



MEMORANDUM: US 29 Travel Time & OTP

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| To:      | Joana Conklin, Montgomery County DOT               |
| From:    | James A. Bunch, SWAI                               |
| Subject: | US 29 Travel Time and On Time Performance Analysis |
| Date:    | March 15, 2017                                     |

This memorandum documents the US 29 corridor travel time and on time performance (OTP) analysis carried out using Automatic Vehicle Location (AVL)/Automatic Passenger Counter (APC) data for October 3<sup>rd</sup> – October 7<sup>th</sup> 2016 provided by WMATA and Ride On. The AVL/APC provides data for every trip made during this first week in October, the trip start time, time stamps of the vehicles along the route, when the doors open and close, dwell times, and event types. The Ride On data also provides the boardings, alightings, and passengers on board each vehicle as they traverse their routes. This information is invaluable in understanding the reliability of travel times and how they vary by time of day, direction, etc. The analysis shows that the actual travel times of trips though sometimes shorter are often much longer than the scheduled times, and get longer during the peak periods as well as more unreliable (see the appendix for plots). BRT provides end to end (Burtonsville to Silver Spring) travel time savings of around 26% but this varies between specific Origin Destination pairs depending on the directness of current service, location, and other factors (as high as 60% between Burtonsville and White Oak to 0 to 2% from Four Corners to the Silver Spring Transit Center. BRT may also improve reliability.

## 1 On Time Performance

Montgomery County Ride On defines On Time Performance (OTP) as the percentage of vehicles arriving at a time point within 1 minute early and 4 minutes late of their scheduled arrival time (and departure time for the start of each trip). This captures not only whether the trip is on time based on its final destination, but also if it maintains its schedule as it travels along its route. WMATA uses for its performance measurement a different definition of OTP as the % of vehicles arriving with 2 minutes early and 7 minutes late. As described below the OTP was estimated for both the Ride On and WMATA

Routes along the US 29 corridor using the Ride On definition of OTP. Daily OTP for Ride On routes varied between 54% and 75%, and Daily OTP for WMATA routes varied between 40% and 54%.

**Table 1 WMATA US 29 Route On Time Performance**

| WMATA US 29 On Time* Performance |                       |
|----------------------------------|-----------------------|
| Route                            | Weekday Oct 3-7, 2016 |
| Z2                               | 48%                   |
| Z6                               | 47%                   |
| Z7                               | 40%                   |
| Z8                               | 48%                   |
| Z11                              | 54%                   |

\* On time = time at timepoint is within 1 minute early and 4 minutes late

### 1.1 WMATA OTP

Weekday OTP for WMATA service within the US 29 Corridor was estimated using the Automated Vehicle Location (AVL) data for October 3<sup>rd</sup> – October 7<sup>th</sup> provided by WMATA on their PlanITMetro website: <https://planitmetro.com/2016/11/16/data-download-metrobus-vehicle-location-data/>

The data sets provide the AVL data for every bus trip that took place during the 5 day time period. Snapshots are recorded for "events" along each run which include the event type, time, location, direction

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etc. One of the variables included in the data is Delta\_Time defined as “The time difference, in seconds, between the actual and scheduled stop times”. The formal definition of % On-Time Performance is the % of stops at Time Points that are "On Time" versus all stops at Time points. To be consistent with the thresholds used by Ride On a bus was considered to be on time if it was within 1 minute early and 4 minutes late when it departed the stop location. This translates to Delta Time being greater than -60 seconds and less than 240 seconds.

The results of the analysis are shown in Table 2. As shown the OTP varies from a low of 40% for the Z7 and a high of 54% for the Z11. This compares to the overall WMATA Bus OTP for 2015 (using the less stringent 2 minutes early to 7 minutes late criteria) of 77.7%. Upon further investigation we believe that one reason for the lower OTP is WMATA may set constant schedules within the peak periods that some specific trips will be behind and some ahead of schedule. For example using the WMATA trip planner a person leaving the Tech Road P&R lot at 8:00 am using the z7 route is scheduled to take 20 minutes (in-vehicle time) to reach the Silver Spring Transit Center. However, Google maps and our independent field measurement using GPS probe analysis show that the 6.4 mile trip typically take 22 – 50 minutes in a private car when leaving at 8 AM in the morning. Figure 1 illustrates the variance in actual bus travel times from Tech Road to the Silver Spring Transit Center and the fact that the southbound Z7 trips (green dots) actually have shorter travel times than 20 minutes earlier than 6:00 am but quickly increase from 7 to 9 am. Likewise, their travel times are longer than 20 minutes in the evening peak from 4 to 6 pm.

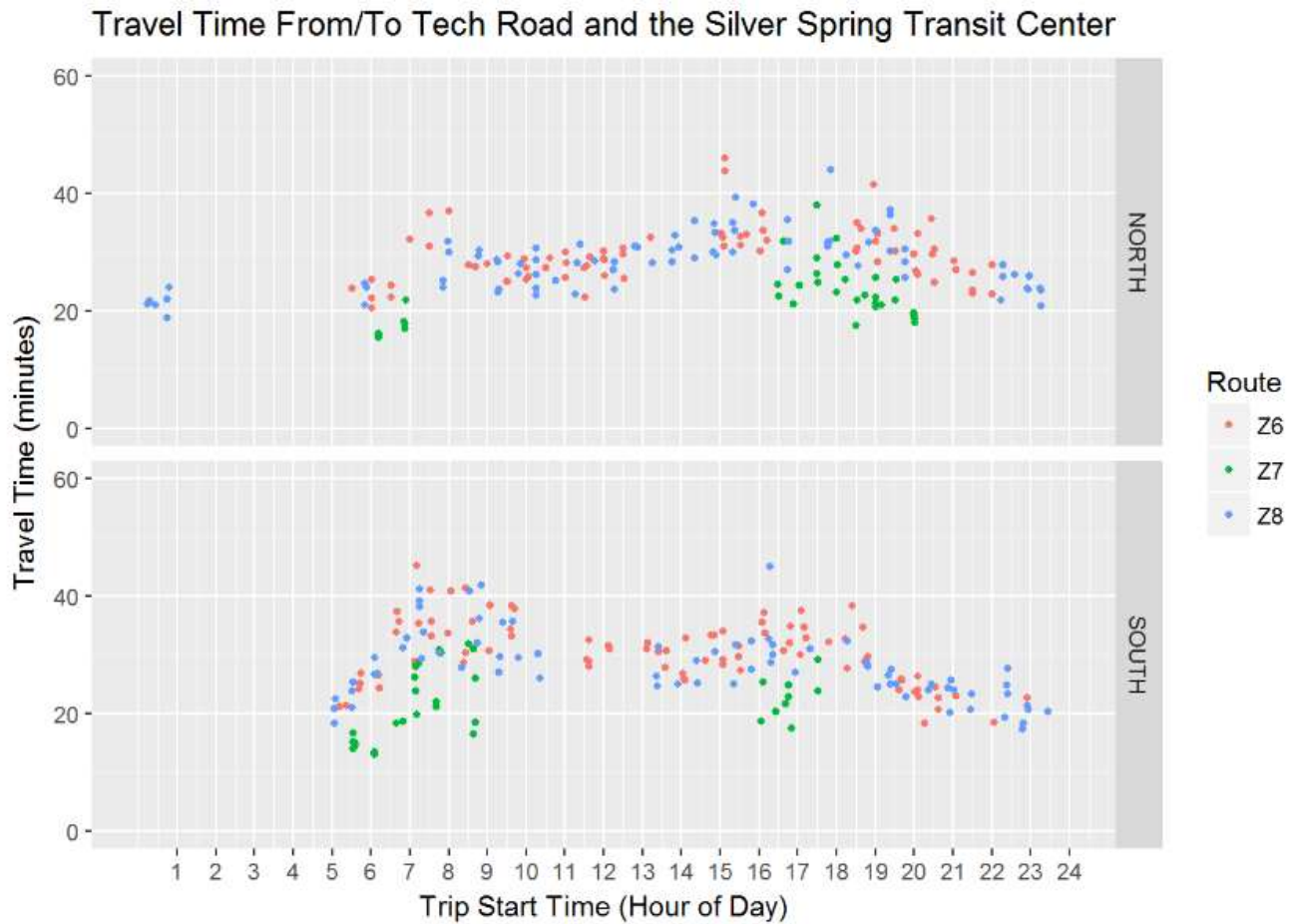


Figure 1 WMATA travel times from Tech Road to Silver Spring Transit Center

### 1.2 Ride On OTP

Ride On OTP was provided by the Ride On Automatic Vehicle Location (AVL) / Automatic Passenger Counter (APC) system reports run by Ride On staff in February 2017. Data was pulled from the AVL/APC databases for two time periods: October 3 – October 7<sup>th</sup> 2016 for consistency with the WMATA data, and January 30 – February 3 2017 to capture any recent performance trends and changes in service. The results are shown in Table 2. Ride On OTP for US 29 routes varies from 54% to 75% in October 2016 and 63% to 79% in February 2017. Ride On adjusts its schedules within each time period to reflect observed differences in congestion within the peak of the peak and this results in higher OTP percentages than observed for the WMATA routes. As can be seen the OTP for the February 2017 also improves, which may be due to a recent adjustment to how initial departure times for Ride On trips are monitored. However, even after tailoring to conditions, Ride On service within the US 29 corridor still does not meet the overall Ride On performance goal of 90% OTP due to the delays caused by auto congestion and the day to day variability that results.

Table 2 Ride On US 29 Route On Time Performance

| RideOn US 29 On Time* Performance |                          |                               |
|-----------------------------------|--------------------------|-------------------------------|
| Route                             | Weekday<br>Oct 3-7, 2016 | Weekday<br>Jan 30-Feb 3, 2017 |
| 8                                 | 57%                      | 63%                           |
| 9                                 | 58%                      | 64%                           |
| 12                                | 69%                      | 77%                           |
| 13                                | 64%                      | 66%                           |
| 14                                | 56%                      | 73%                           |
| 16                                | 56%                      | 69%                           |
| 17                                | 61%                      | 79%                           |
| 20                                | 54%                      | 70%                           |
| 21                                | 67%                      | 72%                           |
| 22                                | 75%                      | 68%                           |

\* On time = time at timepoint is within 1 minute early and 4 minutes late

## 2 Travel Times and Travel Time Variability

The AVL/APC data from October 2017 was also used to analyze the AM Peak Travel Times and Travel Time Variability from key origins to key destinations within the US 29 Corridor. These were then compared with the BRT opening year travel times estimated as part of the US 29 TIGER Grant application.

The travel times for all trips that travel between each origin and destination pair were extracted from the October 3 to October 7 2016 Ride On and WMATA AVL/APC databases. For each Origin Destination pair the median, 10% and 90% percentile values were calculated. In order to capture the variance in travel times (this removes from the analysis the outliers that are either very slow or very slow and very fast trips). Table 3 and Figure 2 show the results of this analysis. They illustrate that the actual travel times that 80% of all trips are made within can vary by as much as 25 minutes (for Briggs Chaney to Silver Spring). Of course the shorter trips such as Four Corners to Silver Spring have much less variation. However, they may have very long trips as well (that were removed as outliers). The Appendix provides detailed plots of the travel times for each origin destination pair by time of day and route.

Table 3 US 29 Corridor Travel times (Observed Current Service versus BRT in minutes)

| Origin-Destination                      | Current Service Travel Times from AVL/APC Data (Oct, 2016) |        |     | BRT  |         |
|---|--|--------|-----|------|---------|
|   | Q10  | Median | Q90 | Time | Savings |
| Burtonsville to Silver Spring           | 34   | 42     | 48  | 31   | 11      |
| Burtonsville to White Oak               | 34   | 40     | 46  | 16   | 24      |
| Briggs Chaney to Silver Spring (Wmata)  | 27   | 34     | 52  | 28   | 6       |
| Tech Road to Silver Spring              | 29   | 35     | 42  | 18   | 17      |
| White Oak to Silver Spring (WMATA)      | 19   | 22     | 25  | 15   | 7       |
| White Oak to Silver Spring (Ride On)    | 20   | 23     | 27  | 15   | 8       |
| Four Corners to Silver Spring (WMATA)   | 7  | 9      | 12  | 9    | 0       |
| Four Corners To Silver Spring (Ride On) | 9  | 12     | 15  | 9    | 3       |

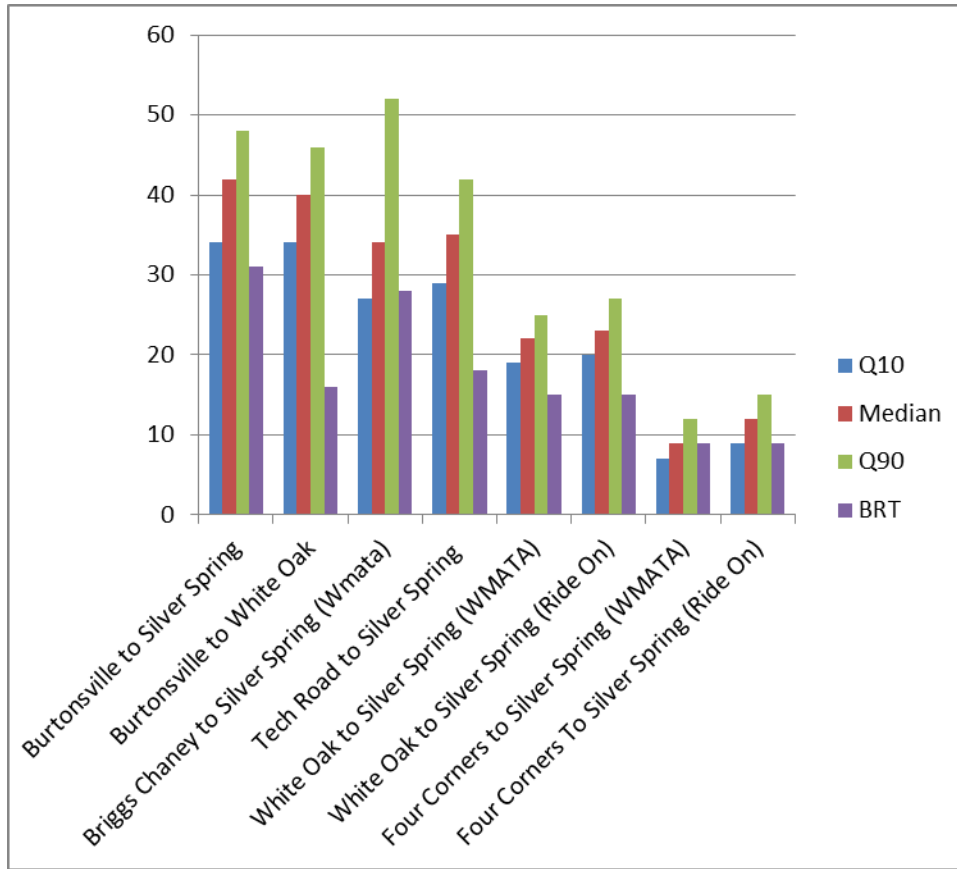


Figure 2 US 29 Corridor Travel times (Observed Current Service versus BRT)

Table 3 and Figure 2 also provide the BRT travel times for the opening year service estimated as part of the revised US 29 TIGER Grant Application (in December 2016 Montgomery County revised the US 29 TIGER Grant to change the managed lane service to mixed use, reduce the initial BRT headways to 15 minutes for each BRT service pattern or 7.5 minutes in the trunk portions, and maintain current service for the Ride On 21 and 22 routes). The BRT origin destination travel times were therefore based on the following assumptions<sup>1</sup>:

- Running way Assumptions
  - Shoulder Use North of 650
  - Mixed Traffic South of 650
  - Median Stations South of 650
  - Tech Road Station on East Side
- Performance Assumptions
  - Level Platforms
  - Off Board Fare Payment
  - Multiple Door Access
  - Transit Signal Priority (5 secs /intersection)
  - Dwell Time = 20 seconds
  - Speeds

<sup>1</sup> Used for analysis and modeling purposes. Station locations and other details will be finalized during project design

- > Bus on Shoulder = 20 mph above parallel Roadway. In 2015 ~ 45 mph
- > Mixed Use = Congested speeds. In 2015 varies from 15 to 25 mph
- > Reverse direction in mixed use

As can be seen the BRT provides significant reductions in travel time when compared to the median values for current service ranging from 0 to 2 minutes for Four Corners to the Silver Spring Transit Center to over 10 minutes from Burtonsville to Silver Spring, and even more time savings to intermediate destinations such as Burtonsville to White Oak Transit Center. Note that this does not account for the anticipated improvement in reliability that BRT will offer and is an added benefit.

As an additional check, origin destination travel times were also calculated based upon schedules using the WMATA trip planner for trips starting at 8 am in the morning on typical weekdays. These are shown in Table 4. Note that the travel times from the schedule are typically shorter than the observed travel times from the AVL/APC data discussed above (particularly for the WMATA service). Also, this analysis could include transfers. As shown, some of the largest benefits may occur because the BRT is providing more direct service between intermediate points than is currently available. An example is the improved connectivity from Burtonsville to the White Oak Science Gateway (both Tech Road and the White Oak Transit Center). This is also true for the service BRT offers in the reverse peak direction and midday.

**Table 4 US 29 Scheduled Current Service and BRT AM Peak Travel Times**

| From   | To                   | Current Service*   |            | US 29 BRT  |
|--|----------------------|--|------------|------------|
|  |                      | Service  | Time (min) | Time (min) |
| Burtonsville P&R   | Stewart Lane & US 29 | WMATA z7 then transfer to RO 10 or Z8<br>No Direct Ride On | 32 to 40   | 13         |
|  | Four Corners         | WMATA z11<br>No Direct Ride On                             | 42         | 22         |
|  | SSTC                 | WMATA Z7<br>No Direct Ride On                              | 36         | 31         |
| Briggs Chaney P&R  | Stewart Lane & US 29 | WMATA z6   | 19         | 10         |
|  | Four Corners         | WMATA z11<br>No Direct Ride On                             | 21         | 24         |
|  | SSTC                 | WMATA z11  | 31         | 28         |
| Tech Road<br>Current Travel Times from<br>existing P&R lot | Stewart Lane & US 29 | Ride On 10   | 8          | 6          |
|  | Four Corners         | WMATA z8   | 23         | 16         |
|  | SSTC                 | WMATA z7   | 20         | 18         |
| Stewart Lane & US 29                                       | Stewart Lane & US 29 |  |            |            |
|  | Four Corners         | WMATA z6 or z8   | 18         | 9          |
|  | SSTC                 | WMATA z6 or z8   | 28         | 18         |
| White Oak Transit Center                                   | Stewart Lane & US 29 |  |            |            |
|  | Four Corners         | WMATA z2,z6  | 9          | 7          |
|  | SSTC                 | Ride On 22 or<br>WMATA z6,z8                               | 18 to 20   | 15         |
| University Boulevard & US 29                               | Stewart Lane & US 29 |  |            |            |
|  | Four Corners         |  |            |            |
|  | SSTC                 | Ride On 9, or<br>WMATA z2,z6                               | 9          | 9          |

\* Current service may not be direct via US 29

Travel times for the 2020 opening year BRT service are also being refined using a separate operations simulation analysis using VISSIM. Results of this analysis when it is complete will be documented in a separate technical memorandum.

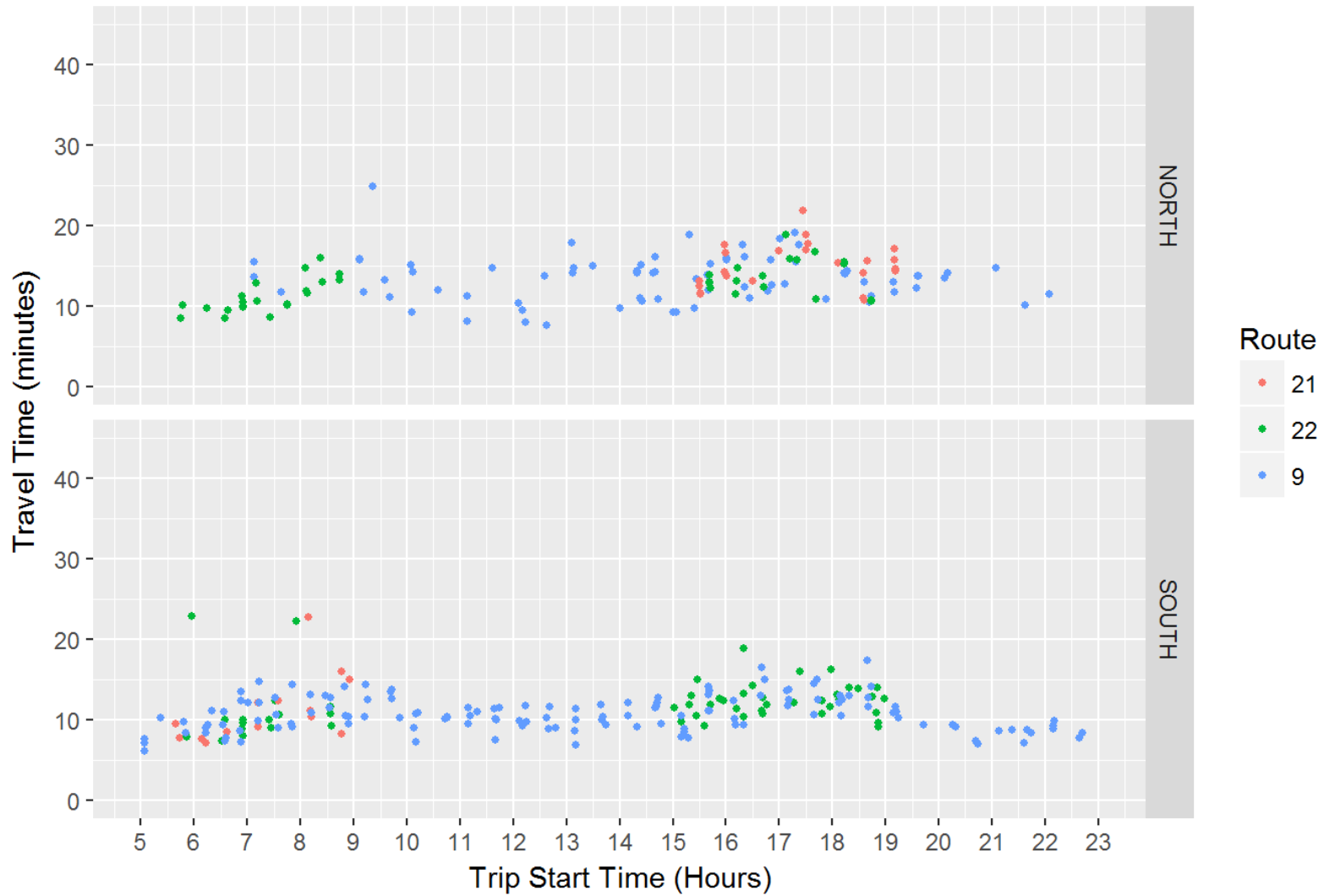
# Appendix

## Origin To Destination Travel Time Scatter Plots



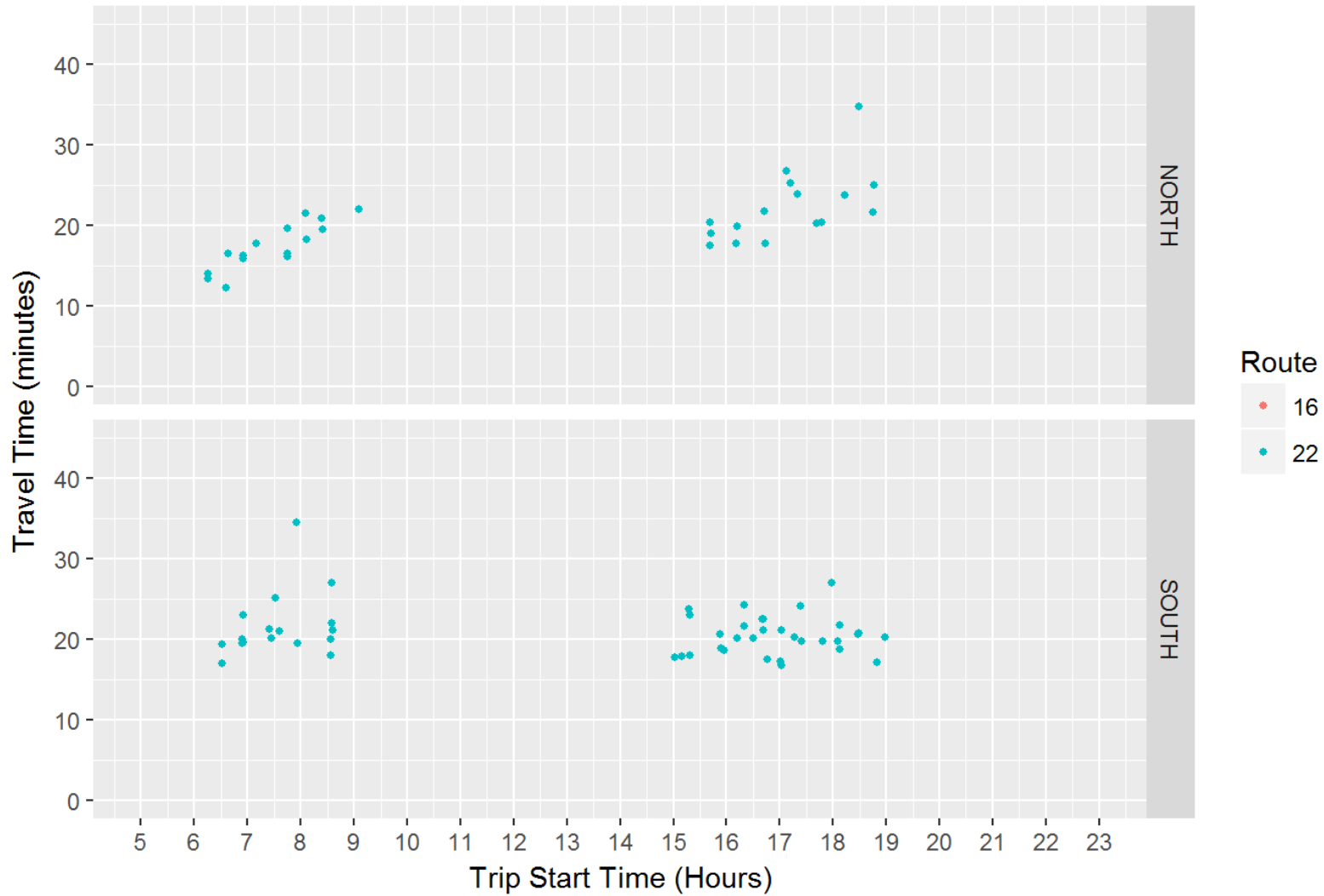
RIDE ON

Travel Time from/To Colesville & University and the Silver Spring Transit Center



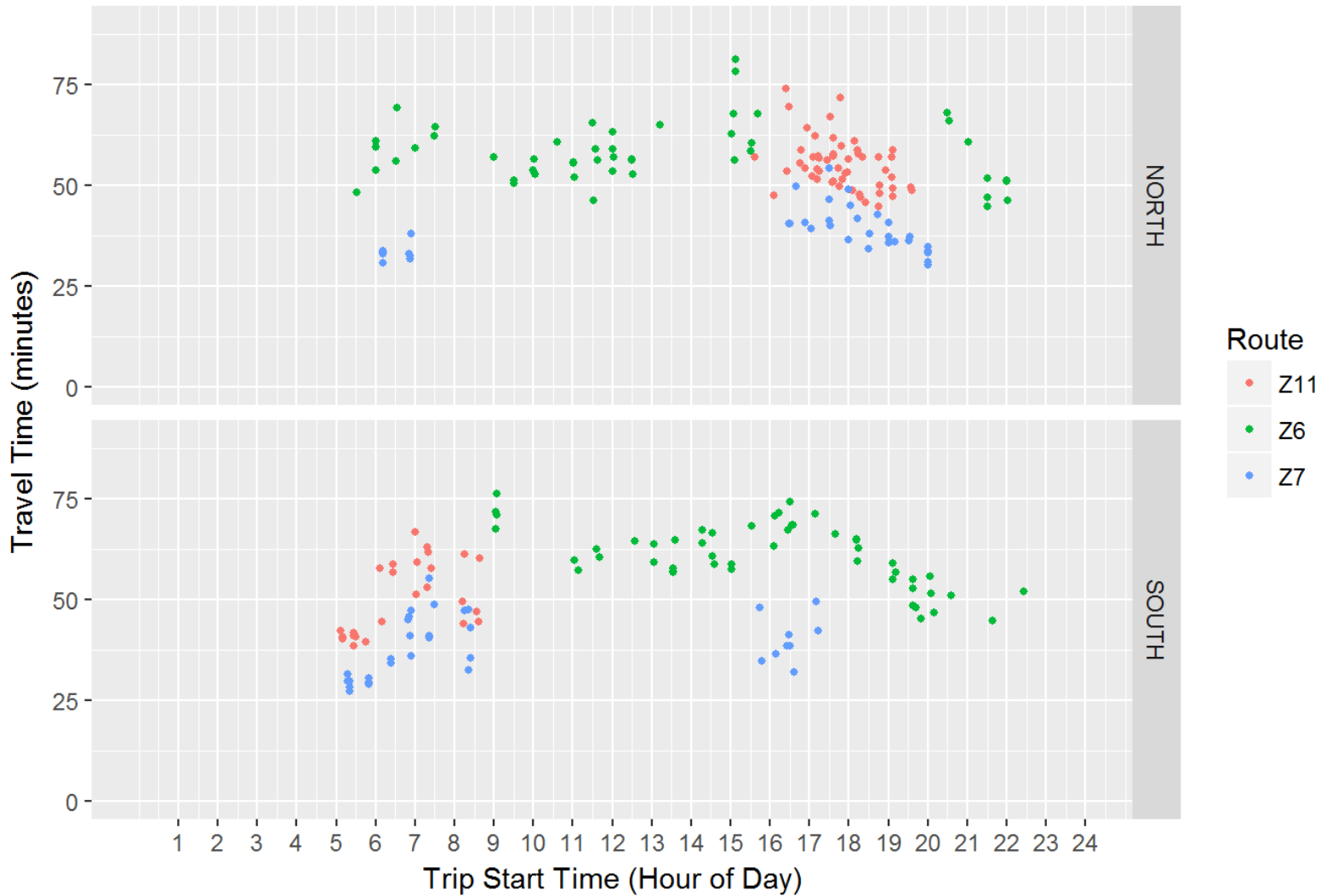
RIDE ON

Travel Time from/To White Oak TC and the Silver Spring Transit Center



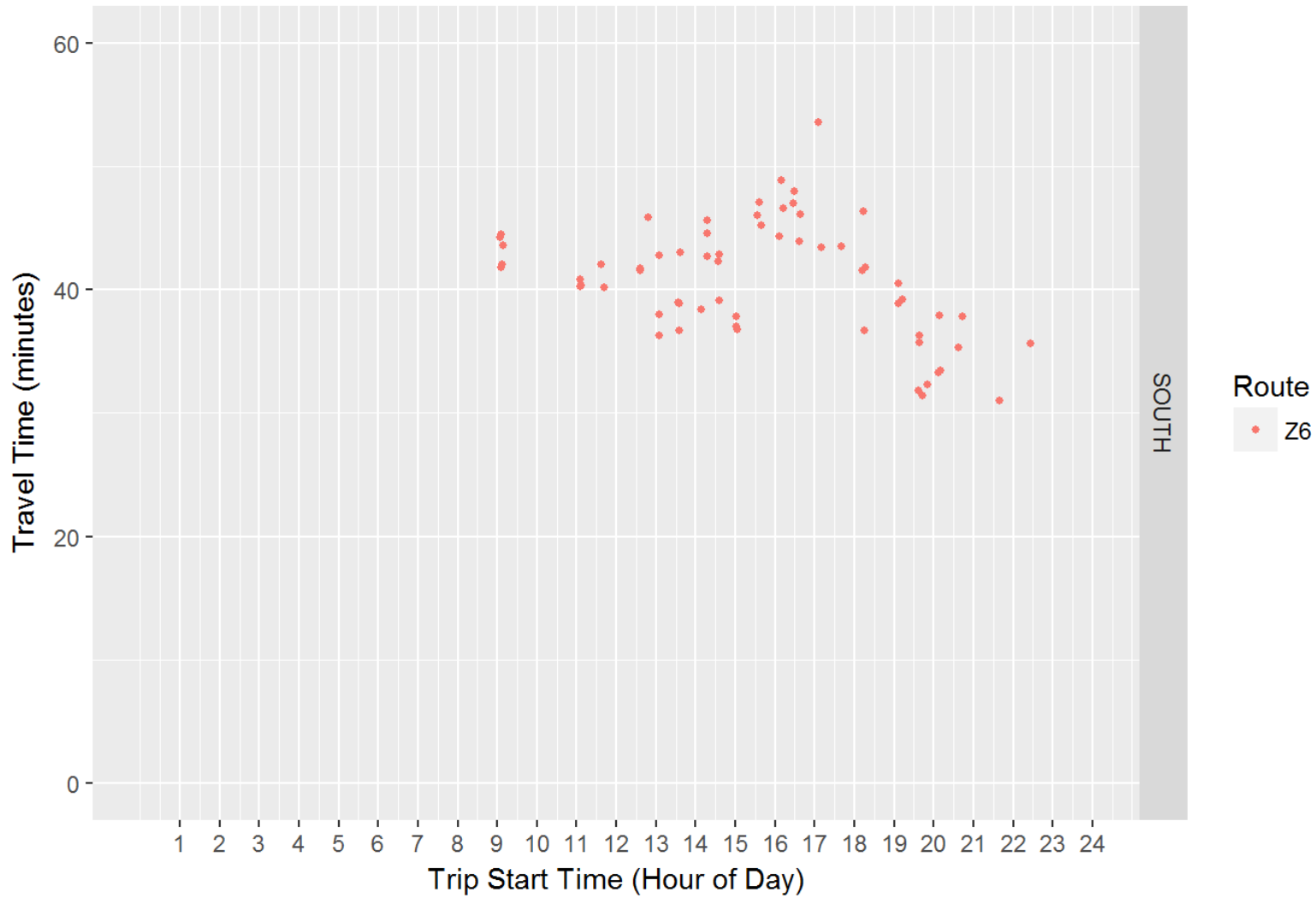
WMATA

### Travel Time From/To Burtonsville P&R and the Silver Spring Transit Center



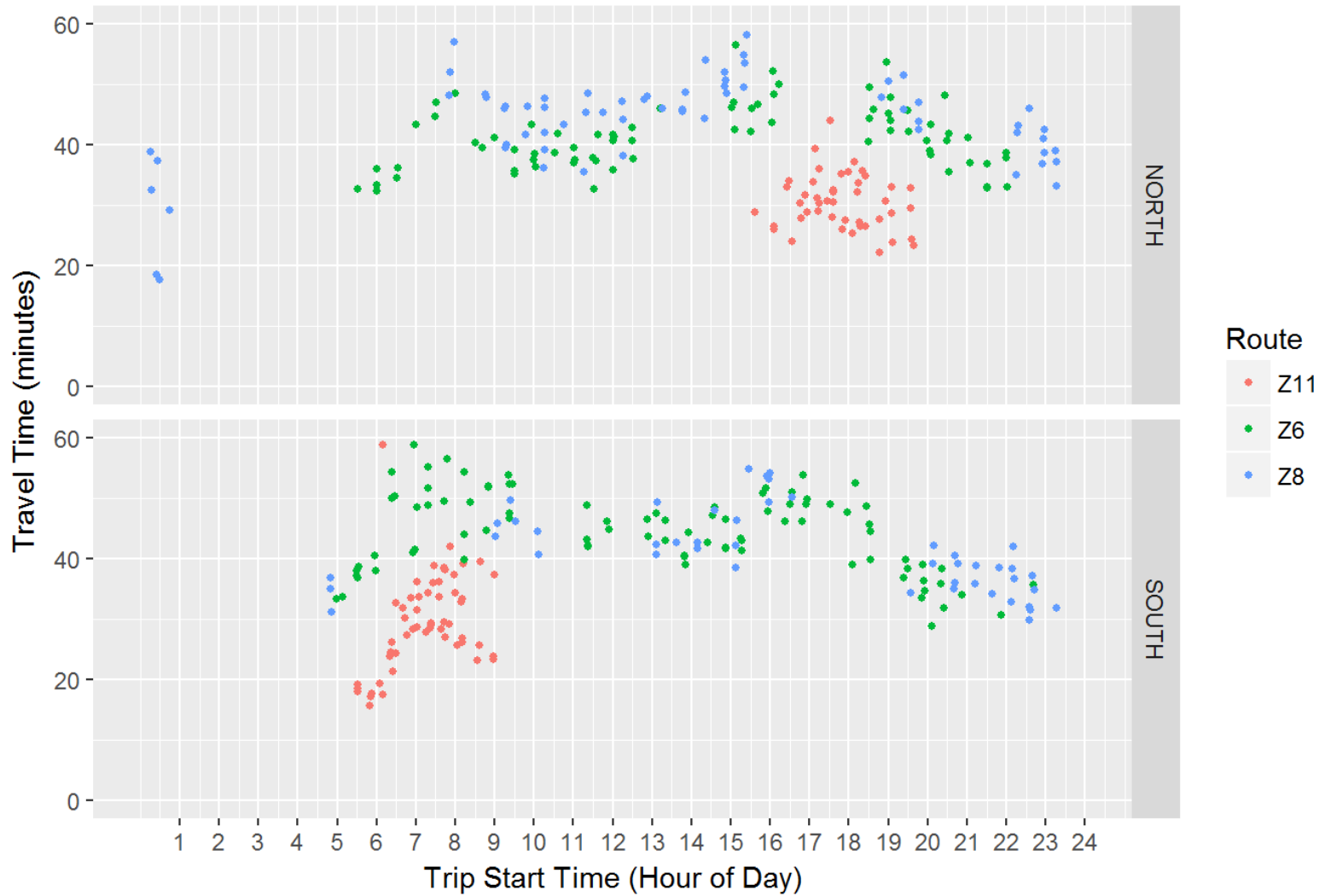
WMATA

### Travel Time From/To Burtonsville P&R and the White Oak Transit Center



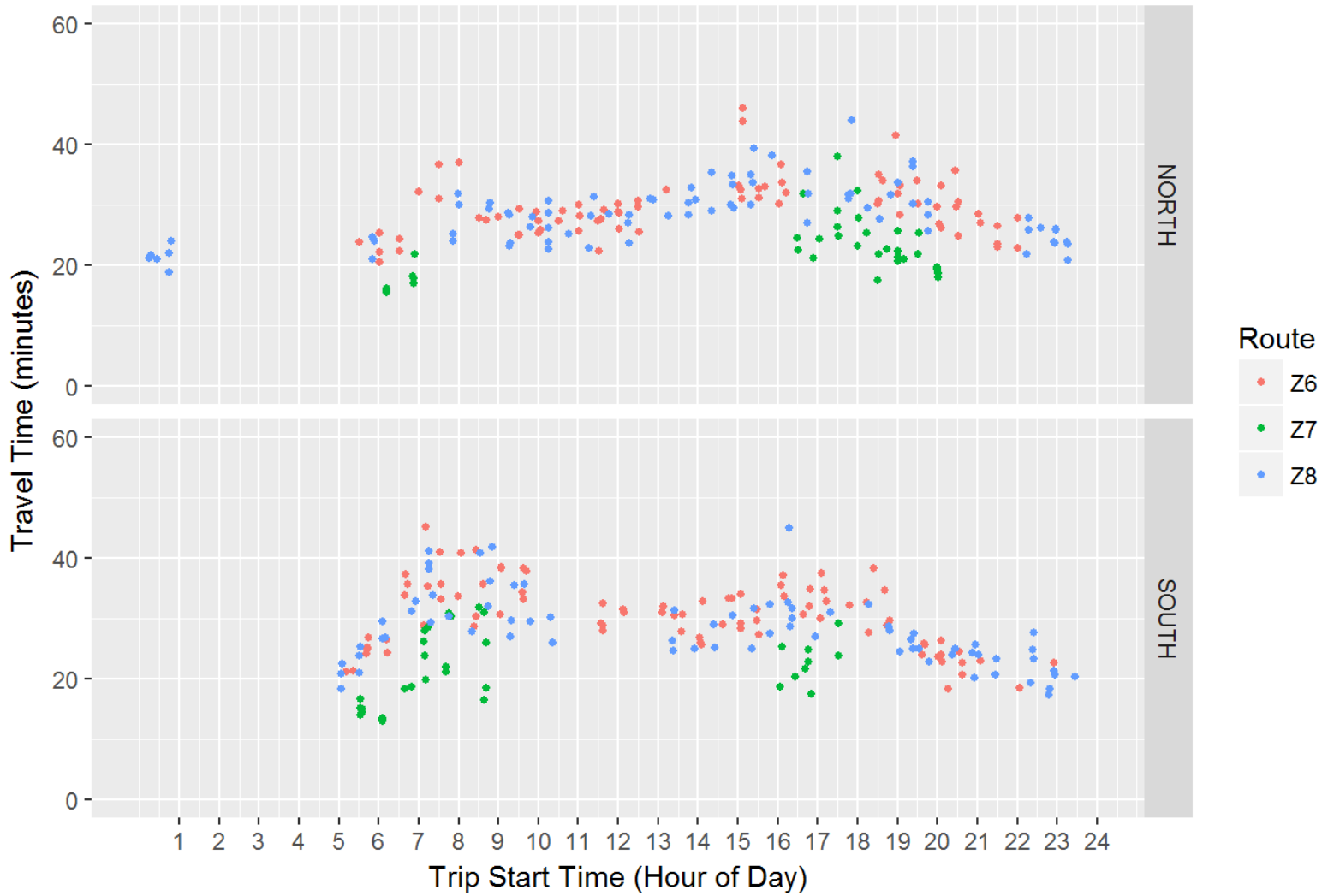
WMATA

### Travel Time From/To Briggs Chaney P&R and the Silver Spring Transit Center



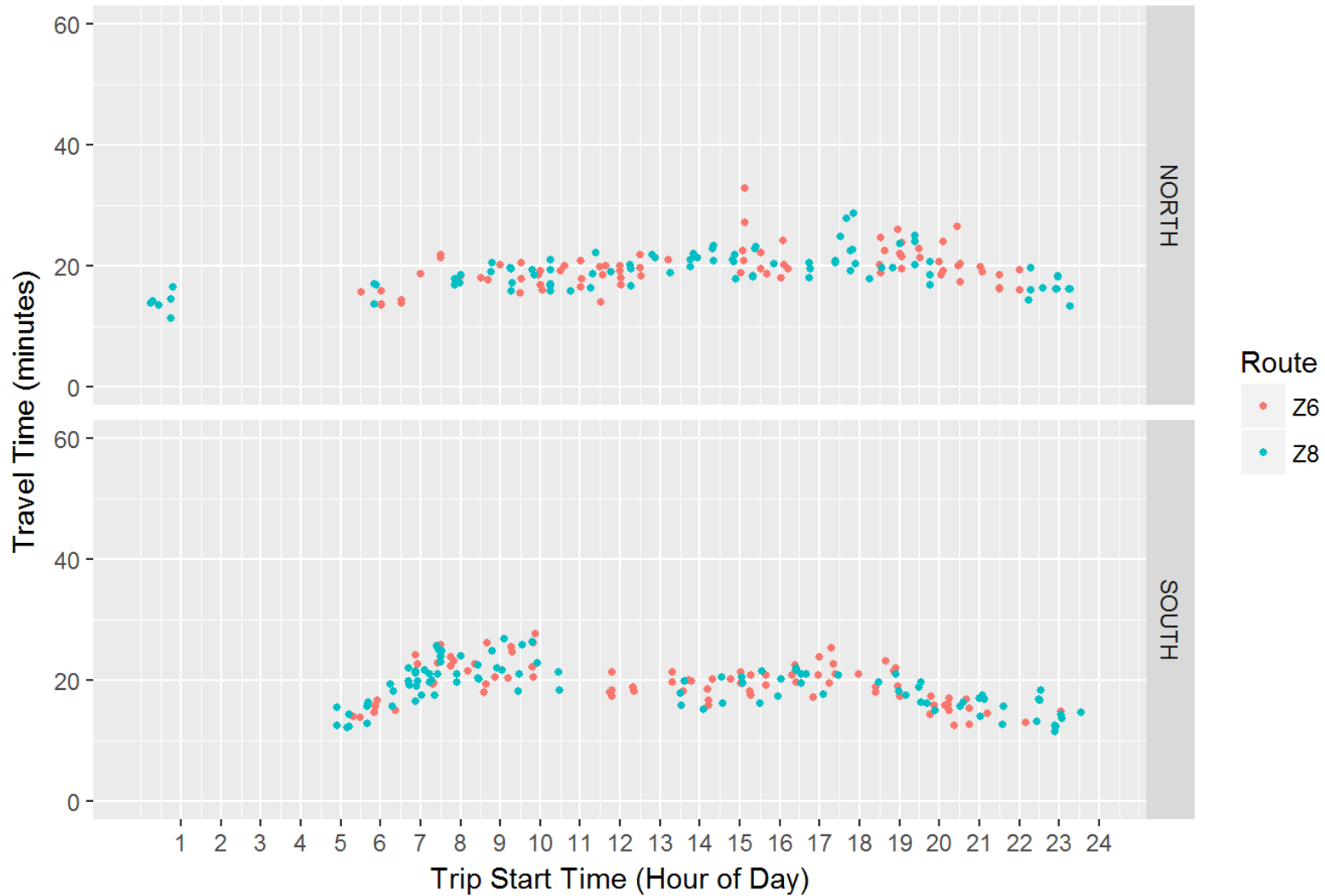
WMATA

### Travel Time From/To Tech Road and the Silver Spring Transit Center



WMATA

### Travel Time From/To White Oak Transit Center and the Silver Spring Transit Center



WMATA

### Travel Time From/To University Drive at US-29 and the Silver Spring Transit Center

