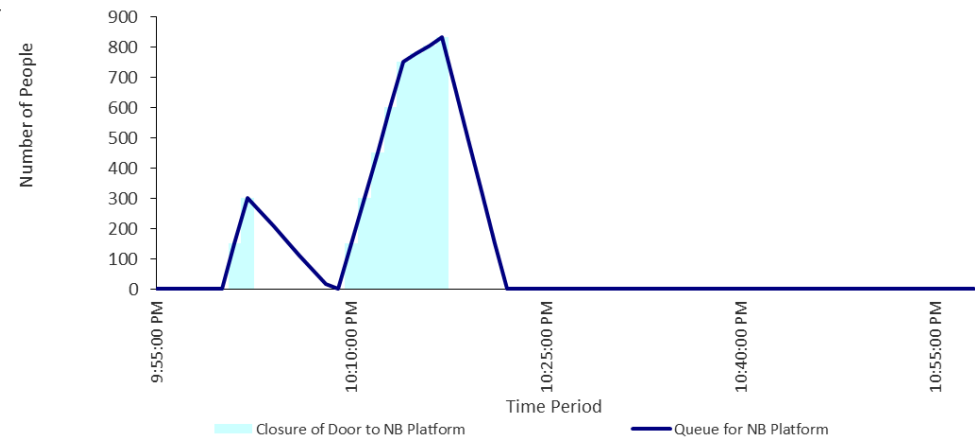
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

⚠ The duration of queuing outside the station would be **21 mins**

⚠ The maximum wait time for any individual would be **22 mins** from arrival to boarding a train

- 67% of spectators would wait for 10 mins or less
- 25% of spectators would be delayed for 11 ÷ 15 mins
- 3% of spectators would be delayed for 16 ÷ 20 mins
- 5% of spectators would wait for more than 20 mins

Extent of Queuing outside White Hart Lane Station during the Post-Match for NB Services if Platform Capacity Capped at 859 persons



Post-Match: White Hart Lane Station i Sensitivity Tests

⚠ Northbound trains from White Hart Lane follow two routes, one to Enfield and one to Hatfield. The previous assessment assumed that all spectators board the first available train, and any changes then occurred upstream. However, it may be the case that people wait on the platform for the next available train to their destination. This therefore affects the potential clearance rate during the post-match period.

⚠ Sensitivity tests have been run which show the impact on queuing of 25%, 33% and 50% of spectators waiting on the platform for the second train destination to pass.

⚠ In all instances, the maximum queue length outside the station increases, and the periods for which queues endure will extend to more than an hour, albeit at low levels.

⚠ However, the maximum delay for any individual at the station only increases in a scenario where more than 25% remain behind at the station. Nevertheless, the proportion of spectators delayed for longer will increase as the available train capacity is not being used as efficiently

% awaiting next train	Queue Duration (outside the station)	Maximum number of people in the queue	Maximum Delay for any Individual
0%	21 mins	833	22 mins
25%	> 1hr	1,001	22 mins
33%	> 1hr	1,198	29 mins
50%	> 1hr	1,593	33 mins

Post-Match: White Hart Lane Station

Å Southbound Platform

- Some queues are anticipated to form outside the station for access to the southbound platform. It is assumed that the capacity of the platform is capped at 859 people, as this matches the capacity per train (assuming that new Class 378 rolling stock is in use).

Å Maximum queue length: **1,347 people**

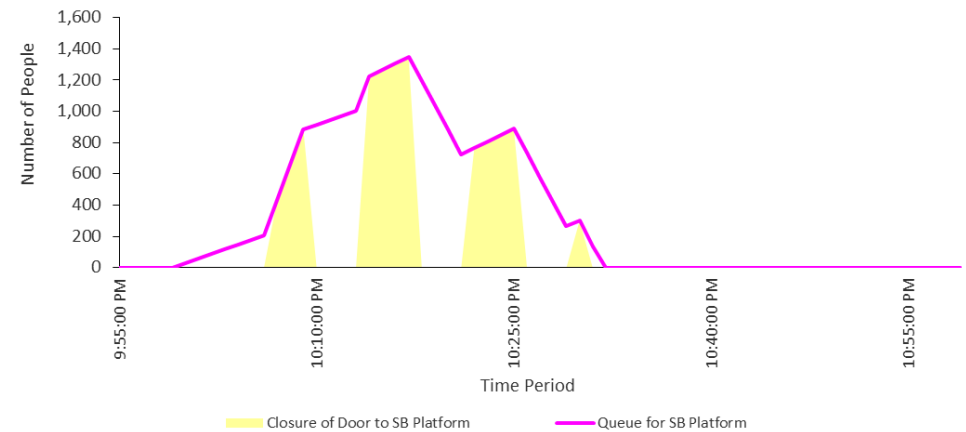
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

Å The duration of queuing outside the station would be **32 mins**

Å The maximum wait time for any individual would be **29 mins** from arrival to boarding a train

- 37% of spectators would wait for 10 mins or less
- 26% of spectators would be delayed for 11 ÷ 15 mins
- 31% of spectators would be delayed for 16 ÷ 20 mins
- 7% of spectators would wait for more than 20 mins

Extent of Queuing outside White Hart Lane Station during the Post-Match for SB Services if Platform Capacity Capped at 859 persons

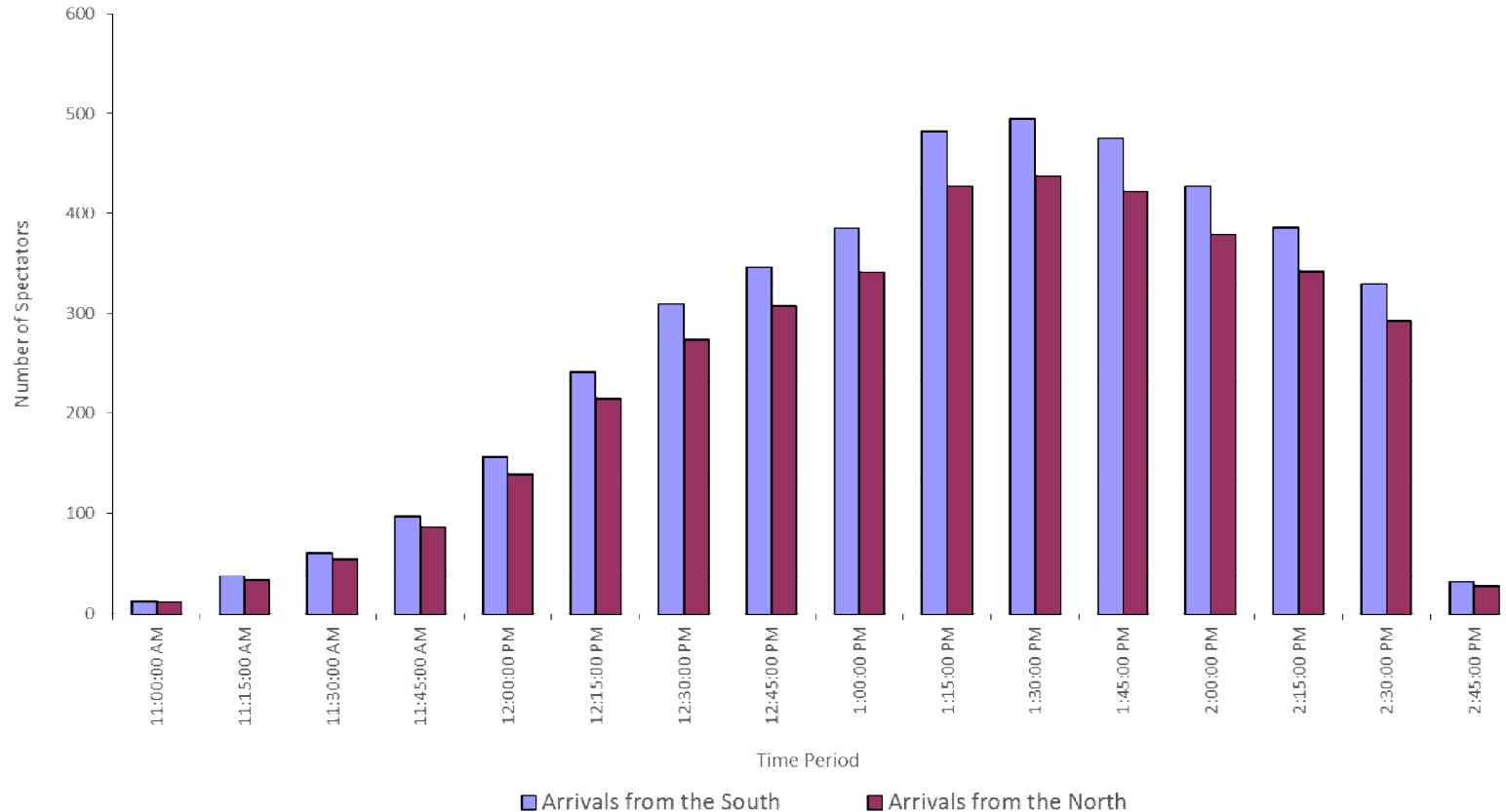




Weekend Matchday Scenario

Pre-Match: Northumberland Park Station

Spectator Arrivals at Northumberland Park during the Pre-Match Period

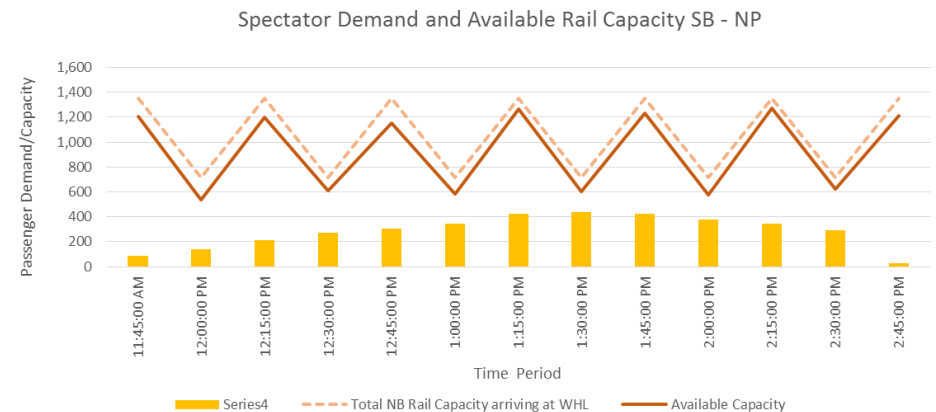
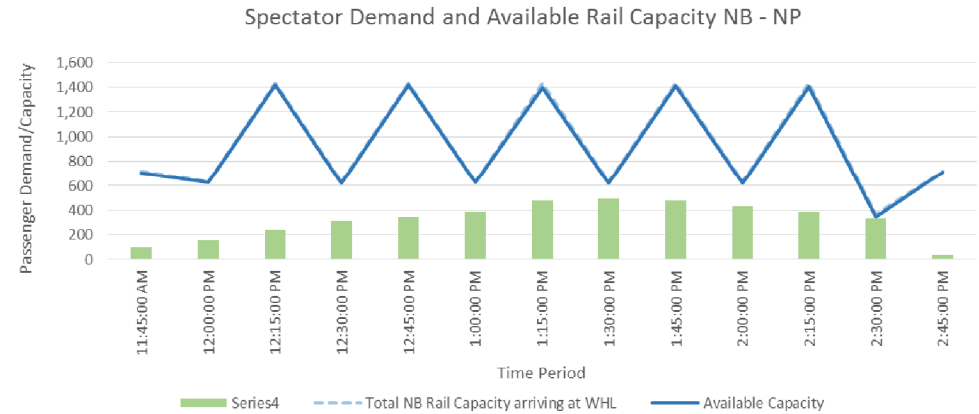


8,085 spectators in total (~13% of Spectators)

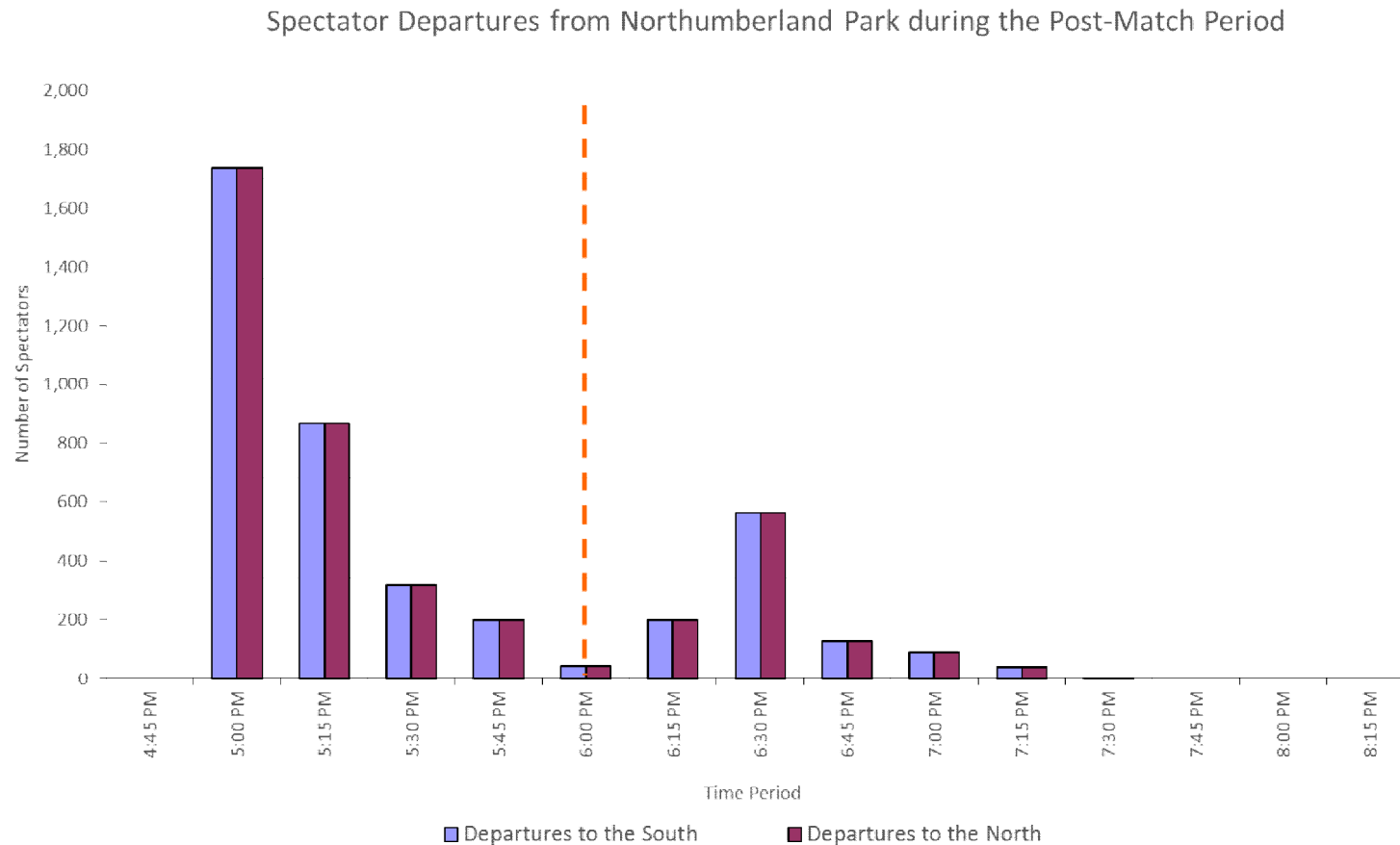
- 4,285 arriving from the north
- 3,800 arriving from the south (2,090 of these interchange from the Victoria Line at Tottenham Hale)

Pre-Match: Northumberland Park Station

There are **no** constraints on this route in either direction during the pre-match period, assuming 8-car operation is maintained



Post-Match: Northumberland Park Station



8,374 spectators in total (~14% of Spectators)

- 4,187 heading to the north
- 4,187 heading to the south (1,496 of these interchange onto the Victoria Line at Tottenham Hale)

Post-Match: Northumberland Park Station

⚠ Northbound Platform

- Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 700 people, as this broadly matches the capacity per train.

⚠ Maximum queue length: **1,057 people**

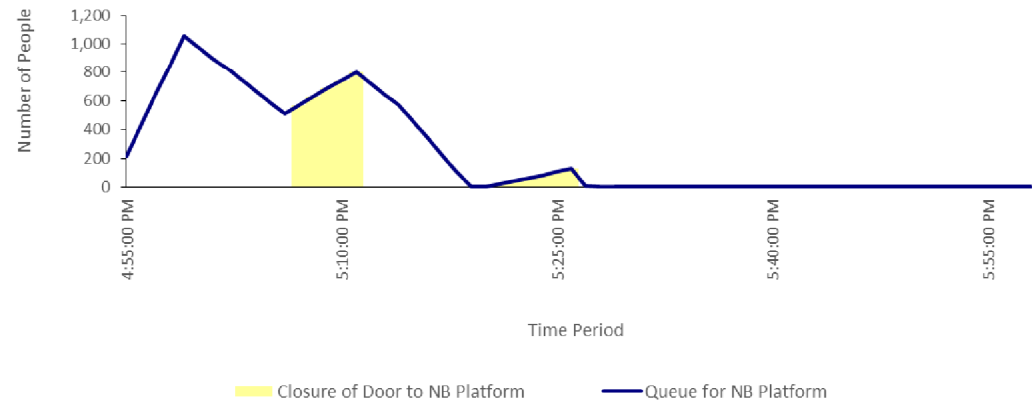
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

⚠ The duration of queuing outside the station would be **33 mins**

⚠ The maximum wait time for any individual would be **22 mins** from arrival to boarding a train

- 36% of spectators would wait for 10 mins or less
- 41% of spectators would wait for 11 – 15 mins
- 20% of spectators would wait for 16 – 20 mins
- 4% of spectators would wait for more than 20 mins

Extent of Queuing outside Northumberland Park Station during the Post-Match if Platform Capacity Capped at 700 persons



Post-Match: Northumberland Park Station

Å Southbound Platform

- ï Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 700 people, as this broadly matches the capacity per train.

Å Maximum queue length: **1,099 people**

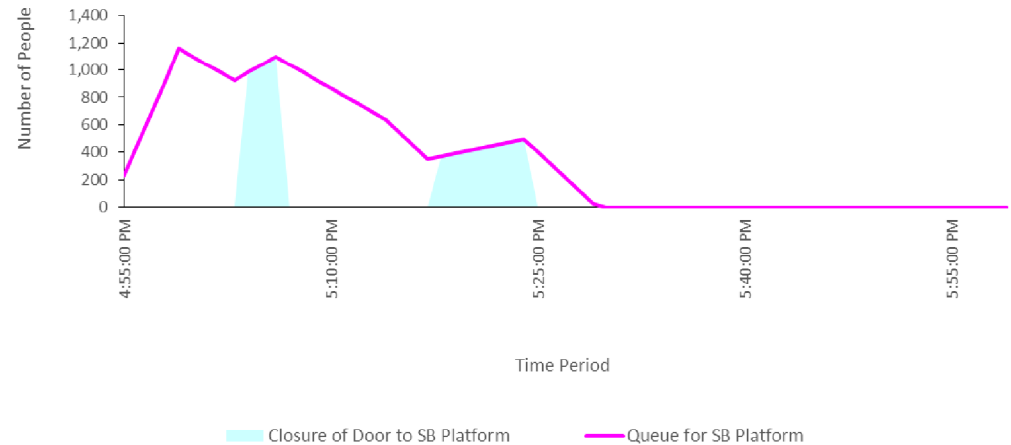
- ï **NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)**

Å The duration of queuing outside the station would be **35 mins**

Å The maximum wait time for any individual would be **26 mins** from arrival to boarding a train

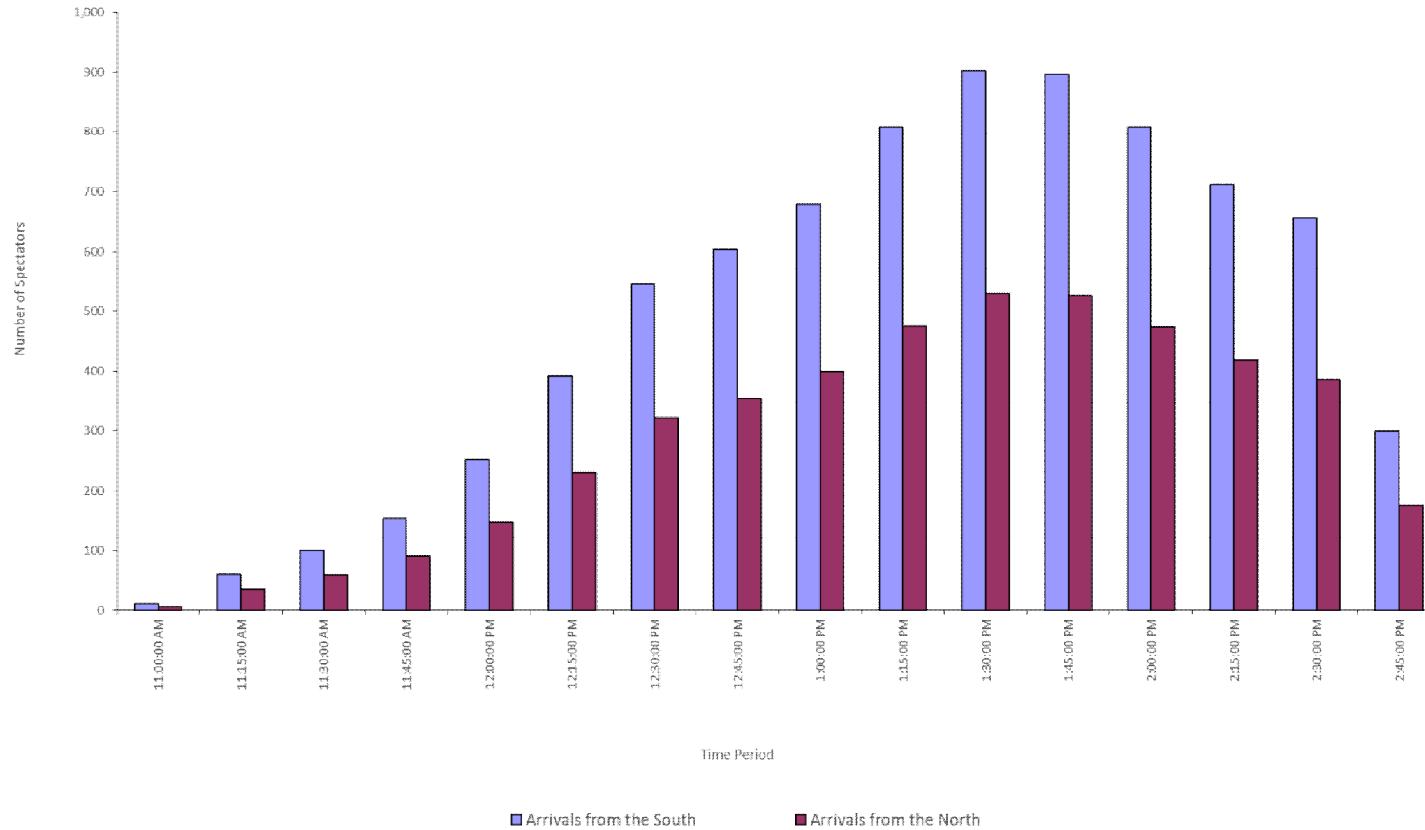
- ï 34% of spectators would wait for 10 mins or less
- ï 30% of spectators would wait for 11 ÷ 15 mins
- ï 16% of spectators would wait for 16 ÷ 20 mins
- ï 20% of spectators would wait for more than 20 mins

Extent of Queuing outside Northumberland Park Station during the Post-Match if Platform Capacity Capped at 700 persons



Pre-Match: White Hart Lane Station

Spectator Arrivals at White Hart Lane during the Pre-Match Period

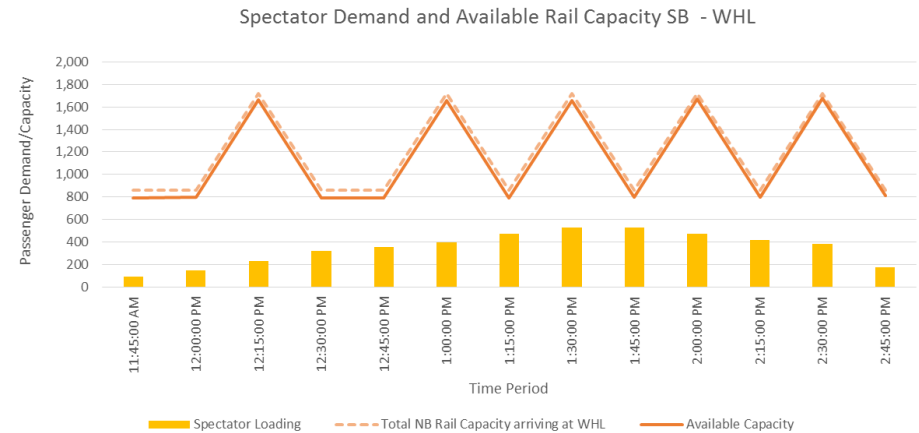


Å 12,511 spectators in total (~21% of Spectators)

- 4,629 arriving from the north
- 7,882 arriving from the south (3,216 of these interchange from the Victoria Line at Seven Sisters)

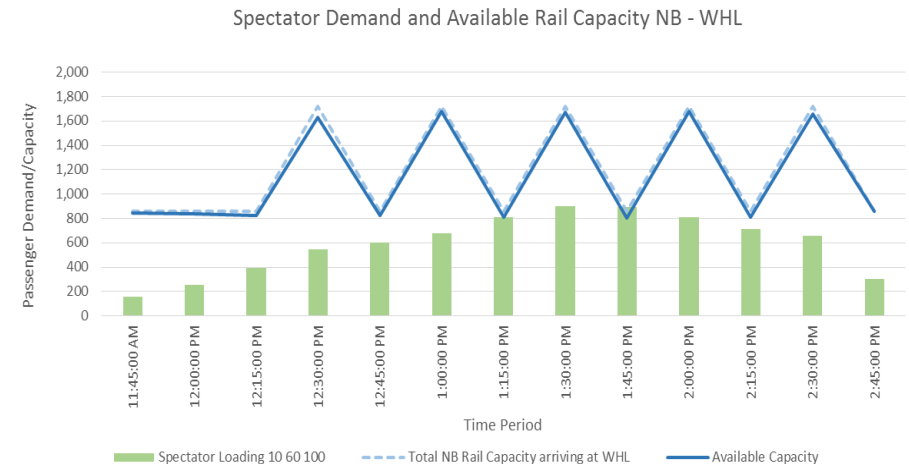
Pre-Match: SB Services to White Hart Lane

- Assuming the use of 8-car Class 378 rolling stock, no capacity constraints are anticipated on southbound services into White Hart Lane.
- The train headway of southbound services is 6 minutes during the pre-match.
- In terms of platform clearance at White Hart Lane station, the principal capacity constraint in the station is the stairs from the platform, at **3m** wide.
- Assuming a flow rate of 43p/m/min (SPSG Special Events), the capacity of the stairs is **129p/min**. This is a clearance capacity within 6 minutes of 770 people.
- The forecasts indicate that the train with the highest number of THFC spectators expected to alight at White Hart Lane station will have approximately **633 spectators**. In this instance the platform will clear in less than **5 minutes**.

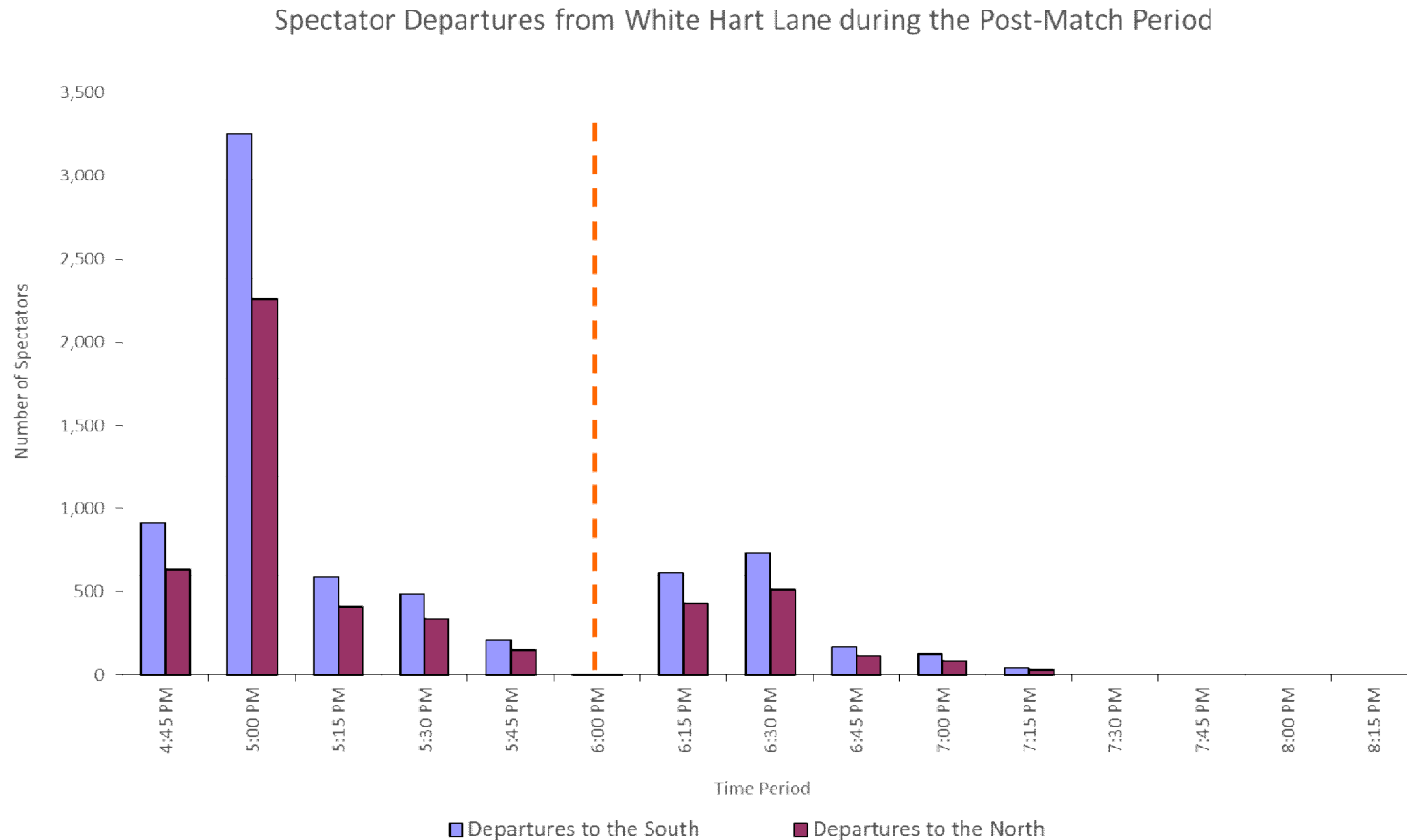


Pre-Match: NB Services to White Hart Lane

- ⚠ Assuming the use of 8-car Class 378 rolling stock, the available capacity during the pre-match period should be sufficient to meet the forecast demands.
- ⚠ However, given less frequent services than the midweek, there will be some periods where the build up of demand at Seven Sisters will be greater than others. Most notably, the peak arrival period between 13:45 and 14:00 coincides with a significant gap in the service.
- ⚠ It may be the case that a small number of people (<100) are unable to board the first train at Seven Sisters during this period.
- ⚠ The minimum train headway of northbound services is 10 minutes during the pre-match.
- ⚠ In terms of platform clearance at White Hart Lane station, clearance capacity within 10 minutes is 1,290 people.
- ⚠ This exceeds the capacity of the train, so all alighters will clear the platform before the next train arrives.



Post-Match: White Hart Lane Station



Å 12,105 spectators in total (~20% of Spectators)

- 4,963 heading to the north
- 7,142 heading to the south (4,035 of these interchange onto the Victoria Line at Seven Sisters)

Post-Match: White Hart Lane Station

⚠ Northbound Platform

- Some queues are anticipated to form outside the station for access to the northbound platform. It is assumed that the capacity of the platform is capped at 859 people, as this broadly matches the capacity per train.

⚠ Maximum queue length: **518 people**

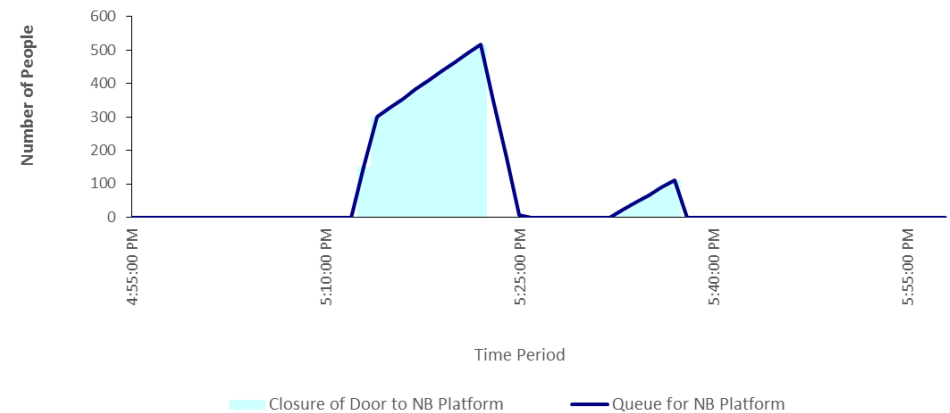
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

⚠ The maximum duration of queuing outside the station would be **12 mins**

⚠ The maximum wait time for any individual would be **32 mins** from arrival to boarding a train

- 43% of spectators would wait for 10 mins or less
- 15% of spectators would wait for 11 – 15 mins
- 15% of spectators would wait for 16 – 20 mins
- 26% of spectators would wait for more than 20 mins

Extent of Queuing outside White Hart Lane Station during the Post-Match
if Platform Capacity Capped at 859 persons



Post-Match: White Hart Lane Station i Sensitivity Tests

⚠ Northbound trains from White Hart Lane follow two routes, one to Enfield and one to Hatfield. The previous assessment assumed that all spectators board the first available train, and any changes then occurred upstream. However, it may be the case that people wait on the platform for the next available train to their destination. This therefore affects the potential clearance rate during the post-match period.

⚠ Sensitivity tests have been run which show the impact on queuing of 25%, 33% and 50% of spectators waiting on the platform for the second train destination to pass.

⚠ In the weekend scenario, the peak queue and maximum delay remain the same, even if one-third of passengers let one train pass before boarding. However, the duration of queue formation outside the station is extended to 40 mins.

⚠ If 50% of passengers behave in this way, the delays experienced extend to levels that are unlikely to be acceptable.

% awaiting next train	Queue Duration (outside the station)	Maximum number of people in the queue	Maximum Delay for any Individual
0%	12 mins	518	32 mins
25%	40 mins	518	32 mins
33%	40 mins	518	32 mins
50%	> 1hr	1,030	>45 mins

Post-Match: White Hart Lane Station

Å Southbound Platform

- Some queues are anticipated to form outside the station for access to the southbound platform. It is assumed that the capacity of the platform is capped at 859 people, as this matches the capacity per train (assuming that new Class 378 rolling stock is in use).

Å Maximum queue length: **2,177 people**

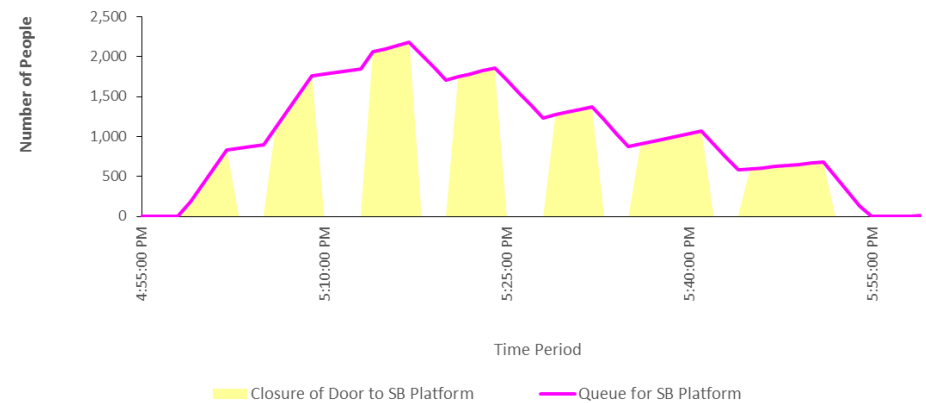
- NEED DRAWING SHOWING FOOTPRINT ON STREET NETWORK (TS&C)

Å The duration of queuing outside the station would be **56 mins**

Å The maximum wait time for any individual would be **29 mins** from arrival to boarding a train

- 31% of spectators would wait for 10 mins or less
- 22% of spectators would be delayed for 11 ÷ 15 mins
- 26% of spectators would be delayed for 16 ÷ 20 mins
- 21% of spectators would wait for more than 20 mins

Extent of Queuing outside White Hart Lane Station during the Post-Match if Platform Capacity Capped at 859 persons





White Hart Lane Station Re-Design

Overview

- ⌘ The core assessment of the spectator conditions are based on the current station and road network layout. However, as part of the regeneration Master Plan for this part of Tottenham, there are proposals under development to change both the station configuration and the routes between the station and the Stadium.
- ⌘ Concept proposals can be found in publicly available Consultation Documents for the High Road West Masterplan. Images taken from this are shown adjacent.
- ⌘ The key features of relevance to the future matchday capacity assessment are:
 - ⌘ All entries/exits to the station via a single location (booking hall), likely to include an automated ticket gateline
 - ⌘ Platforms would be accessed towards the centre, rather than at one end as currently. NB Platforms themselves remain unchanged
 - ⌘ A new route will be opened up leading directly from the station access point to the High Road



Design Advice: Matchday Scenario

- ⚠ Given the proposed development timeframe, it is important that the designs reflect the requirements for accommodating matchday flows.
- ⚠ Based on the spectator demand forecasts covered in this note, there are the following design considerations:
 - ⓘ The existing station layout lends itself to separation of flows during the post-match, facilitating management of spectators by direction. With a single point of access this is no longer the case, and it may be that a larger management response would be required to achieve the same effect. It would also need to extend to the route approaching the station and potentially the High Road.
 - ⓘ To accommodate the peak forecast flows/queues associated with the forecast usage on a matchday, the following dimensions are proposed:
 - ⚠ Sufficient queuing space outside the station to accommodate circa **2,250 people**. Depending on the management arrangement, this may need to be split.
 - ⚠ Stair width of **4 metres** serving both platform ⓘ enabling a full trainload to access/egress within the minimum train headway
 - ⚠ A gateline of **at least 14 ATGs** would be necessary to ensure revenue protection during the post match period whilst allowing both platforms to fill within the minimum train headway. This is an extreme scenario, however it is recommended that at least **7 ATGs** are provided.

Conclusions

⚠ Midweek

- ⚠ During the pre-match period, rail services to/from Northumberland Park, and the station itself has sufficient capacity to accommodate forecast flows.
- ⚠ For travel to White Hart Lane station, the principle challenge will be on northbound services, where spectator flows coincide with commuter travel. Future train capacity on this part of the rail network is yet to be established, however the assessment indicates that there may be some people unable to board the first northbound train at Seven Sisters (see Seven Sisters analysis).
- ⚠ Post-match queuing is expected at both White Hart Lane and Northumberland Park, and it will be necessary for these to be managed at peak times to prevent the risk of platform overloading. However, all spectators would be anticipated to board a train within 30 minutes of arrival at the station, and queues will tend to endure for no more than 45 minutes. These are considered to be reasonable within the context of the existing spectator experience.
- ⚠ The one unknown factor is the impact of alternative destinations on boarding patterns for northbound services from White Hart Lane – sensitivity tests have been run to establish the potential impact on queuing of this behaviour.

⚠ Weekend

- ⚠ Across both the pre- and post-match periods, the demand forecasts can more comfortably be accommodated within the available capacity (lower background demand).

- ⚠ Some post-match queuing is longer in this scenario than the midweek, although this is due to lower frequency

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