

# London Borough of Temporality: Mapping London’s Dynamic Mobility with Big Transit Data

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## Introduction

The rise of large-scale open datasets offers valuable insights for urban planning and transit management. Traditional spatial network analysis often assumes static node relationships, yet real-world transit networks are dynamic and continuously evolving. Leveraging open access mobility data allows us to uncover these changes in human transit behaviour.

This study examines shifts in London’s Underground Transit System from 2019 to 2022, using Transport for London’s NUMBAT datasets, which provide anonymized journey details. By analysing changes in link-loads between stations, the study aims to map the evolving patterns of public mobility in London.

Through detailed analysis and visualizations, this research identifies:

- Persistent Hubs: Stations maintaining high demand.
- Emerging Connections: New activity centres with increasing ridership.
- Weakening Ties: Declining traffic patterns and their implications.

These insights contribute to the broader conversation on ‘Smart Cities’ emphasizing the need for adaptable infrastructure and efficient transport systems to meet the evolving needs of a dynamic metropolis.

## Methodology

### 1. Hypothesis Testing

- Normality Check: Shapiro-Wilk test confirmed non-normal distribution.
- Approach: Used a non-parametric paired test.
- Result: Matched Pair Wilcoxon Test showed a significant difference between 2019 and 2022 datasets, rejecting null hypothesis

### 2. Shortlisting

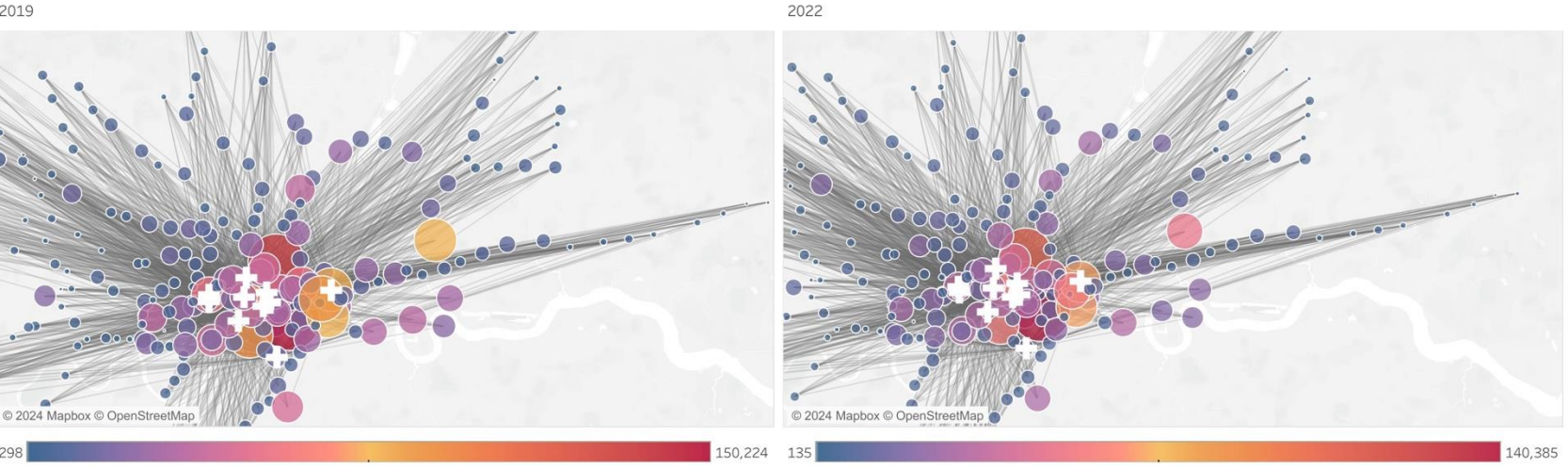
- Percentage change in total weekly exits (2019–2022)
  - Top 20 destinations by total weekly exits [Ranking Change]
  - Most absolute changes in total weekly exits by destination
  - Top 3 destinations preference by station
  - Most popular destinations by origin (2019 vs. 2022)
  - Changes in most preferred destinations for each station [Rankings Change]
- Outcome: Shortlisted 26 key destinations showing significant changes in travel pattern

### 3. Analysing

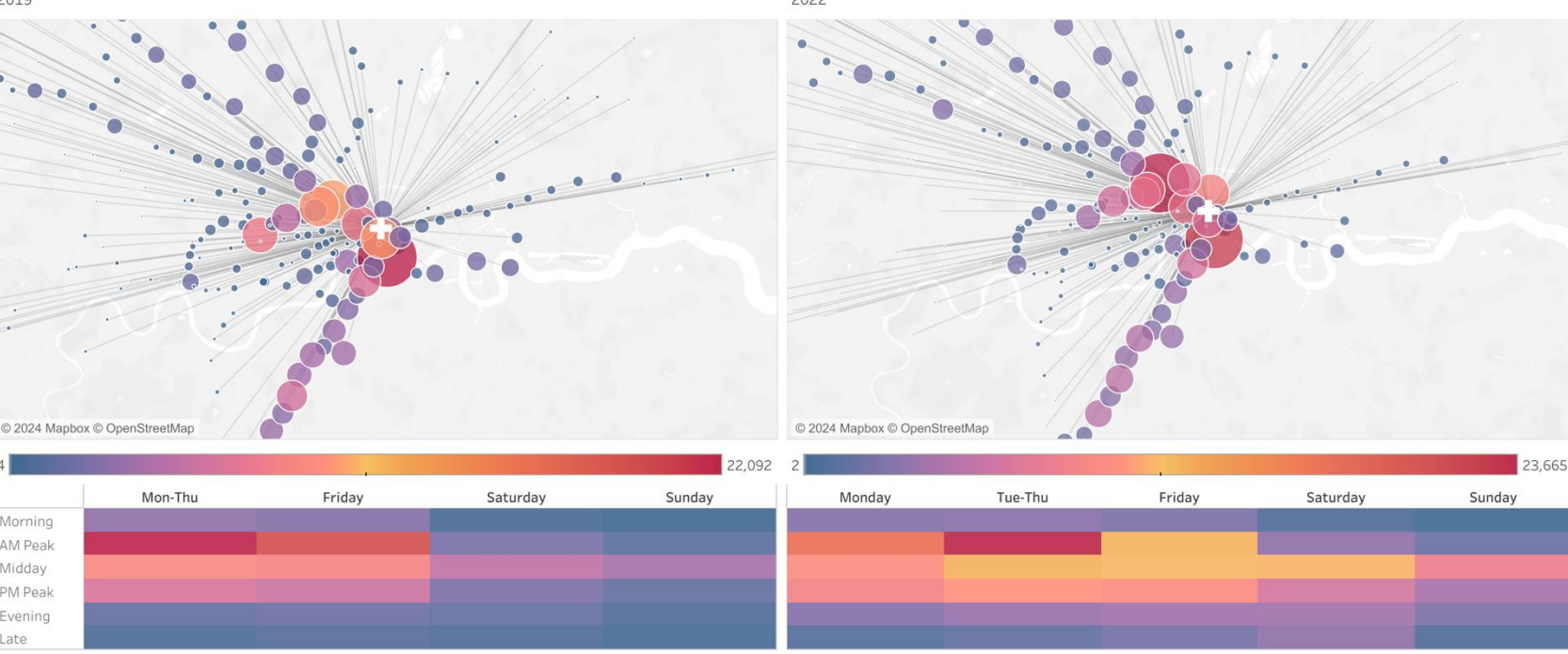
- Network Comparison: Analysed connectivity changes at key stations between 2019 and 2022
- Peak Traffic Hours: Identified peak usage times for each station
- Link Traffic: Assessed changes in traffic from key station connections
- Trend Analysis: Tracked rising and declining traffic trends over time
- Sub-Regional Patterns: Examined regional variations by dividing stations into North, South, East, West, and Central as per ‘The London Plan’

## Notable Observations

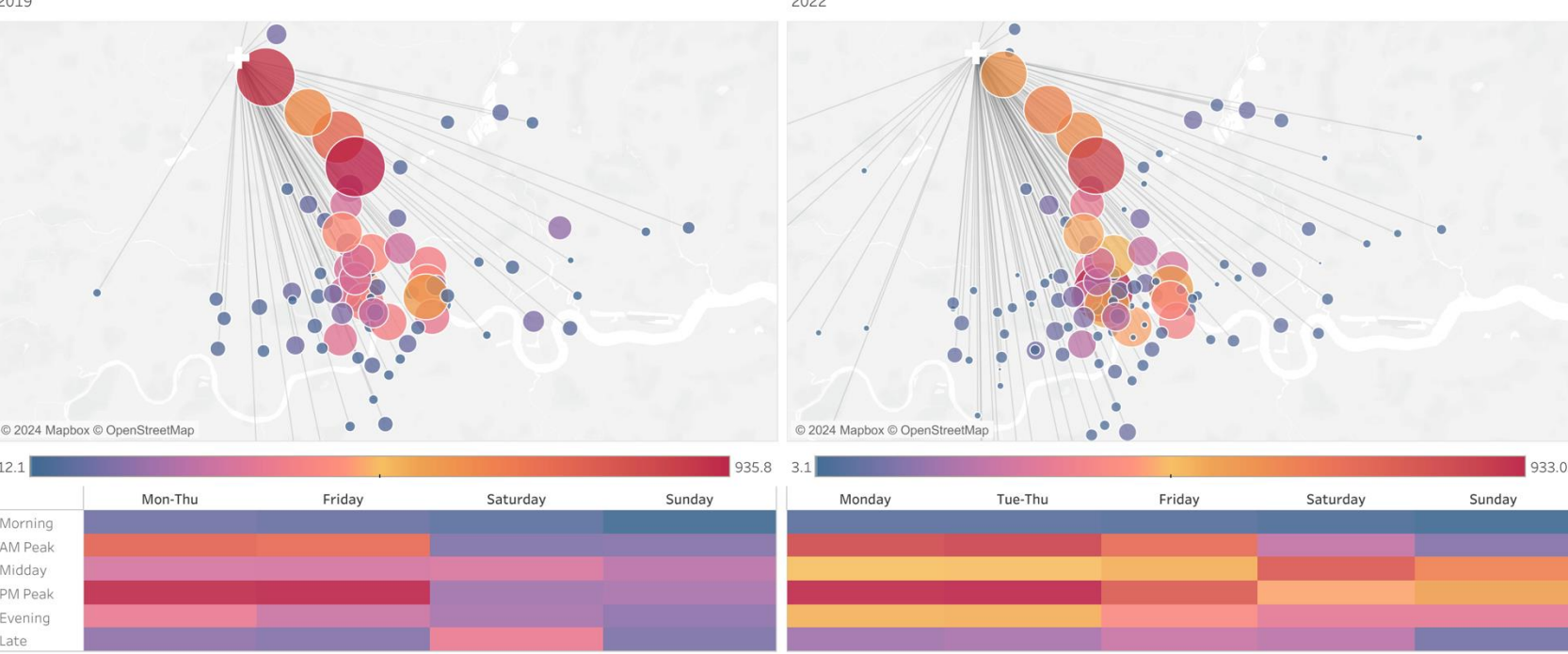
### 1. Central Destinations



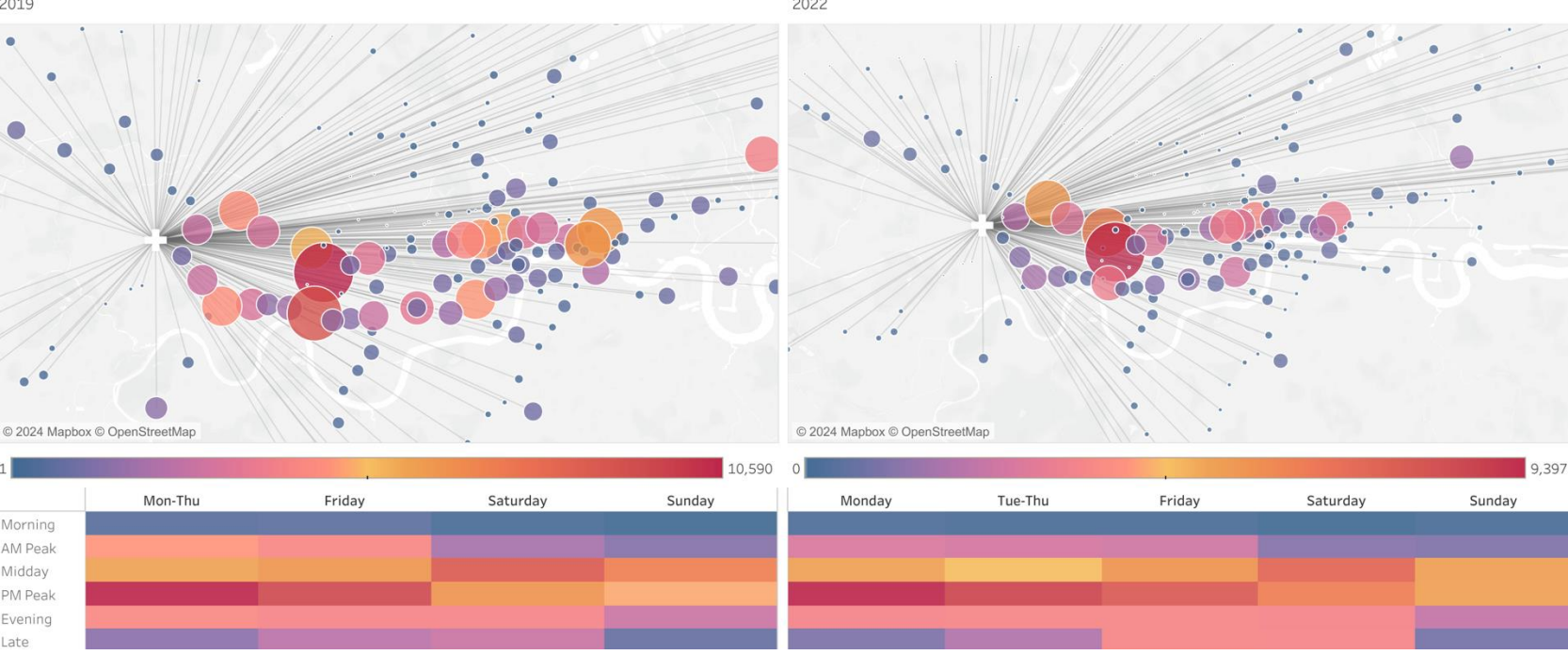
### 2. Moorgate



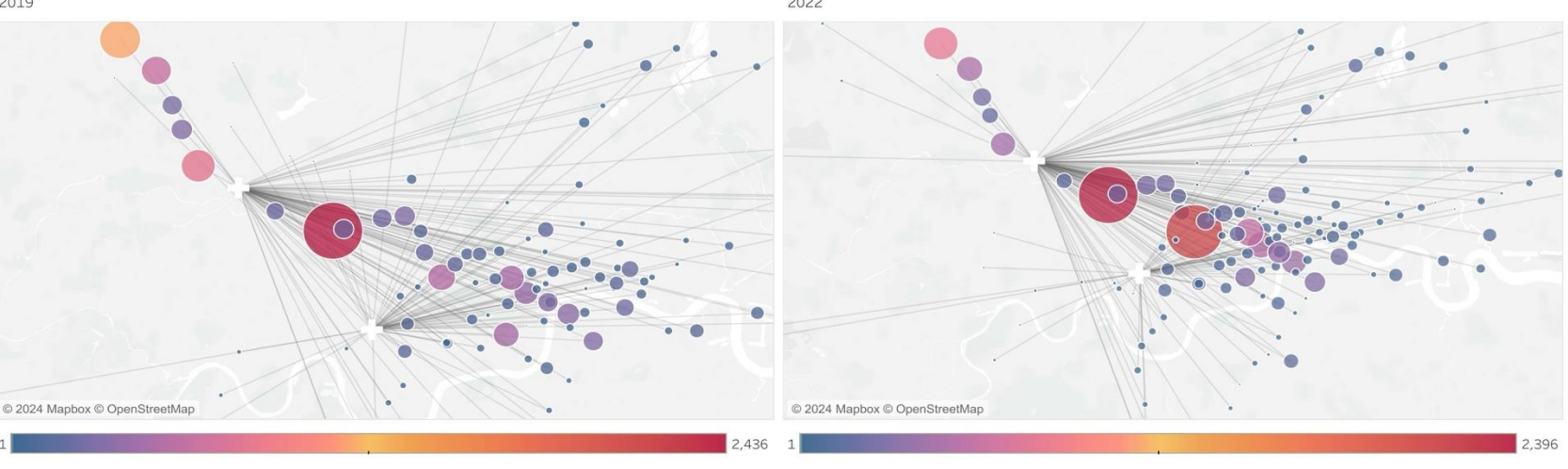
### 3. Mill Hill East



### 4. Ealing Broadway



### 5. Western Emergence



### 6. Sub-Regional Trends



### 7. Weekly Exits Change in Central

Central Locations	Change
Chancery Lane	-46.40%
Barbican	-43.44%
Lancaster Gate	-42.50%
Cannon Street LU	-42.47%
Regent's Park	-41.13%
St. Paul's	-39.88%
Liverpool Street LU	-37.45%
Vauxhall LU	-35.18%
Bank and Monument	-33.50%
Piccadilly Circus	-28.21%
Paddington TfL	-17.82%
Leicester Square	-11.71%
Bond Street	-6.12%
Moorgate	+8.22%
Hyde Park Corner	+14.31%
Tottenham Court Road	+17.45%

## Takeaways

From 2019 to 2022, total weekly exits per station dropped by 21.15% on average, with only six stations experiencing traffic growth.

- East-Central Decline:** Mobility between Central and East regions have significantly declined, while intra-East mobility has increased. Stratford rose from the 5th to the 3rd most visited station, remaining the top destination for the most stations. This suggests a decreasing popularity of Central London destinations and increased local development for residents of the East. [1][6]
- Shifts in Intra-Central Traffic:** Leisure-centric stations like Tottenham Court Road have seen significant traffic growth, while six work-centric stations in Central London—including Bank, Monument, Barbican, and Cannon Street—have experienced a marked decline. Additionally, key stations like Lancaster Gate, Liverpool St, Regent's Park and Vauxhall have shifted from weekday rush to weekend midday peaks, highlighting Central London's transformation into a leisure district.
- Moorgate's Rise:** Moorgate is the only Central London work hub with rising exits, driven by traffic from northern stations like Mill Hill East, indicating more professionals commuting from North London. [2]
- Mill Hill East:** Mill Hill East has experienced significant growth in traffic from North to Central, particularly to leisure-centric stations like Tottenham Court Road and work-centric stations like Moorgate, reinforcing its appeal as a residential area for professionals. [3]
- Changing Centrality in the West:** Ealing Broadway has seen a substantial 45.9% drop in total weekly exits, signalling a decline in its appeal as a residential destination. Richmond experienced the largest drop, at 59.21%, suggesting a loss of interest in tourist and leisure activities. However, stations like Kensington (Olympia) and Stonebridge Park have seen traffic increases, indicating their growing appeal as leisure and residential hubs, and a shift in the West's centrality. [4][5]

Overall, the research suggests a post-pandemic reshaping of London's underground traffic, with local development in areas like Stratford, shifting commuter patterns favouring North and parts of West London, and a decline in Central London's traditional work hubs as the city adapts to changing work environments and leisure preferences.

## Limitations and Future

**Scope:** This study focuses solely on the London Underground, potentially overlooking shifts in other modes of transport. A broader dataset incorporating buses, cycling, or ride-sharing would offer a more complete view of urban mobility.

**Dataset Context:** The data reflects a ‘typical Autumn week’ in both 2019 and 2022, ensuring consistency but possibly missing seasonal or exceptional trends.

**Next Steps:** The focus on major changes may obscure off-peak residential patterns. Expanding the study to include multimodal transport and predictive models (e.g., clustering and machine learning) would provide deeper insights into future mobility trends.

Interactive Dashboard

Full Project Repository

LinkedIn Profile