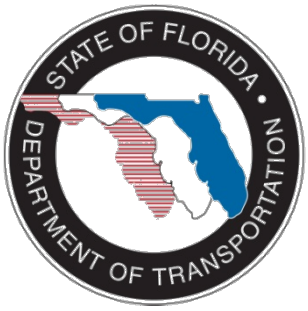


**White Paper**

# SunGuide® Software System


# Volume-Weighted Speeds for Transportation Sensor Subsystem Alerts

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## Prepared for:

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# Study Background

The basic concept of the transportation sensor subsystem (TSS) alerts is to warn operators of potential traffic-related issues on monitored roadways and provide them an option to take action. After the TSS alerts functionality was added to SunGuide® software, operational experience has shown that SunGuide software often produces such a large number of these alerts, resulting in operators ignoring most of them. In the Florida Department of Transportation (FDOT) District Five (D5), for example, SunGuide software generates an average of nearly 3,000 TSS alerts per day.

A study was performed to address this issue of excessive alerts by better-calculating average speeds and applying an additional alert filter. This is intended to reduce the number of alerts by triggering off the best aggregated data possible and producing a more manageable number of alerts that operators can verify. This does not, however, validate that the remaining alerts generated are the result of adverse traffic conditions; it only eliminates the alerts that are likely invalid.

The study verified that the following functionality does have a positive effect on reducing the number of TSS alerts:

- *Calculate volume-weighted speed averages*: This gives more emphasis on reported speeds for time intervals with a larger reported volume.
- *Filter speeds used in calculations for low volumes of data*: This ignores reported speeds if volumes are too low.

# Study Results

Table 1 lists the top ten TSS alert-producing TSS links within FDOT D5's system. The table contains:

- **Alert Count**: The number of alerts generated using the existing SunGuide software algorithm.
- **Volume-Weighted Only**: The number of alerts generated if the alerts were triggered off of volume-weighted speeds.
- **Volume-Weighted plus Volume Filter**: The number of alerts generated if the alerts were triggered off of volume-weighted speeds and speeds based off of very low volumes (three vehicles or less) were ignored.

**Table 1: Top Ten TSS Alert-Producing TSS Links in FDOT D5**

| TSS Link | Alert Count | Volume-Weighted Only | Volume-Weighted plus Volume Filter |
|---|---|---|---|
| **I-4 Just W of Saxon** | 518 | 171 | 6 |
| **I95-I4** | 493 | 288 | 15 |
| **SR 528 @ I-95** | 491 | 344 | 4 |
| **I-4 West of 417** | 425 | 82 | 3 |
| **SR 528 E of Friday Rd** | 408 | 402 | 5 |
| **SR 528 @ Friday Rd** | 402 | 386 | 12 |

| TSS Link | Alert Count | Volume-Weighted Only | Volume-Weighted plus Volume Filter |
|---|---|---|---|
| I-4 West of SR 436 | 399 | 30 | 8 |
| SR 528 W of I-95 | 391 | 225 | 7 |
| SR 528 @ Satellite Blvd | 384 | 295 | 6 |
| I-95 NB @ MM 248.9 | 378 | 243 | 11 |

These initial results were presented during the Change Management Board (CMB) Meeting held on August 15, 2012. Reference slides 44 to 50 of the CMB meeting slides (http://www.dot.state.fl.us/trafficoperations/ITS/Projects_Deploy/CMB/Meetings/120815%20Meeting/2012.08.15%20CMB%20Presentation%20Masterslides.pdf).

## Validating Remaining Alerts

An additional study was performed on four TSS links, as follows:

1. *I-4 Just W of Saxon*: This TSS link produced 518 TSS alerts during the study period using the existing algorithm. When the alerting was triggered off of volume-weighted speed averages, the number of alerts dropped to 171. When an addition filter was applied to only use speeds that were calculated using more than three vehicles, the number of alerts dropped to six.
2. *I95-I4*: This TSS link produced 493 TSS alerts during the study period using the existing algorithm. When the alerting was triggered off of volume-weighted speed averages, the number of alerts dropped to 288. When an addition filter was applied to only use speeds that were calculated using more than three vehicles, the number of alerts dropped to 15.
3. *SR 528 @ I-95*: This TSS link produced 491 TSS alerts during the study period using the existing algorithm. When the alerting was triggered off of volume-weighted speed averages, the number of alerts dropped to 344. When an addition filter was applied to only use speeds that were calculated using more than three vehicles, the number of alerts dropped to four.
4. *SR528 @ Friday Rd:* This TSS link produced 408 TSS alerts during the study period using the existing algorithm. When the alerting was triggered off of volume-weighted speed averages, the number of alerts dropped to 402. When an addition filter was applied to only use speeds that were calculated using more than three vehicles, the number of alerts dropped to five.

Figures 1 to 4 show the volume-weighted speed averages for these three TSS links for the week of May 6 to 12, 2012. The red arrows indicate when the TSS alert was triggered using the volume-weighted averages plus the volume filter.

The following summarizes the findings link by link:

1. *I-4 Just W of Saxon*: The reported data from Tuesday, May 8, shows that speeds were low and erratic throughout the day. This is likely not true to conditions since there were no reported issues during this time. However, in actual operations, false TSS alerts could be triggered from a possible failing sensor such as this. The other two days in which a TSS

alert was triggered appear to be conditions in which speeds dropped during morning peak hours. Separate traffic events, both crashes, on Monday and Thursday, May 7 and 10, resulted in these slow conditions. The TSS alerts could have helped to alert operators of these events.

2. *I95-I4*: The reported data follows an interesting track for this sensor. Nearly all TSS alerts were triggered on Monday, May 7. Throughout the day, overall speeds were very low; no traffic events occurred near this sensor on that day. On Tuesday night, May 8, the sensor failed completely, reporting no data for more than 36 hours. Following this failed period, no TSS alerts were triggered. It is possible that the TSS alerts triggered on May 7 were false alerts, resulting from erratic sensor behavior.
3. *SR 528 @ I-95:* The reported data on Sunday, May 6, dropped in late morning due to a congestion event. Once this occurred, one TSS alert was triggered. The following two TSS alerts, Sunday night and Monday, May 6 and 7, seemed to be reporting anomalies; the reported speeds dropped steeply for no apparent reason and in both cases only lasted a couple minutes. The fourth and final TSS alert was triggered Monday night, May 7, due to a failed sensor. The sensor remained offline until late Thursday morning, May 10, after which no further alerts were triggered. On Friday, May 11, the sensor reported some odd behavior, but reported that speeds remained above thresholds and did not trigger an alert.
4. *SR 528 @ Friday Rd*: The reported data every morning appears to be suspect for this TSS alert. Consequently, the TSS alerts that occur during these periods may be triggered from erroneous data. Two events were reported near this TSS link, both of which triggered TSS alerts. In the late morning of Sunday, May 6, a congestion event triggered a single TSS alert and in the evening of Friday, May 11, a prolonged crash event triggered two TSS alerts.

Using volume-weighted averaging plus a volume filter eliminates a large number of TSS alerts. These methods do not guarantee that the remaining TSS alerts reported indicate a traffic event. In some cases, TSS alerts are still triggered due to sensor failures or other data quality issues. However, the number of TSS alerts is significantly less using these methods, making operator validation of the alerts more operationally viable.

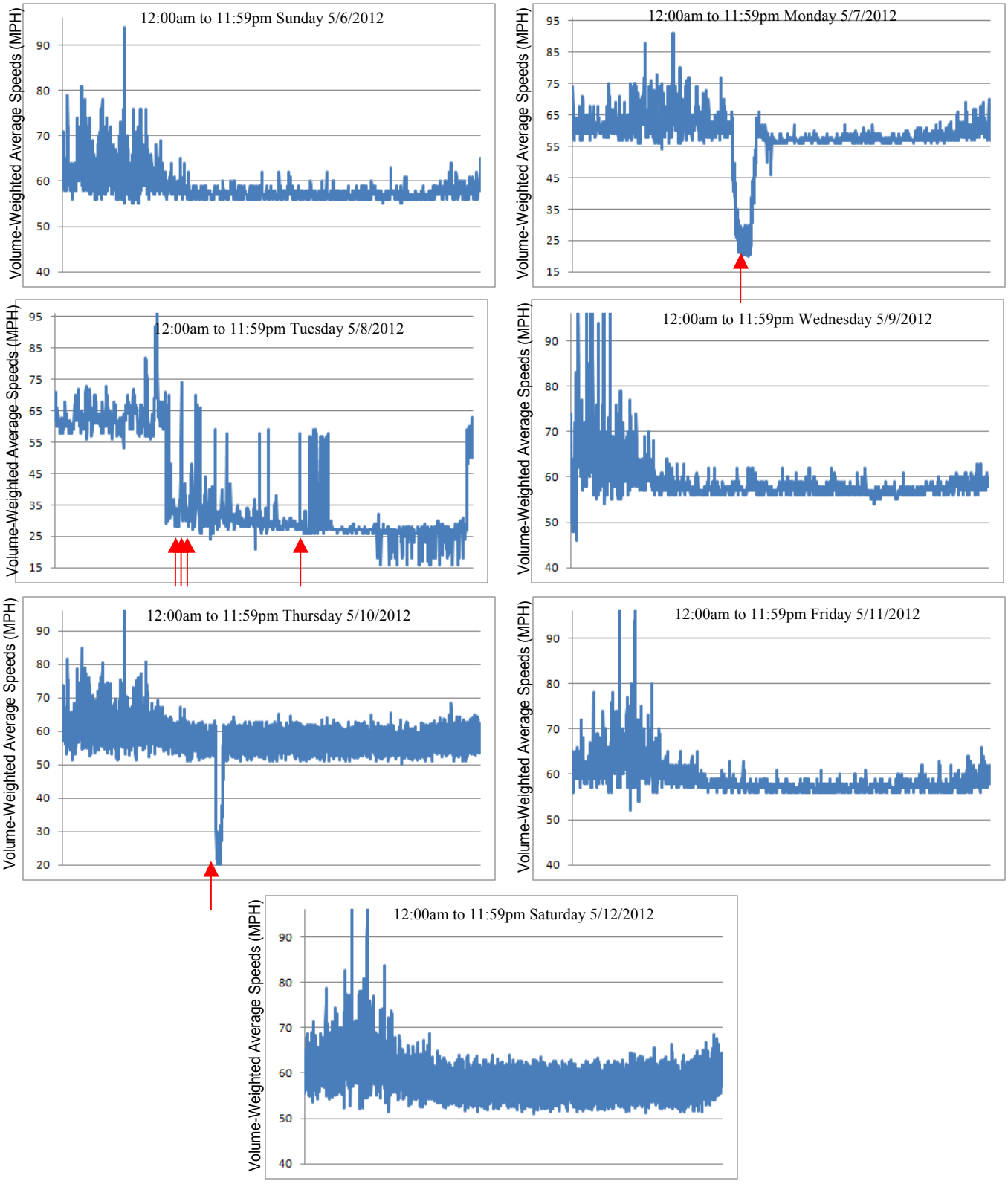



**Figure 1: Volume-Weighted Speed Averages for "I-4 Just W of Saxon"**

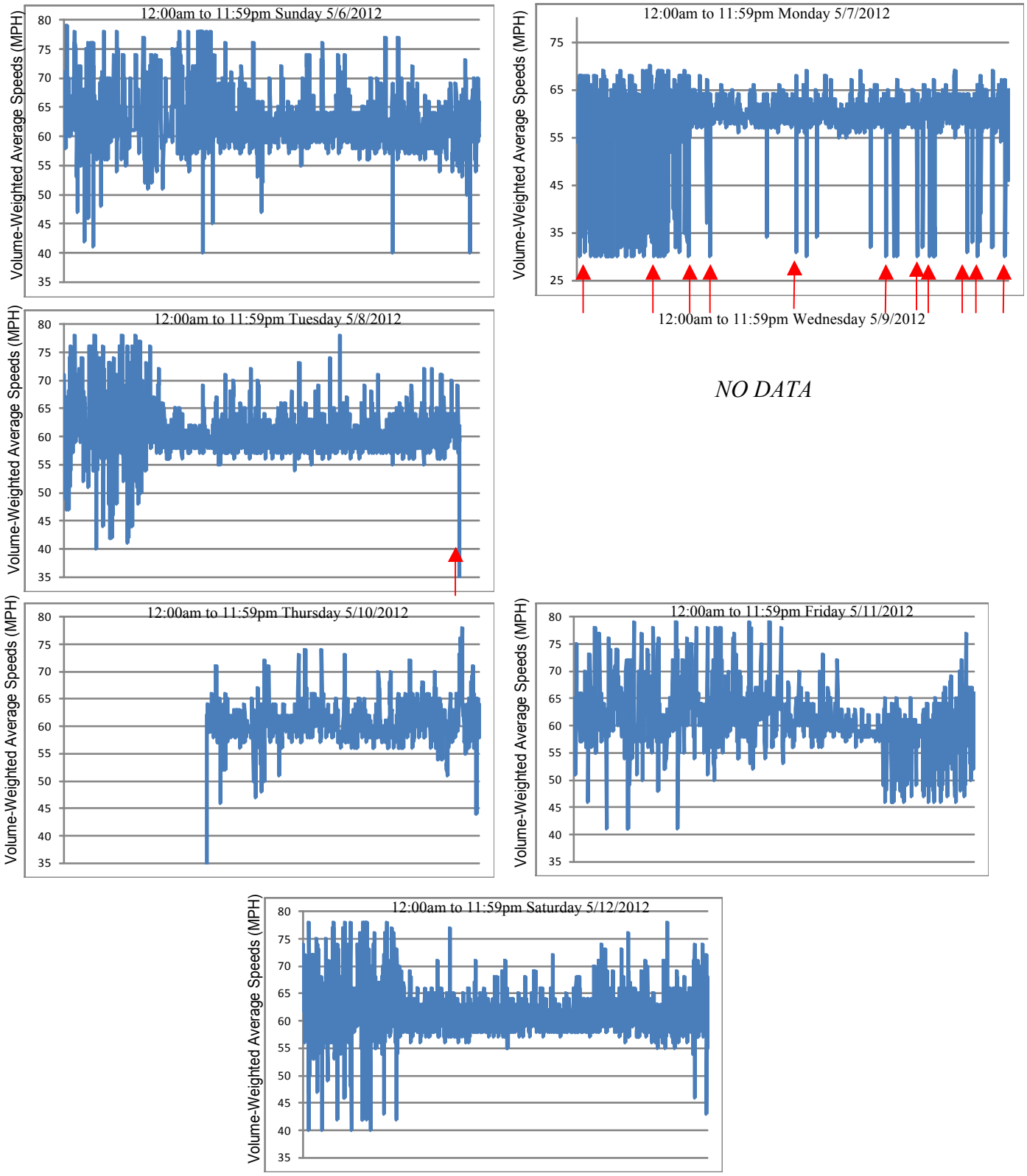
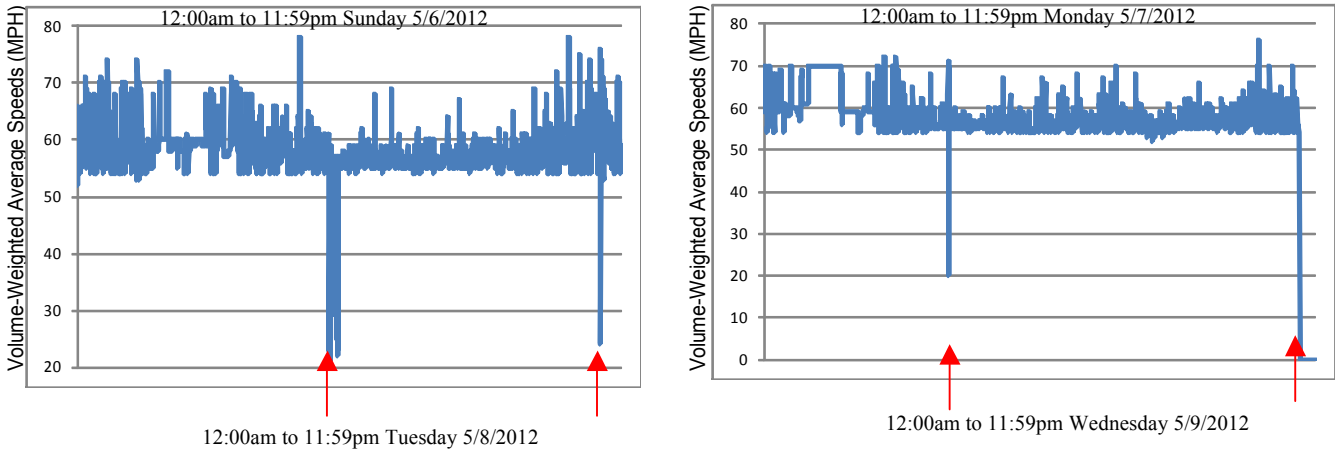



**Figure 2: Volume-Weighted Speed Averages for "I9-I4"**

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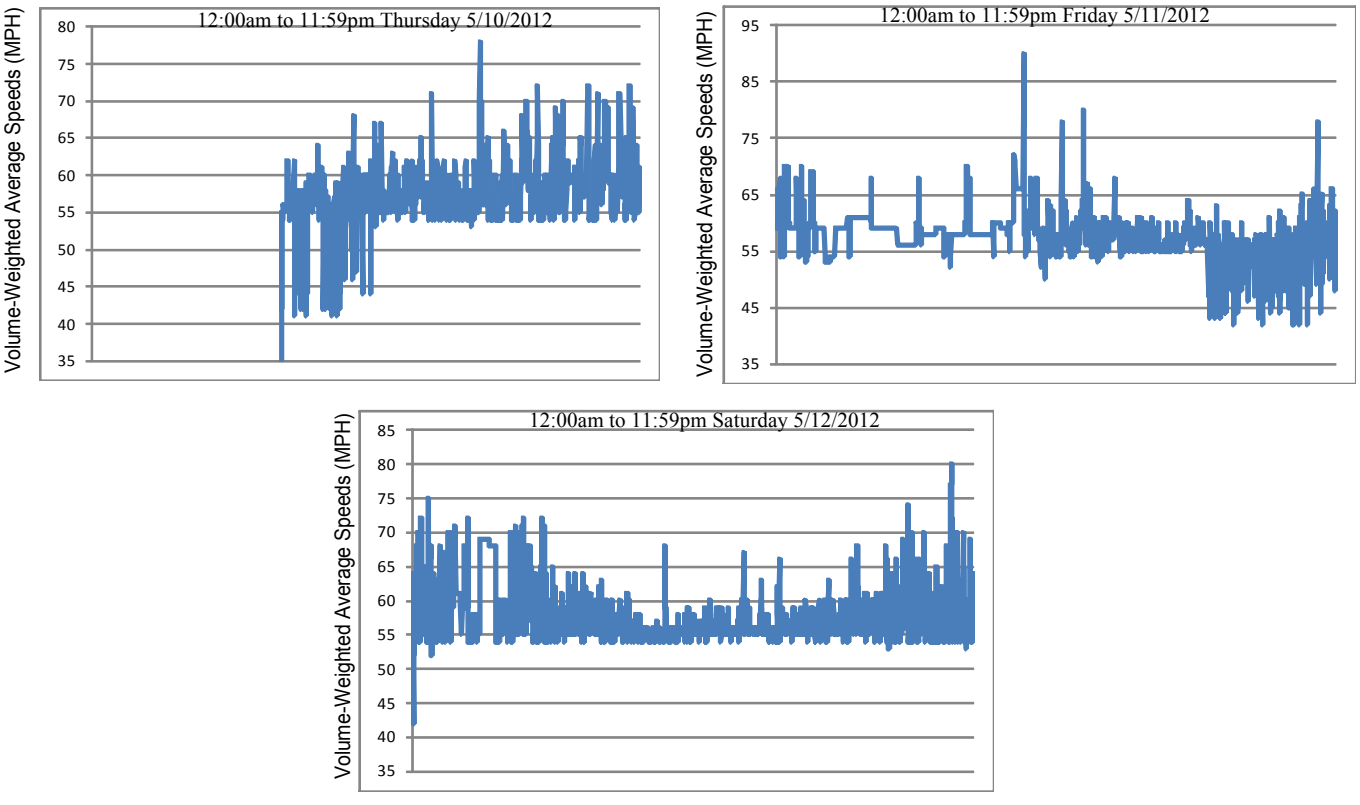


**Figure 3: Volume-Weighted Speed Averages for "SR 528 @ I-95"**

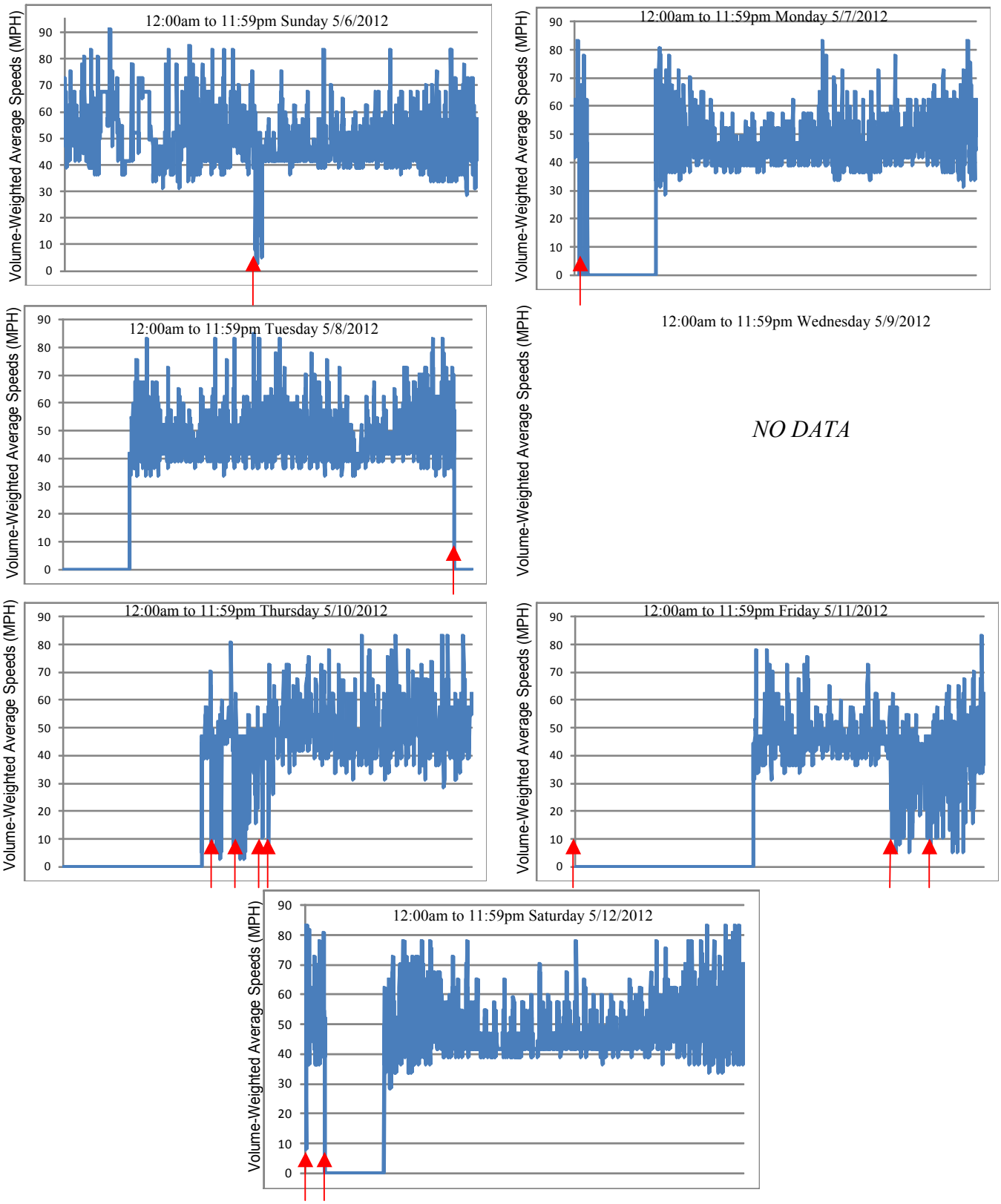


**Figure 4: Volume-Weighted Speed Averages for "SR 528 @ Friday Rd"**