# Cascade / Monster: Errors in the Traffic Study and Peer Review

**Zieff's team presented their traffic study results during the Wayland ZBA hearings in September and October**, based on the study included in Zieff's 40B Comprehensive Permit application. The Wayland ZBA hired TEC to do a 'peer review' and make sure the report was correct. Both contain multiple errors and omissions:

- Much of the data in this traffic report was not collected using equipment suited for this type of traffic, and contains significant errors. Data errors undermine the validity of the analyses and conclusions. Significant traffic issues in the area were not covered. The analyses contain errors and did not include the level of service on Route 20. The TEC peer review did not catch most of these errors and omissions.
- The Wayland ZBA should commission a new, independent and more accurate traffic study, which should also include traffic issues 1/4 mile to the west of the site, impacts on Pine Brook Road and Plain Road, and level of service analyses for Route 20. A LIDAR / radar based ATR system should be used to collect accurate data at the speed range typical in the area, including stop-and-go. The data quality control process must be more thorough and documented.
- Future peer reviews commissioned by the Wayland ZBA need to be more thorough and complete.

**Summary of key issues:**

1. **Data errors:** ProtectWayland members who commute east on Route 20 report that their average speed near the former Mahoney's Garden Center is typically stop-and-go to 5 mph at the peak of the morning rush hour. According to Zieff's traffic study, the average speed is 28 mph and 45% drive faster than 30 mph. This is not credible. Data errors were caused by the use of inappropriate data collection equipment, which undermines the entire report. If the traffic data is wrong, the analyses and conclusions based on that data are also wrong. This major problem was not noted in TEC's peer review. *(See the following pages and page 14 for details on data errors.)*
2. **Calendar errors:** A garden center in the Wayland area is closed or has minimal business for ~6 months of the year. For ~6 months, all of the cars added by Zieff's new apartment complex would be *new* traffic, all day. This was not mentioned in Zieff's study, but the TEC peer review noted the error.

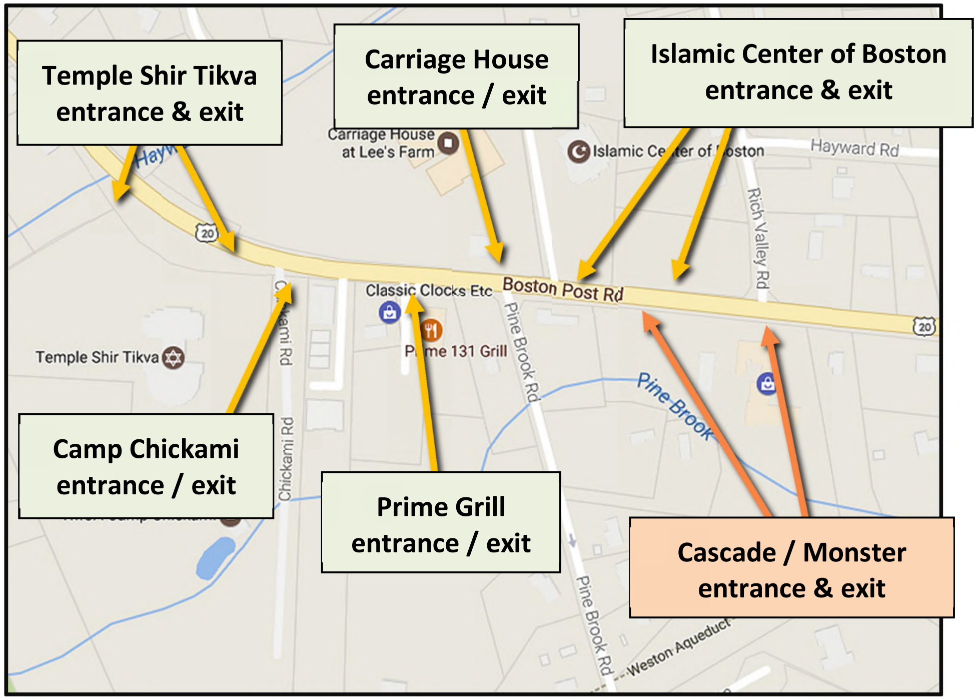
3. **Time errors:** A garden center does not open until 9am. All of the cars added to the morning commute by Zeiff's apartment complex would be new. This was not noted in the traffic study or the TEC peer review.

4. **Inadequate data:** There are unusual traffic jams in this area, in addition to the daily commute. Carriage House, the Islamic Center of Boston, Prime Bar Grill, Camp Chickami and Temple Shir Tikva are all within ¼ mile on Route 20. Traffic and parking on neighborhood streets are issues during holy days.

   Congestion on Route 20 also pushes traffic down Pine Brook and Plain Road, which connect to Route 20.

   Neither of these significant traffic issues were included in Zeiff's study. The first was missed in the TEC peer review.

**Concentrated Traffic Jams – Not Included in the Study**



5. **Inadequate analyes:** Zieff's study includes no standard analyses of the impact and level of service on Route 20. The driveway at the apartment complex is analyzed – but not Route 20. Traffic jams on Route 20 are obviously a key issue. This was missed in TEC's peer review.

With all of these errors and omissions, Wayland cannot rely on Zieff's traffic study. The Wayland ZBA should commission a new, independent and more accurate traffic study and take steps to ensure that all future peer reviews are more thorough and credible.

Details are included on the following pages.

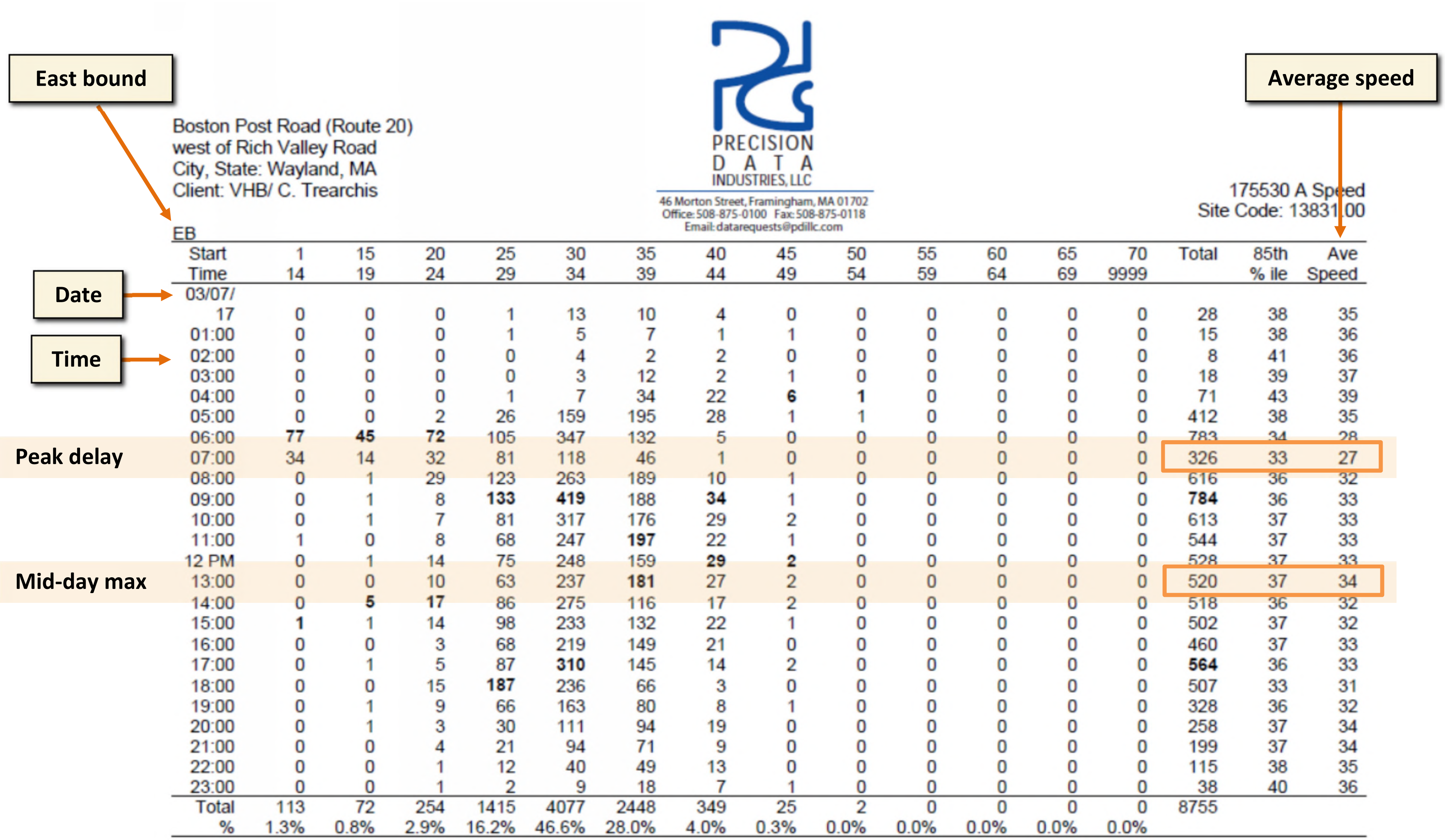
1. **Traffic data collection process:**

   - Zeiff hired VHB to perform the traffic study, an established national firm that analyzes traffic for a wide range of clients. See: www.vhb.com
   - VHB sub-contracted traffic data collection and production of most of the reports to Precision Data Industries (PDI) a small company in Framingham. See: www.pdillc.com
   - PDI installed pneumatic tubes (AKA "road tubes") and a Jamar automatic traffic recorder (ATR) on Route 20 to count the number and type of vehicles and record their speed. The limited budget and scope for traffic data collection was determined, however, by Zieff and VHB. More complete data collection and reporting was possible, with equipment that is accurate at slow / stop-and-go speeds, at more locations for longer periods of time.
   - Traffic counts, speed and classification data was recorded with road tubes and a Jamar ATR on Tuesday and Wednesday, 7 and 8 March, 2017 on Route 20 just west of Rich Valley Road. Traffic counts, turns and classification data were recorded with a Miovision Video Collection Unit on Thursday, April 13, 2017 along Route 20 near the intersection with Old Connecticut Path. (Miovision did not collect speed data.)
   - Many of the pages and reports in Zeiff's traffic study were created by PDI from the Jamar ATR data.
   - The traffic analyses in the study are based on this data.

2. **Traffic data errors:**

   a. **Average traffic speed out of range**: During the peak delay in the morning commute eastbound on Route 20 between 7 and 8am, the report claims the average speed was 27 to 28 mph and 45% to 50% of vehicles were driving faster than 30 mph. These reported speeds are incredibly high in an area known for stop-and-go as traffic backs up behind the intersections of Route 20, Old Connecticut Path and Plain Road, 1/3 mile to the east. According to the report, the average speed during the peak of the morning commute is just 7 mph lower than mid-day. In other words, the report claims there is *no morning traffic jam on Route 20*, simply a minor delay. This is not credible.

PDI traffic report for Tuesday, 7 March, 2017:



Boston Post Road (Route 20)
west of Rich Valley Road
City, State: Wayland, MA
Client: VHB/ C. Trearchis

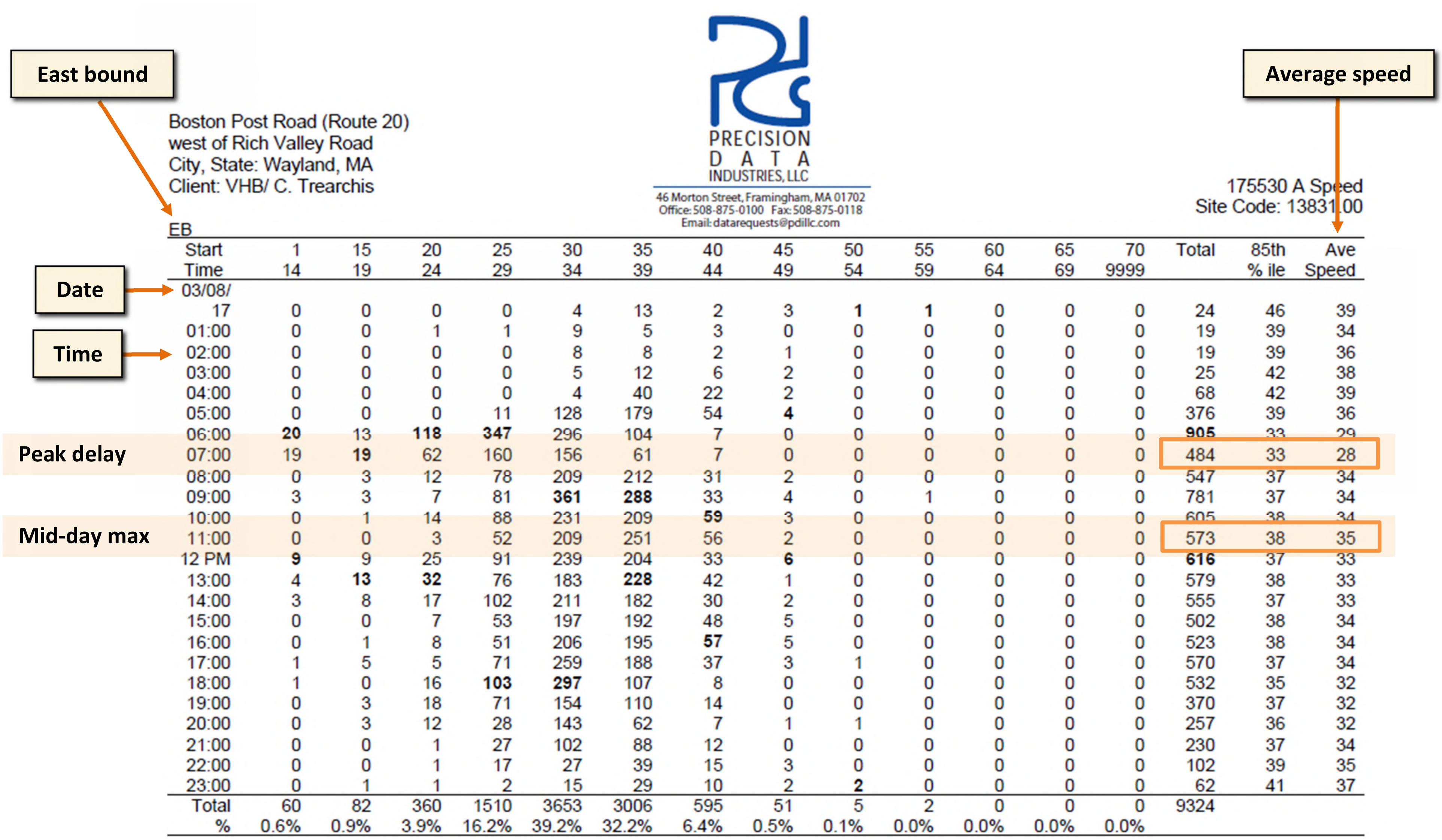
PRECISION
DATA
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

175530 A Speed
Site Code: 13831.00

EB

| Start Time | 1 14 | 15 19 | 20 24 | 25 29 | 30 34 | 35 39 | 40 44 | 45 49 | 50 54 | 55 59 | 60 64 | 65 69 | 70 9999 | Total | 85th % ile | Ave Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/07/17 | 0 | 0 | 0 | 1 | 13 | 10 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 38 | 35 |
| 01:00 | 0 | 0 | 0 | 1 | 5 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 15 | 38 | 36 |
| 02:00 | 0 | 0 | 0 | 0 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 41 | 36 |
| 03:00 | 0 | 0 | 0 | 0 | 3 | 12 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 18 | 39 | 37 |
| 04:00 | 0 | 0 | 0 | 1 | 7 | 34 | 22 | **6** | **1** | 0 | 0 | 0 | 0 | 71 | 43 | 39 |
| 05:00 | 0 | 0 | 2 | 26 | 159 | 195 | 28 | 1 | 1 | 0 | 0 | 0 | 0 | 412 | 38 | 35 |
| 06:00 | **77** | **45** | **72** | 105 | 347 | 132 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 783 | 34 | 28 |
| 07:00 | 34 | 14 | 32 | 81 | 118 | 46 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 326 | 33 | 27 |
| 08:00 | 0 | 1 | 29 | 123 | 263 | 189 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 616 | 36 | 32 |
| 09:00 | 0 | 1 | 8 | **133** | **419** | 188 | **34** | 1 | 0 | 0 | 0 | 0 | 0 | **784** | 36 | 33 |
| 10:00 | 0 | 1 | 7 | 81 | 317 | 176 | 29 | 2 | 0 | 0 | 0 | 0 | 0 | 613 | 37 | 33 |
| 11:00 | 1 | 0 | 8 | 68 | 247 | **197** | 22 | 1 | 0 | 0 | 0 | 0 | 0 | 544 | 37 | 33 |
| 12 PM | 0 | 1 | 14 | 75 | 248 | 159 | **29** | **2** | 0 | 0 | 0 | 0 | 0 | 528 | 37 | 33 |
| 13:00 | 0 | 0 | 10 | 63 | 237 | **181** | 27 | 2 | 0 | 0 | 0 | 0 | 0 | 520 | 37 | 34 |
| 14:00 | 0 | **5** | **17** | 86 | 275 | 116 | 17 | 2 | 0 | 0 | 0 | 0 | 0 | 518 | 36 | 32 |
| 15:00 | **1** | 1 | 14 | 98 | 233 | 132 | 22 | 1 | 0 | 0 | 0 | 0 | 0 | 502 | 37 | 32 |
| 16:00 | 0 | 0 | 3 | 68 | 219 | 149 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 460 | 37 | 33 |
| 17:00 | 0 | 1 | 5 | 87 | **310** | 145 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | **564** | 36 | 33 |
| 18:00 | 0 | 0 | 15 | **187** | 236 | 66 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 507 | 33 | 31 |
| 19:00 | 0 | 1 | 9 | 66 | 163 | 80 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 328 | 36 | 32 |
| 20:00 | 0 | 1 | 3 | 30 | 111 | 94 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 258 | 37 | 34 |
| 21:00 | 0 | 0 | 4 | 21 | 94 | 71 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 199 | 37 | 34 |
| 22:00 | 0 | 0 | 1 | 12 | 40 | 49 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 38 | 35 |
| 23:00 | 0 | 0 | 1 | 2 | 9 | 18 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 38 | 40 | 36 |
| Total | 113 | 72 | 254 | 1415 | 4077 | 2448 | 349 | 25 | 2 | 0 | 0 | 0 | 0 | 8755 | | |
| % | 1.3% | 0.8% | 2.9% | 16.2% | 46.6% | 28.0% | 4.0% | 0.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | | |

PDI traffic report for Wednesday, 8 March, 2017:



Boston Post Road (Route 20)
west of Rich Valley Road
City, State: Wayland, MA
Client: VHB/ C. Trearchis

PRECISION
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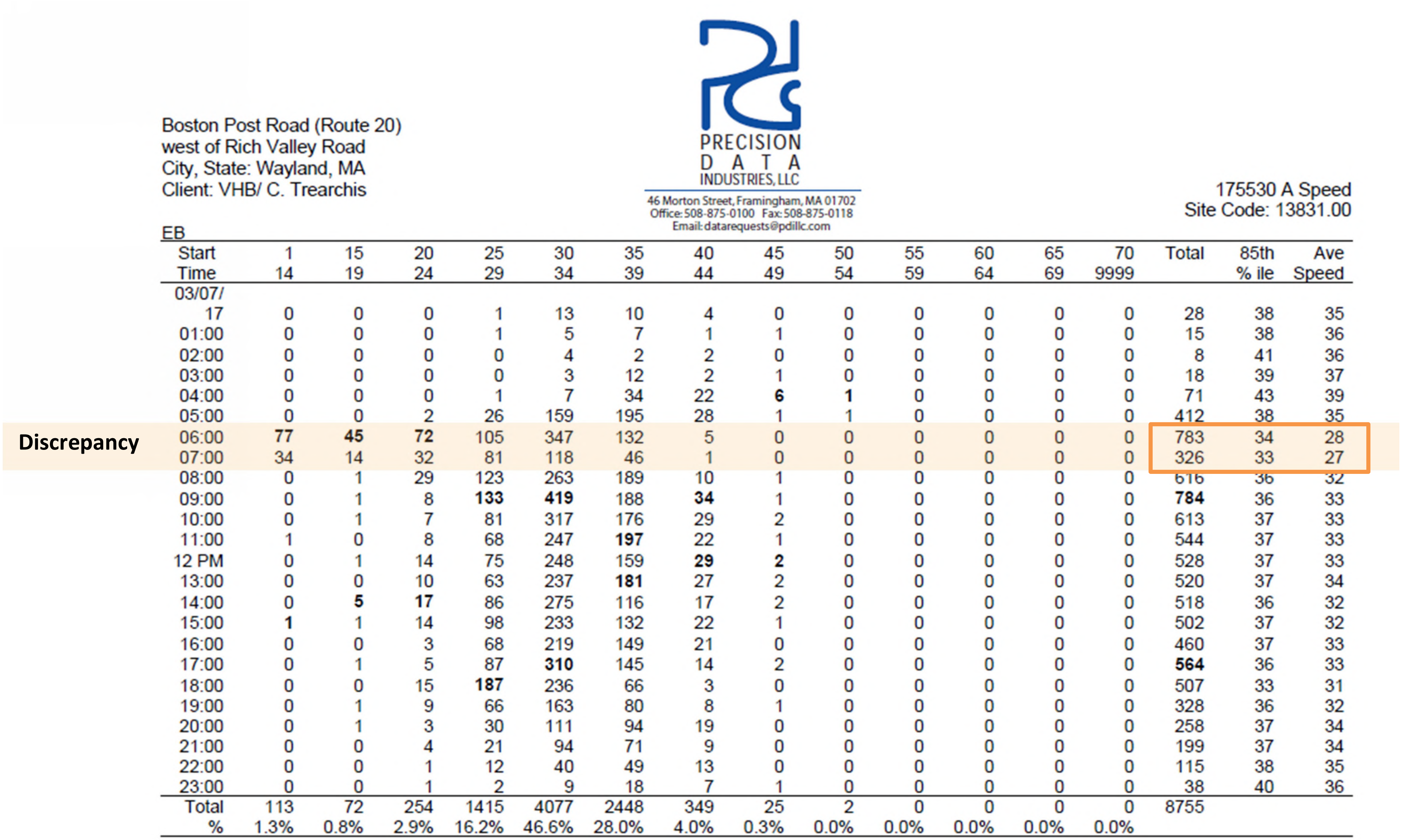
| Start Time | 1 14 | 15 19 | 20 24 | 25 29 | 30 34 | 35 39 | 40 44 | 45 49 | 50 54 | 55 59 | 60 64 | 65 69 | 70 9999 | Total | 85th % ile | Ave Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/08/17 | 0 | 0 | 0 | 0 | 4 | 13 | 2 | 3 | **1** | **1** | 0 | 0 | 0 | 24 | 46 | 39 |
| 01:00 | 0 | 0 | 1 | 1 | 9 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 39 | 34 |
| 02:00 | 0 | 0 | 0 | 0 | 8 | 8 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 19 | 39 | 36 |
| 03:00 | 0 | 0 | 0 | 0 | 5 | 12 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 25 | 42 | 38 |
| 04:00 | 0 | 0 | 0 | 0 | 4 | 40 | 22 | 2 | 0 | 0 | 0 | 0 | 0 | 68 | 42 | 39 |
| 05:00 | 0 | 0 | 0 | 11 | 128 | 179 | 54 | **4** | 0 | 0 | 0 | 0 | 0 | 376 | 39 | 36 |
| 06:00 | **20** | 13 | **118** | **347** | 296 | 104 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | **905** | 33 | 29 |
| 07:00 | 19 | **19** | 62 | 160 | 156 | 61 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 484 | 33 | 28 |
| 08:00 | 0 | 3 | 12 | 78 | 209 | 212 | 31 | 2 | 0 | 0 | 0 | 0 | 0 | 547 | 37 | 34 |
| 09:00 | 3 | 3 | 7 | 81 | **361** | **288** | 33 | 4 | 0 | 1 | 0 | 0 | 0 | 781 | 37 | 34 |
| 10:00 | 0 | 1 | 14 | 88 | 231 | 209 | **59** | 3 | 0 | 0 | 0 | 0 | 0 | 605 | 38 | 34 |
| 11:00 | 0 | 0 | 3 | 52 | 209 | 251 | 56 | 2 | 0 | 0 | 0 | 0 | 0 | 573 | 38 | 35 |
| 12 PM | **9** | 9 | 25 | 91 | 239 | 204 | 33 | **6** | 0 | 0 | 0 | 0 | 0 | **616** | 37 | 33 |
| 13:00 | 4 | **13** | **32** | 76 | 183 | **228** | 42 | 1 | 0 | 0 | 0 | 0 | 0 | 579 | 38 | 33 |
| 14:00 | 3 | 8 | 17 | 102 | 211 | 182 | 30 | 2 | 0 | 0 | 0 | 0 | 0 | 555 | 37 | 33 |
| 15:00 | 0 | 0 | 7 | 53 | 197 | 192 | 48 | 5 | 0 | 0 | 0 | 0 | 0 | 502 | 38 | 34 |
| 16:00 | 0 | 1 | 8 | 51 | 206 | 195 | **57** | 5 | 0 | 0 | 0 | 0 | 0 | 523 | 38 | 34 |
| 17:00 | 1 | 5 | 5 | 71 | 259 | 188 | 37 | 3 | 1 | 0 | 0 | 0 | 0 | 570 | 37 | 34 |
| 18:00 | 1 | 0 | 16 | **103** | **297** | 107 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 532 | 35 | 32 |
| 19:00 | 0 | 3 | 18 | 71 | 154 | 110 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 370 | 37 | 32 |
| 20:00 | 0 | 3 | 12 | 28 | 143 | 62 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 257 | 36 | 32 |
| 21:00 | 0 | 0 | 1 | 27 | 102 | 88 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 230 | 37 | 34 |
| 22:00 | 0 | 0 | 1 | 17 | 27 | 39 | 15 | 3 | 0 | 0 | 0 | 0 | 0 | 102 | 39 | 35 |
| 23:00 | 0 | 1 | 1 | 2 | 15 | 29 | 10 | 2 | **2** | 0 | 0 | 0 | 0 | 62 | 41 | 37 |
| Total | 60 | 82 | 360 | 1510 | 3653 | 3006 | 595 | 51 | 5 | 2 | 0 | 0 | 0 | 9324 | | |
| % | 0.6% | 0.9% | 3.9% | 16.2% | 39.2% | 32.2% | 6.4% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | | | |

Here are photos of actual stop-and-go conditions on Route 20 during the morning commute:

These conditions are typical according to ProtectWayland members who commute on Route 20 every day. If any members of the Wayland ZBA commute on Route 20 into Boston, we are certain that your experience matches these photos.

b. **Average speed vs vehicle count discrepancy**: During both days of the traffic study, there is a discrepancy in the number of vehicles vs the average speed during the peak of the morning commute into Boston. From 6 am to 7 am, the volume of vehicles is ~100% higher than 7am to 8 am – even though the average speed is only 1 mph more:



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**Discrepancy**

| Start Time | 1 14 | 15 19 | 20 24 | 25 29 | 30 34 | 35 39 | 40 44 | 45 49 | 50 54 | 55 59 | 60 64 | 65 69 | 70 9999 | Total | 85th % ile | Ave Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/07/ 17 | 0 | 0 | 0 | 1 | 13 | 10 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 38 | 35 |
| 01:00 | 0 | 0 | 0 | 1 | 5 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 15 | 38 | 36 |
| 02:00 | 0 | 0 | 0 | 0 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 41 | 36 |
| 03:00 | 0 | 0 | 0 | 0 | 3 | 12 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 18 | 39 | 37 |
| 04:00 | 0 | 0 | 0 | 1 | 7 | 34 | 22 | **6** | **1** | 0 | 0 | 0 | 0 | 71 | 43 | 39 |
| 05:00 | 0 | 0 | 2 | 26 | 159 | 195 | 28 | 1 | 1 | 0 | 0 | 0 | 0 | 412 | 38 | 35 |
| 06:00 | **77** | **45** | **72** | 105 | 347 | 132 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 783 | 34 | 28 |
| 07:00 | 34 | 14 | 32 | 81 | 118 | 46 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 326 | 33 | 27 |
| 08:00 | 0 | 1 | 29 | 123 | 263 | 189 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 616 | 36 | 32 |
| 09:00 | 0 | 1 | 8 | **133** | **419** | 188 | **34** | 1 | 0 | 0 | 0 | 0 | 0 | **784** | 36 | 33 |
| 10:00 | 0 | 1 | 7 | 81 | 317 | 176 | 29 | 2 | 0 | 0 | 0 | 0 | 0 | 613 | 37 | 33 |
| 11:00 | 1 | 0 | 8 | 68 | 247 | **197** | 22 | 1 | 0 | 0 | 0 | 0 | 0 | 544 | 37 | 33 |
| 12 PM | 0 | 1 | 14 | 75 | 248 | 159 | **29** | **2** | 0 | 0 | 0 | 0 | 0 | 528 | 37 | 33 |
| 13:00 | 0 | 0 | 10 | 63 | 237 | **181** | 27 | 2 | 0 | 0 | 0 | 0 | 0 | 520 | 37 | 34 |
| 14:00 | 0 | **5** | **17** | 86 | 275 | 116 | 17 | 2 | 0 | 0 | 0 | 0 | 0 | 518 | 36 | 32 |
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| 16:00 | 0 | 0 | 3 | 68 | 219 | 149 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 460 | 37 | 33 |
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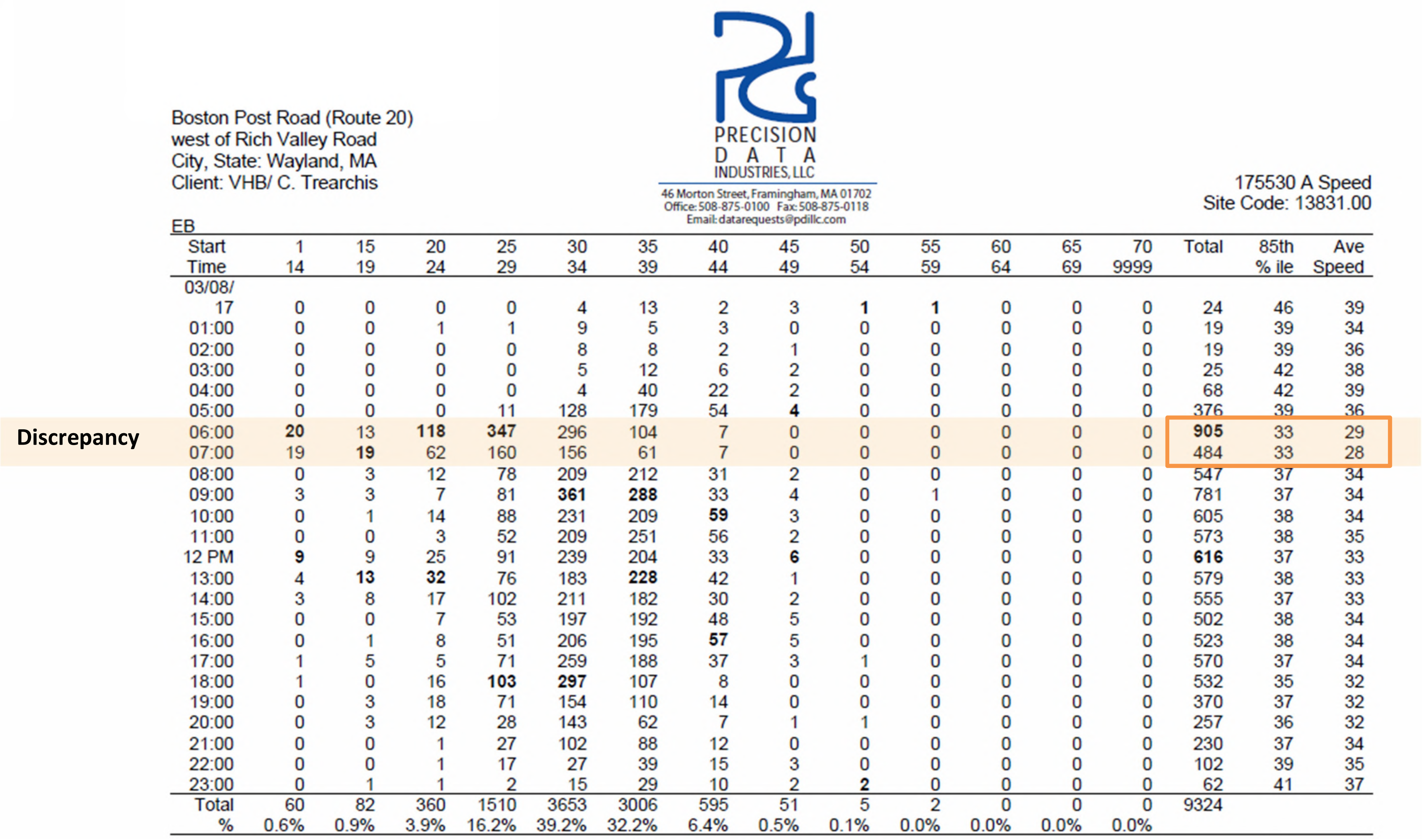
| 18:00 | 0 | 0 | 15 | **187** | 236 | 66 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 507 | 33 | 31 |
| 19:00 | 0 | 1 | 9 | 66 | 163 | 80 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 328 | 36 | 32 |
| 20:00 | 0 | 1 | 3 | 30 | 111 | 94 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 258 | 37 | 34 |
| 21:00 | 0 | 0 | 4 | 21 | 94 | 71 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 199 | 37 | 34 |
| 22:00 | 0 | 0 | 1 | 12 | 40 | 49 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 38 | 35 |
| 23:00 | 0 | 0 | 1 | 2 | 9 | 18 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 38 | 40 | 36 |
| Total | 113 | 72 | 254 | 1415 | 4077 | 2448 | 349 | 25 | 2 | 0 | 0 | 0 | 0 | 8755 | | |
| % | 1.3% | 0.8% | 2.9% | 16.2% | 46.6% | 28.0% | 4.0% | 0.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | | |

**Here is the report for the following day, Wednesday, 8 March, with the same anomaly.** How would nearly twice as many vehicles pass the same point at the same average speed? This is another indication of fundamental problems with the data:



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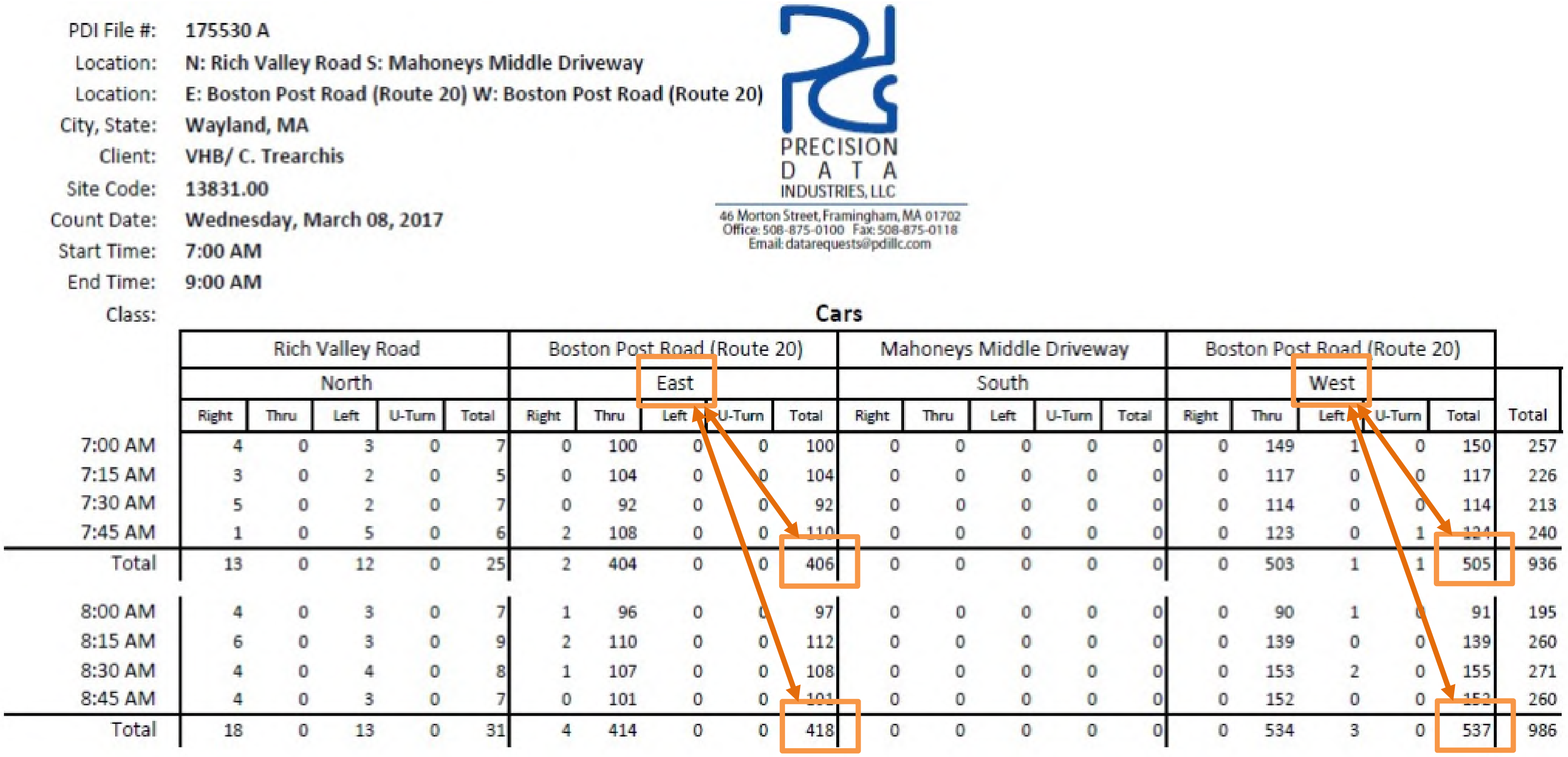
175530 A Speed
Site Code: 13831.00

EB

Discrepancy

| Start | 1 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | Total | 85th | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 14 | 19 | 24 | 29 | 34 | 39 | 44 | 49 | 54 | 59 | 64 | 69 | 9999 | | % ile | Speed |
| 03/08/17 | 0 | 0 | 0 | 0 | 4 | 13 | 2 | 3 | **1** | **1** | 0 | 0 | 0 | 24 | 46 | 39 |
| 01:00 | 0 | 0 | 1 | 1 | 9 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 39 | 34 |
| 02:00 | 0 | 0 | 0 | 0 | 8 | 8 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 19 | 39 | 36 |
| 03:00 | 0 | 0 | 0 | 0 | 5 | 12 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 25 | 42 | 38 |
| 04:00 | 0 | 0 | 0 | 0 | 4 | 40 | 22 | 2 | 0 | 0 | 0 | 0 | 0 | 68 | 42 | 39 |
| 05:00 | 0 | 0 | 0 | 11 | 128 | 179 | 54 | **4** | 0 | 0 | 0 | 0 | 0 | 376 | 39 | 36 |
| 06:00 | **20** | 13 | **118** | **347** | 296 | 104 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | **905** | 33 | 29 |
| 07:00 | 19 | **19** | 62 | 160 | 156 | 61 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 484 | 33 | 28 |
| 08:00 | 0 | 3 | 12 | 78 | 209 | 212 | 31 | 2 | 0 | 0 | 0 | 0 | 0 | 547 | 37 | 34 |
| 09:00 | 3 | 3 | 7 | 81 | **361** | **288** | 33 | 4 | 0 | 1 | 0 | 0 | 0 | 781 | 37 | 34 |
| 10:00 | 0 | 1 | 14 | 88 | 231 | 209 | **59** | 3 | 0 | 0 | 0 | 0 | 0 | 605 | 38 | 34 |
| 11:00 | 0 | 0 | 3 | 52 | 209 | 251 | 56 | 2 | 0 | 0 | 0 | 0 | 0 | 573 | 38 | 35 |
| 12 PM | **9** | 9 | 25 | 91 | 239 | 204 | 33 | **6** | 0 | 0 | 0 | 0 | 0 | **616** | 37 | 33 |
| 13:00 | 4 | **13** | **32** | 76 | 183 | **228** | 42 | 1 | 0 | 0 | 0 | 0 | 0 | 579 | 38 | 33 |
| 14:00 | 3 | 8 | 17 | 102 | 211 | 182 | 30 | 2 | 0 | 0 | 0 | 0 | 0 | 555 | 37 | 33 |
| 15:00 | 0 | 0 | 7 | 53 | 197 | 192 | 48 | 5 | 0 | 0 | 0 | 0 | 0 | 502 | 38 | 34 |
| 16:00 | 0 | 1 | 8 | 51 | 206 | 195 | **57** | 5 | 0 | 0 | 0 | 0 | 0 | 523 | 38 | 34 |
| 17:00 | 1 | 5 | 5 | 71 | 259 | 188 | 37 | 3 | 1 | 0 | 0 | 0 | 0 | 570 | 37 | 34 |
| 18:00 | 1 | 0 | 16 | **103** | **297** | 107 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 532 | 35 | 32 |
| 19:00 | 0 | 3 | 18 | 71 | 154 | 110 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 370 | 37 | 32 |
| 20:00 | 0 | 3 | 12 | 28 | 143 | 62 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 257 | 36 | 32 |
| 21:00 | 0 | 0 | 1 | 27 | 102 | 88 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 230 | 37 | 34 |
| 22:00 | 0 | 0 | 1 | 17 | 27 | 39 | 15 | 3 | 0 | 0 | 0 | 0 | 0 | 102 | 39 | 35 |
| 23:00 | 0 | 1 | 1 | 2 | 15 | 29 | 10 | 2 | **2** | 0 | 0 | 0 | 0 | 62 | 41 | 37 |
| Total | 60 | 82 | 360 | 1510 | 3653 | 3006 | 595 | 51 | 5 | 2 | 0 | 0 | 0 | 9324 | | |
| % | 0.6% | 0.9% | 3.9% | 16.2% | 39.2% | 32.2% | 6.4% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | | | |

c. **East vs West bound label and volume discrepancies:** According to the traffic report, more cars commute *west* during the morning, and *east* during the evening. This does not match reality. Either the data are erroneous or the report labels are incorrect. For example, here is the report for Wednesday morning, 8 March, 2017:



PDI File #: 175530 A
Location: N: Rich Valley Road S: Mahoneys Middle Driveway
Location: E: Boston Post Road (Route 20) W: Boston Post Road (Route 20)
City, State: Wayland, MA
Client: VHB/ C. Trearchis
Site Code: 13831.00
Count Date: Wednesday, March 08, 2017
Start Time: 7:00 AM
End Time: 9:00 AM
Class:

PRECISION
DATA
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

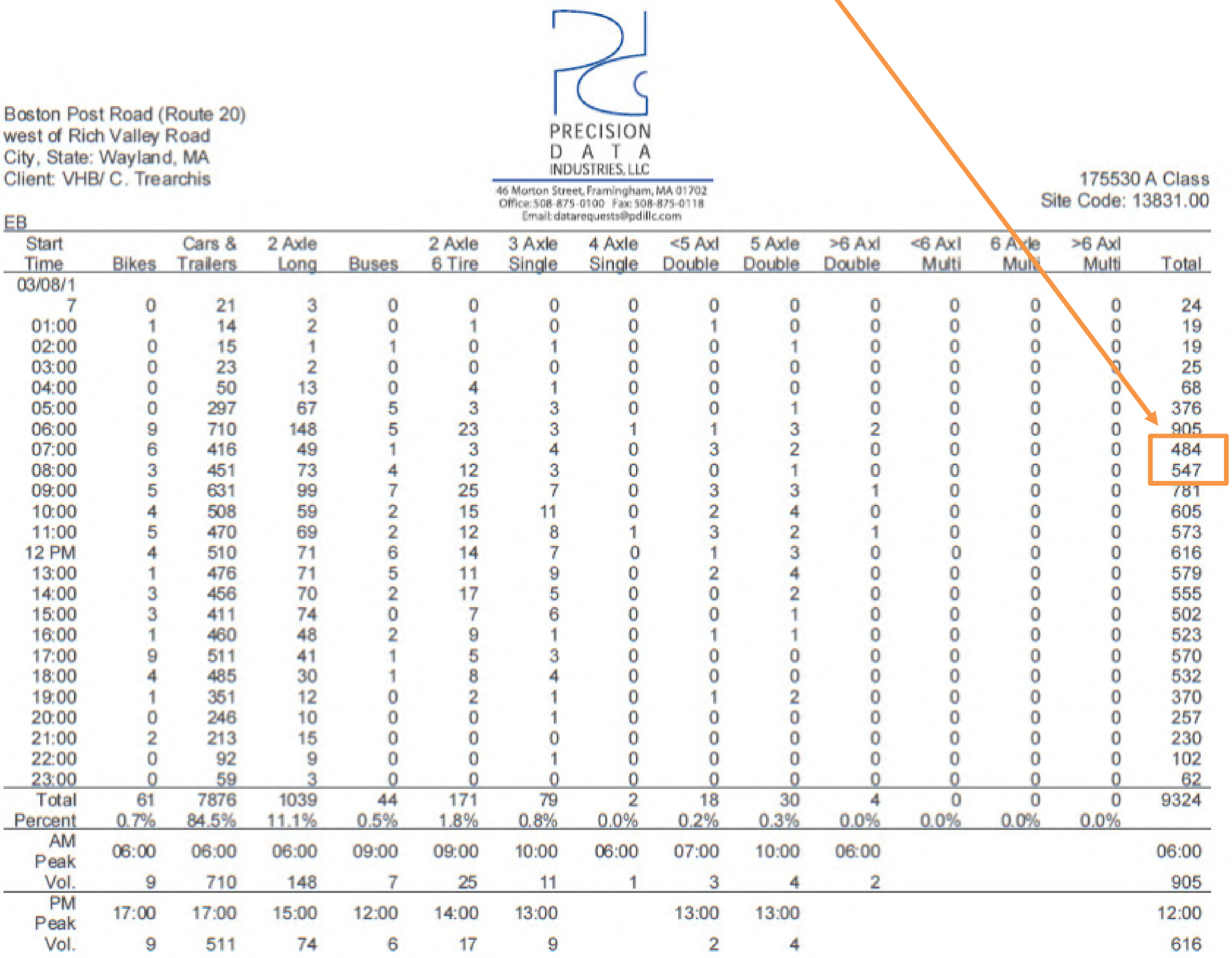
**Cars**

| | Rich Valley Road | | | | | Boston Post Road (Route 20) | | | | | Mahoneys Middle Driveway | | | | | Boston Post Road (Route 20) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | North | | | | | East | | | | | South | | | | | West | | | | | |
| | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Total |
| 7:00 AM | 4 | 0 | 3 | 0 | 7 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 149 | 1 | 0 | 150 | 257 |
| 7:15 AM | 3 | 0 | 2 | 0 | 5 | 0 | 104 | 0 | 0 | 104 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 0 | 0 | 117 | 226 |
| 7:30 AM | 5 | 0 | 2 | 0 | 7 | 0 | 92 | 0 | 0 | 92 | 0 | 0 | 0 | 0 | 0 | 0 | 114 | 0 | 0 | 114 | 213 |
| 7:45 AM | 1 | 0 | 5 | 0 | 6 | 2 | 108 | 0 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 123 | 0 | 1 | 124 | 240 |
| Total | 13 | 0 | 12 | 0 | 25 | 2 | 404 | 0 | 0 | 406 | 0 | 0 | 0 | 0 | 0 | 0 | 503 | 1 | 1 | 505 | 936 |
| 8:00 AM | 4 | 0 | 3 | 0 | 7 | 1 | 96 | 0 | 0 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 1 | 0 | 91 | 195 |
| 8:15 AM | 6 | 0 | 3 | 0 | 9 | 2 | 110 | 0 | 0 | 112 | 0 | 0 | 0 | 0 | 0 | 0 | 139 | 0 | 0 | 139 | 260 |
| 8:30 AM | 4 | 0 | 4 | 0 | 8 | 1 | 107 | 0 | 0 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 153 | 2 | 0 | 155 | 271 |
| 8:45 AM | 4 | 0 | 3 | 0 | 7 | 0 | 101 | 0 | 0 | 101 | 0 | 0 | 0 | 0 | 0 | 0 | 152 | 0 | 0 | 152 | 260 |
| Total | 18 | 0 | 13 | 0 | 31 | 4 | 414 | 0 | 0 | 418 | 0 | 0 | 0 | 0 | 0 | 0 | 534 | 3 | 0 | 537 | 986 |

This is probably a labeling error; "East" must mean "From the East" and "West" must mean "From the West" – which differs from labels on other pages.

Vehicle counts also appear to be out of range for the direction *opposite* the standard commute, e.g. 505 vehicles reportedly drove eastbound from 7am to 8am vs 406 heading westbound toward Sudbury. As noted previously, slow speeds lead to data errors with road tube based recorders.

**d. Vehicle count discrepancies:** Different sections of the traffic report contain different total vehicle counts – for the same day and time. For example: here is the page that classifies all of the types of vehicles heading eastbound on Route 20 – from bikes to large trucks – on Wednesday, 8 March, with totals of **484 from 7am to 8am** and **547 from 8am to 9am**:



PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

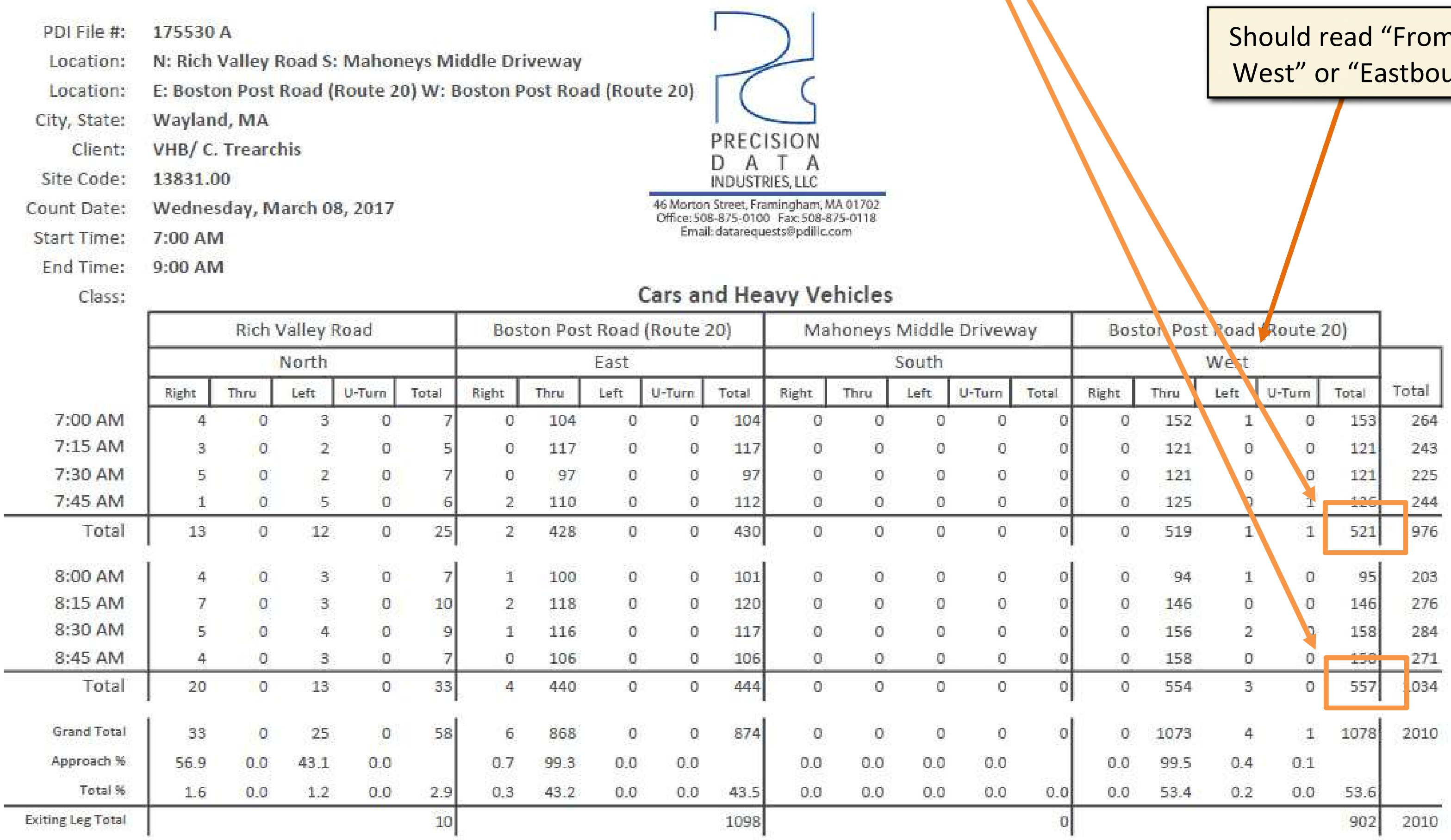
Boston Post Road (Route 20)
west of Rich Valley Road
City, State: Wayland, MA
Client: VHB/ C. Trearchis

175530 A Class
Site Code: 13831.00

EB

| Start Time | Bikes | Cars & Trailers | 2 Axle Long | Buses | 2 Axle 6 Tire | 3 Axle Single | 4 Axle Single | <5 Axl Double | 5 Axle Double | >6 Axl Double | <6 Axl Multi | 6 Axle Multi | >6 Axl Multi | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/08/17 | 0 | 21 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 01:00 | 1 | 14 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 19 |
| 02:00 | 0 | 15 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 19 |
| 03:00 | 0 | 23 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 04:00 | 0 | 50 | 13 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68 |
| 05:00 | 0 | 297 | 67 | 5 | 3 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 376 |
| 06:00 | 9 | 710 | 148 | 5 | 23 | 3 | 1 | 1 | 3 | 2 | 0 | 0 | 0 | 905 |
| 07:00 | 6 | 416 | 49 | 1 | 3 | 4 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 484 |
| 08:00 | 3 | 451 | 73 | 4 | 12 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 547 |
| 09:00 | 5 | 631 | 99 | 7 | 25 | 7 | 0 | 3 | 3 | 1 | 0 | 0 | 0 | 781 |
| 10:00 | 4 | 508 | 59 | 2 | 15 | 11 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 605 |
| 11:00 | 5 | 470 | 69 | 2 | 12 | 8 | 1 | 3 | 2 | 1 | 0 | 0 | 0 | 573 |
| 12 PM | 4 | 510 | 71 | 6 | 14 | 7 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 616 |
| 13:00 | 1 | 476 | 71 | 5 | 11 | 9 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 579 |
| 14:00 | 3 | 456 | 70 | 2 | 17 | 5 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 555 |
| 15:00 | 3 | 411 | 74 | 0 | 7 | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 502 |
| 16:00 | 1 | 460 | 48 | 2 | 9 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 523 |
| 17:00 | 9 | 511 | 41 | 1 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 570 |
| 18:00 | 4 | 485 | 30 | 1 | 8 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 532 |
| 19:00 | 1 | 351 | 12 | 0 | 2 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 370 |
| 20:00 | 0 | 246 | 10 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 257 |
| 21:00 | 2 | 213 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 230 |
| 22:00 | 0 | 92 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 102 |
| 23:00 | 0 | 59 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| Total | 61 | 7876 | 1039 | 44 | 171 | 79 | 2 | 18 | 30 | 4 | 0 | 0 | 0 | 9324 |
| Percent | 0.7% | 84.5% | 11.1% | 0.5% | 1.8% | 0.8% | 0.0% | 0.2% | 0.3% | 0.0% | 0.0% | 0.0% | 0.0% | |
| AM Peak | 06:00 | 06:00 | 06:00 | 09:00 | 09:00 | 10:00 | 06:00 | 07:00 | 10:00 | 06:00 | | | | 06:00 |
| Vol. | 9 | 710 | 148 | 7 | 25 | 11 | 1 | 3 | 4 | 2 | | | | 905 |
| PM Peak | 17:00 | 17:00 | 15:00 | 12:00 | 14:00 | 13:00 | | 13:00 | 13:00 | | | | | 12:00 |
| Vol. | 9 | 511 | 74 | 6 | 17 | 9 | | 2 | 4 | | | | | 616 |

Here is the report for all cars and heavy vehicles during the same peak 7 am to 9 am period on the same morning, 8 March, with totals of **521 from 7am to 8am**, and **557 from 8am to 9am.** These totals are higher than the “all vehicles” report on the previous page, which also included bikes:



PDI File #: 175530 A
Location: N: Rich Valley Road S: Mahoneys Middle Driveway
Location: E: Boston Post Road (Route 20) W: Boston Post Road (Route 20)
City, State: Wayland, MA
Client: VHB/ C. Trearchis
Site Code: 13831.00
Count Date: Wednesday, March 08, 2017
Start Time: 7:00 AM
End Time: 9:00 AM
Class:

PRECISION
DATA
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles

| | Rich Valley Road | | | | | Boston Post Road (Route 20) | | | | | Mahoneys Middle Driveway | | | | | Boston Post Road (Route 20) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | North | | | | | East | | | | | South | | | | | West | | | | | |
| | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Right | Thru | Left | U-Turn | Total | Total |
| 7:00 AM | 4 | 0 | 3 | 0 | 7 | 0 | 104 | 0 | 0 | 104 | 0 | 0 | 0 | 0 | 0 | 0 | 152 | 1 | 0 | 153 | 264 |
| 7:15 AM | 3 | 0 | 2 | 0 | 5 | 0 | 117 | 0 | 0 | 117 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 0 | 0 | 121 | 243 |
| 7:30 AM | 5 | 0 | 2 | 0 | 7 | 0 | 97 | 0 | 0 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 0 | 0 | 121 | 225 |
| 7:45 AM | 1 | 0 | 5 | 0 | 6 | 2 | 110 | 0 | 0 | 112 | 0 | 0 | 0 | 0 | 0 | 0 | 125 | 0 | 1 | 126 | 244 |
| Total | 13 | 0 | 12 | 0 | 25 | 2 | 428 | 0 | 0 | 430 | 0 | 0 | 0 | 0 | 0 | 0 | 519 | 1 | 1 | 521 | 976 |
| 8:00 AM | 4 | 0 | 3 | 0 | 7 | 1 | 100 | 0 | 0 | 101 | 0 | 0 | 0 | 0 | 0 | 0 | 94 | 1 | 0 | 95 | 203 |
| 8:15 AM | 7 | 0 | 3 | 0 | 10 | 2 | 118 | 0 | 0 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 0 | 0 | 146 | 276 |
| 8:30 AM | 5 | 0 | 4 | 0 | 9 | 1 | 116 | 0 | 0 | 117 | 0 | 0 | 0 | 0 | 0 | 0 | 156 | 2 | 0 | 158 | 284 |
| 8:45 AM | 4 | 0 | 3 | 0 | 7 | 0 | 106 | 0 | 0 | 106 | 0 | 0 | 0 | 0 | 0 | 0 | 158 | 0 | 0 | 158 | 271 |
| Total | 20 | 0 | 13 | 0 | 33 | 4 | 440 | 0 | 0 | 444 | 0 | 0 | 0 | 0 | 0 | 0 | 554 | 3 | 0 | 557 | 1034 |
| Grand Total | 33 | 0 | 25 | 0 | 58 | 6 | 868 | 0 | 0 | 874 | 0 | 0 | 0 | 0 | 0 | 0 | 1073 | 4 | 1 | 1078 | 2010 |
| Approach % | 56.9 | 0.0 | 43.1 | 0.0 | | 0.7 | 99.3 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 99.5 | 0.4 | 0.1 | | |
| Total % | 1.6 | 0.0 | 1.2 | 0.0 | 2.9 | 0.3 | 43.2 | 0.0 | 0.0 | 43.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 53.4 | 0.2 | 0.0 | 53.6 | |
| Exiting Leg Total | | | | | 10 | | | | | 1098 | | | | | 0 | | | | | 902 | 2010 |

Should read “From the West” or “Eastbound”

**e. Discrepancies in level of service analyses:** The traffic report includes standard analyses of road capacity at key intersections with the “volume to capacity ratio” (V/C) and “level of service” (LOS). This is the report for the Route 20 intersection with the Cascade / Monster main driveway:

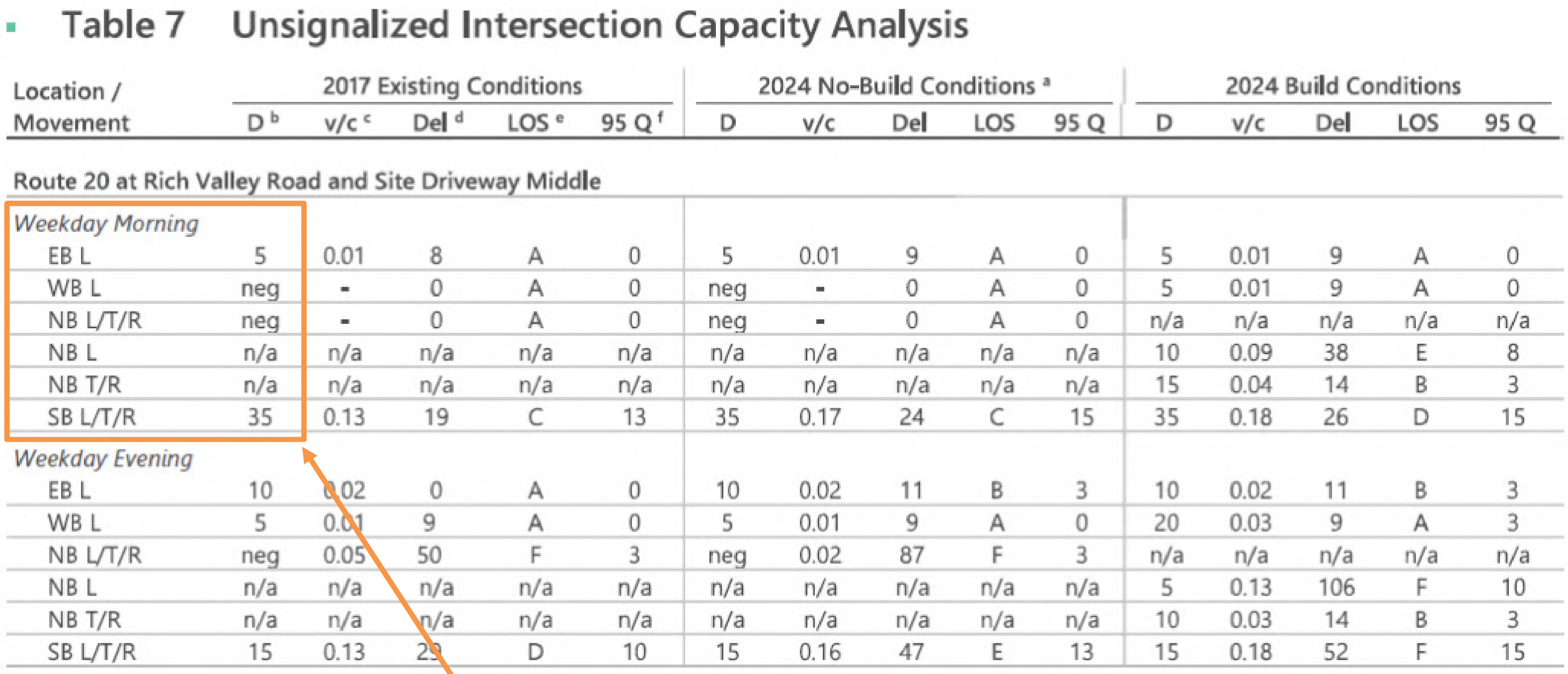
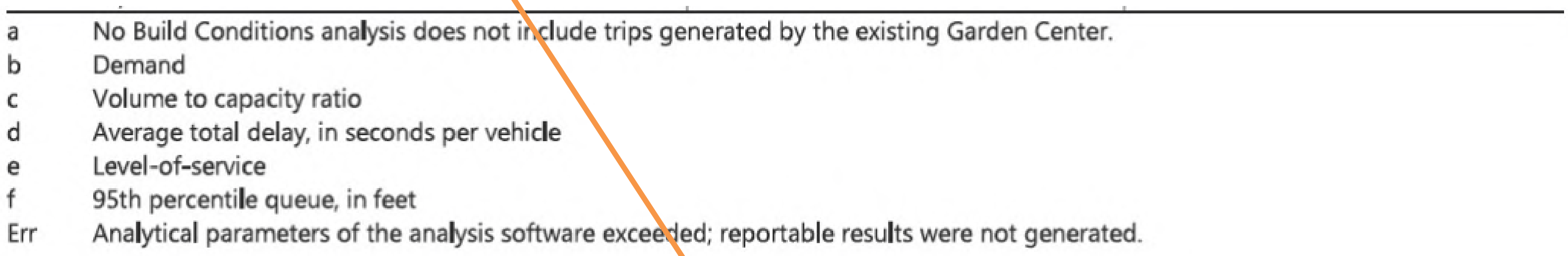


Table 7 Unsignalized Intersection Capacity Analysis

| Location / Movement | 2017 Existing Conditions | | | | | 2024 No-Build Conditions [a] | | | | | 2024 Build Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D [b] | v/c [c] | Del [d] | LOS [e] | 95 Q [f] | D | v/c | Del | LOS | 95 Q | D | v/c | Del | LOS | 95 Q |
| Route 20 at Rich Valley Road and Site Driveway Middle | | | | | | | | | | | | | | | |
| *Weekday Morning* | | | | | | | | | | | | | | | |
| EB L | 5 | 0.01 | 8 | A | 0 | 5 | 0.01 | 9 | A | 0 | 5 | 0.01 | 9 | A | 0 |
| WB L | neg | - | 0 | A | 0 | neg | - | 0 | A | 0 | 5 | 0.01 | 9 | A | 0 |
| NB L/T/R | neg | - | 0 | A | 0 | neg | - | 0 | A | 0 | n/a | n/a | n/a | n/a | n/a |
| NB L | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 10 | 0.09 | 38 | E | 8 |
| NB T/R | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 15 | 0.04 | 14 | B | 3 |
| SB L/T/R | 35 | 0.13 | 19 | C | 13 | 35 | 0.17 | 24 | C | 15 | 35 | 0.18 | 26 | D | 15 |
| *Weekday Evening* | | | | | | | | | | | | | | | |
| EB L | 10 | 0.02 | 0 | A | 0 | 10 | 0.02 | 11 | B | 3 | 10 | 0.02 | 11 | B | 3 |
| WB L | 5 | 0.01 | 9 | A | 0 | 5 | 0.01 | 9 | A | 0 | 20 | 0.03 | 9 | A | 3 |
| NB L/T/R | neg | 0.05 | 50 | F | 3 | neg | 0.02 | 87 | F | 3 | n/a | n/a | n/a | n/a | n/a |
| NB L | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 5 | 0.13 | 106 | F | 10 |
| NB T/R | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 10 | 0.03 | 14 | B | 3 |
| SB L/T/R | 15 | 0.13 | 29 | D | 10 | 15 | 0.16 | 47 | E | 13 | 15 | 0.18 | 52 | F | 15 |

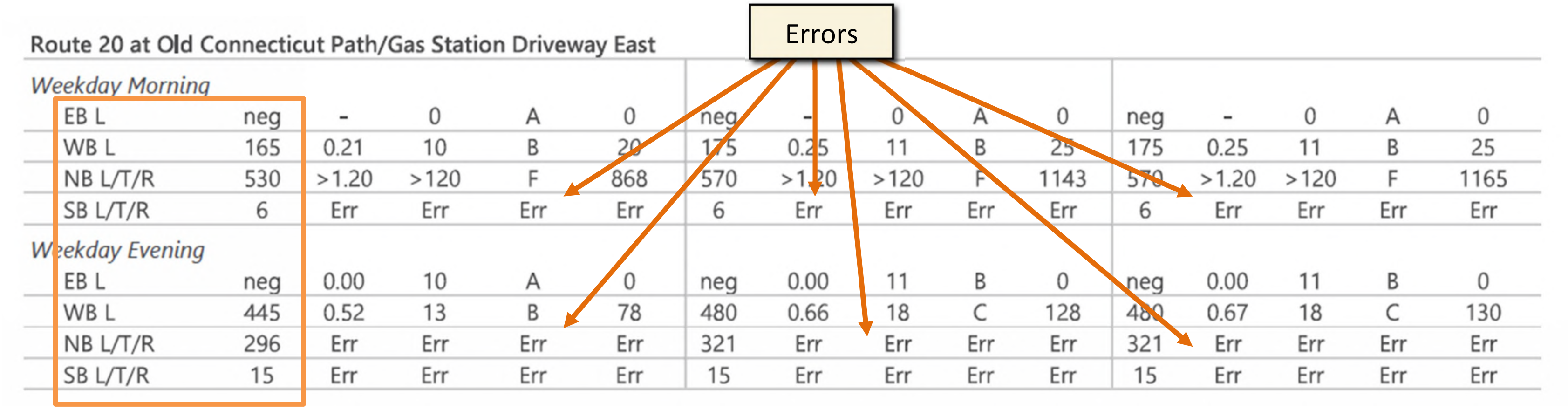
Here are definitions, e.g. for the first D<sup>b</sup> column:



| | |
|---|---|
| a | No Build Conditions analysis does not include trips generated by the existing Garden Center. |
| b | Demand |
| c | Volume to capacity ratio |
| d | Average total delay, in seconds per vehicle |
| e | Level-of-service |
| f | 95th percentile queue, in feet |
| Err | Analytical parameters of the analysis software exceeded; reportable results were not generated. |

Note that the first “D<sup>b</sup>”column shows only 5 and 35 vehicles in the morning. This is the “demand” (number of vehicles). In other words, this analysis *only covers the Cascade / Monster driveway,* <u>not the level of service on Route 20</u> despite the label at the top.

The capacity analysis for the intersection of Route 20 and Old Connecticut Path has the same issue – plus processing errors. The data is for Old Connecticut Path and the driveway at the gas station, *__not Route 20__*:



Route 20 at Old Connecticut Path/Gas Station Driveway East

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Weekday Morning* | | | | | | | | | | | | | | | |
| EB L | neg | - | 0 | A | 0 | neg | - | 0 | A | 0 | neg | - | 0 | A | 0 |
| WB L | 165 | 0.21 | 10 | B | 20 | 175 | 0.25 | 11 | B | 25 | 175 | 0.25 | 11 | B | 25 |
| NB L/T/R | 530 | >1.20 | >120 | F | 868 | 570 | >1.20 | >120 | F | 1143 | 570 | >1.20 | >120 | F | 1165 |
| SB L/T/R | 6 | Err | Err | Err | Err | 6 | Err | Err | Err | Err | 6 | Err | Err | Err | Err |
| *Weekday Evening* | | | | | | | | | | | | | | | |
| EB L | neg | 0.00 | 10 | A | 0 | neg | 0.00 | 11 | B | 0 | neg | 0.00 | 11 | B | 0 |
| WB L | 445 | 0.52 | 13 | B | 78 | 480 | 0.66 | 18 | C | 128 | 480 | 0.67 | 18 | C | 130 |
| NB L/T/R | 296 | Err | Err | Err | Err | 321 | Err | Err | Err | Err | 321 | Err | Err | Err | Err |
| SB L/T/R | 15 | Err | Err | Err | Err | 15 | Err | Err | Err | Err | 15 | Err | Err | Err | Err |

In short, Zieff's traffic report does not contain any analyses of the impact or level of service on Route 20, which is obviously a key factor. A new study should fill this important gap.

## How could ATR data in this study be inaccurate?

The accuracy of Automatic Traffic Recorder data depends on the type of detector, the way it is installed and configured, weather, equipment condition etc. PDI used road tubes placed across Route 20, connected to a Jamar ATR. Road tubes have been used for decades to collect traffic data, and are subject to more potential problems than newer radar and LIDAR (laser based) detectors. Data gathered from road tubes can be affected by traffic speed, the exact length of the tubes, exact spacing between the tubes, the exact angle of the tubes vs the roadway, condition of the tubes, proper configuration of the ATR, a mismatch between ATR settings and actual distance between the tubes, etc. As the U.S. Army Corps of Engineers noted in their “best practices” guide:

> “There are almost no situations where pneumatic tubes are a best choice. This technology is easy to deploy, but notoriously inaccurate even in well-installed conditions. Crossing a tube at an angle can result in excessive counts; too slowly and it will undercount. Tubes can wear out quickly, resulting in holes that leak air and cause the meter to miss some vehicles. …The many ways in which errors can occur is the reason why pneumatic tubes are not a good choice.”
>
> (See: Best Practices Guide for Selecting and Deploying Equipment to Meter Vehicular Traffic at USACE Project Site Areas, U.S. Army Corps of Engineers, U.S. Department of Transportation and Volpe National Transportation Systems Center Cambridge, MA)

**Low-speed traffic:** In addition, road tubes are not accurate with slow, stop-and-go traffic – like the traffic on Route 20 during the morning commute. As the Federal Highway Administration noted in their review, “Does not work well in high volume or slow or stopped traffic.” VehicleCounts, an ATR manufacturer, offers the best explanation:

> “You cannot collect accurate classification data with a hose-based counter at low speeds, so attempting to collect vehicle classification data should be avoided in these situations.
>
> Calculating the speed and spacings at lower speeds is a problem because vehicles can easily be slowing or speeding up at quite a high percentage of the speed they are traveling at, so the two sets of tires may be at quite different speeds when they cross the hoses, making axle spacing calculations inaccurate.
>
> An additional problem at these lower speeds is that there will be a lot more "noise" on the hose (especially when you are down closer to 5mph), because the tires will be on the hose longer there will actually be more air pulses bouncing around in the hose.” (See: www.vehiclecounts.com/low_speed)

ATR manufacturers highlight this problem in their user guides and recommend against collecting traffic data with road tubes in stop-and-go conditions. For example:

**IRD:** "If speed or vehicle classification data (which is dependent on accurate speeds) are collected, the site should be at a location where vehicles travel at a nearly constant speed…"

**Jamar:** "For the best results, do not install the tubes in a location where traffic will be queueing up and stopping on the tubes…"

**Peek:** "Look for free flowing traffic traveling at a consistent speed. The minimum vehicle speed at the site should be 15 mph."

**Diamond:** "Choose a spot preferably on a straight, flat roadway with free flowing traffic between 10mph and 70+mph..."

**Metrocount:** "Select roads where most traffic is travelling at a constant speed across the tubes. If possible, avoid sites where vehicles are accelerating / decelerating due to bends, steep inclines, traffic signals or intersections. Try to avoid sites where vehicles stop over the tubes."

**VehicleCounts:** "Set the hoses as far from intersections as practical…back far enough that vehicles are not stopping on the hose, or accelerating, or decelerating (big problem at slow speeds)."

**The Jamar ATR and low speeds:** Jamar, the manufacturer of the ATR used in Zieff's study, explains that their product can be used to *count* vehicles at low speeds, e.g. in parking lots – but the 'dwell' (DT) setting must be changed to match the speed of traffic:

> "… the DT is typically set at 20 to 40 milliseconds for normal traffic, as this will cover most speeds. Speeds from idle to 10 mph will require the DT setting to be increased. When recording traffic in a very low speed situation, use a DT setting of 200 to 300 milliseconds to avoid double counting. Whenever you adjust the DT setting, we recommend that you watch the TRAX as a few vehicles are recorded to be sure the TRAX is recording correctly.

> NOTE: Be sure to reset the DT setting once you have finished your low speed counting. Using an incorrect DT setting for normal speed traffic will produce incorrect data.” (See: JAMAR Apollyon User Manual, Appendix 1)

The DT / dwell setting can be set for slow speeds or normal traffic – but not both; this is a binary either-or choice. In other words, the ATR used in this study cannot accurately record data on Route 20 in Wayland where vehicle speeds vary from stop-and-go to 35 mph.

**Why is data accuracy important?** As the Florida Department of Transportation noted, “"Regardless of the tool used, the outputs from the traffic analysis will be no better than the accuracy of the data used in the analysis." The ZBA and Wayland citizens cannot rely on the accuracy of the data in this study or the analysis it contains.

## Conclusions:

1: The data in this traffic report was not collected using equipment suited for this type of traffic, and contains significant errors. Data errors undermine the accuracy of the analyses and conclusions. The analyses contain errors and did not include the level of service on Route 20. Significant traffic issues were not included. The peer review did not catch these errors and omissions. As a result, Wayland cannot rely on this study.

2: The Wayland ZBA should commission a new, independent and accurate traffic study, which should also include the traffic sources and issues 1/4 mile to the west of the site, impacts on Pine Brook Road and Plain Road, and level of service analyses of Route 20. This study should use a radar / LIDAR-based system to collect accurate vehicle data at the range of speeds typical in this area, including stop-and-go. The data quality control process must be more thorough and documented.

# Appendix

## 1. ATR manufacturer recommendations for road tube site selection and configuration:

Jamar Apollyon User Manual, Appendix A-7 and A-8

Diamond Traffic Products User Guide, page 3

IRD Operator’s Manual, page 3-1

Peek Traffic ADR Plus Operating Manual, page 81

MetroCount Operator Guide, page 4

VehicleCounts Setting Up for Low Speeds (documentation is web based)

## 2. Best practices and standards:

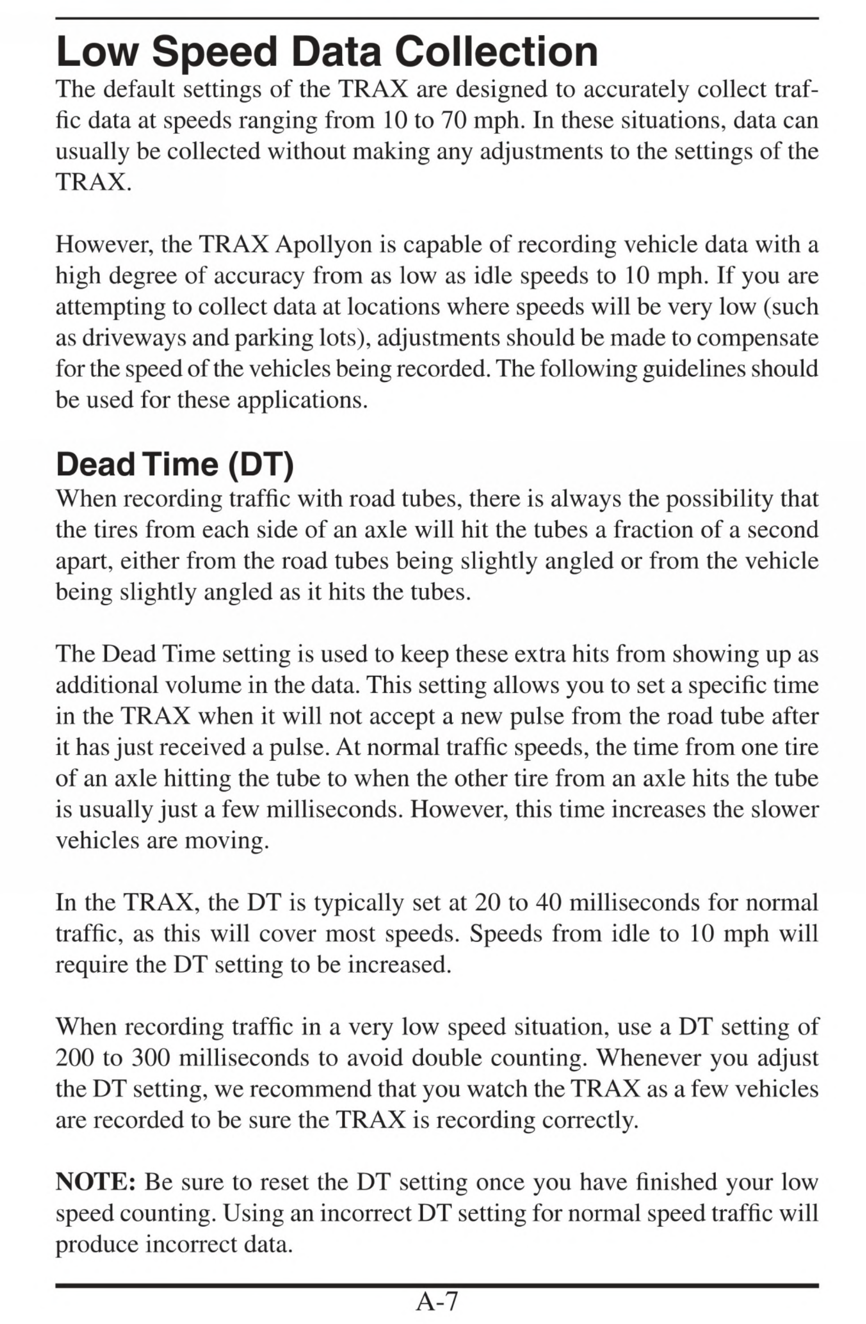
US Army Corps of Engineers:  Best Practices for Metering Vehicular Traffic, page 31

US Department of Transportation: Best Practices Guide,  page 10

Federal Highway Administration: Traffic Monitoring Guide (web-based)

ASTM Standard 1957-04, page 1

Jamar Apollyon User Guide, Appendix pages A-7 and A-8



## Low Speed Data Collection

The default settings of the TRAX are designed to accurately collect traffic data at speeds ranging from 10 to 70 mph. In these situations, data can usually be collected without making any adjustments to the settings of the TRAX.

However, the TRAX Apollyon is capable of recording vehicle data with a high degree of accuracy from as low as idle speeds to 10 mph. If you are attempting to collect data at locations where speeds will be very low (such as driveways and parking lots), adjustments should be made to compensate for the speed of the vehicles being recorded. The following guidelines should be used for these applications.

### Dead Time (DT)

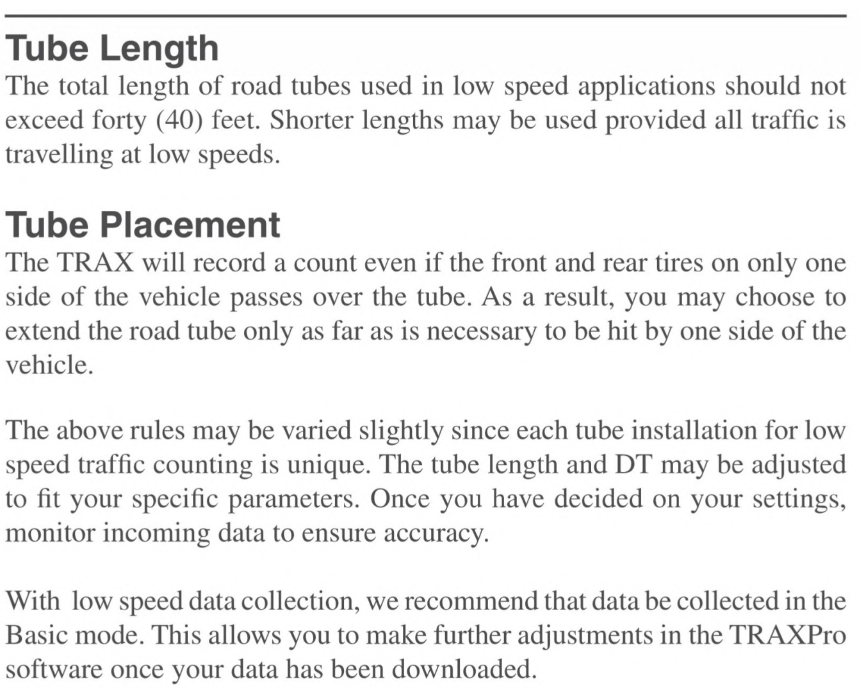
When recording traffic with road tubes, there is always the possibility that the tires from each side of an axle will hit the tubes a fraction of a second apart, either from the road tubes being slightly angled or from the vehicle being slightly angled as it hits the tubes.

The Dead Time setting is used to keep these extra hits from showing up as additional volume in the data. This setting allows you to set a specific time in the TRAX when it will not accept a new pulse from the road tube after it has just received a pulse. At normal traffic speeds, the time from one tire of an axle hitting the tube to when the other tire from an axle hits the tube is usually just a few milliseconds. However, this time increases the slower vehicles are moving.

In the TRAX, the DT is typically set at 20 to 40 milliseconds for normal traffic, as this will cover most speeds. Speeds from idle to 10 mph will require the DT setting to be increased.

When recording traffic in a very low speed situation, use a DT setting of 200 to 300 milliseconds to avoid double counting. Whenever you adjust the DT setting, we recommend that you watch the TRAX as a few vehicles are recorded to be sure the TRAX is recording correctly.

**NOTE:** Be sure to reset the DT setting once you have finished your low speed counting. Using an incorrect DT setting for normal speed traffic will produce incorrect data.



### Tube Length

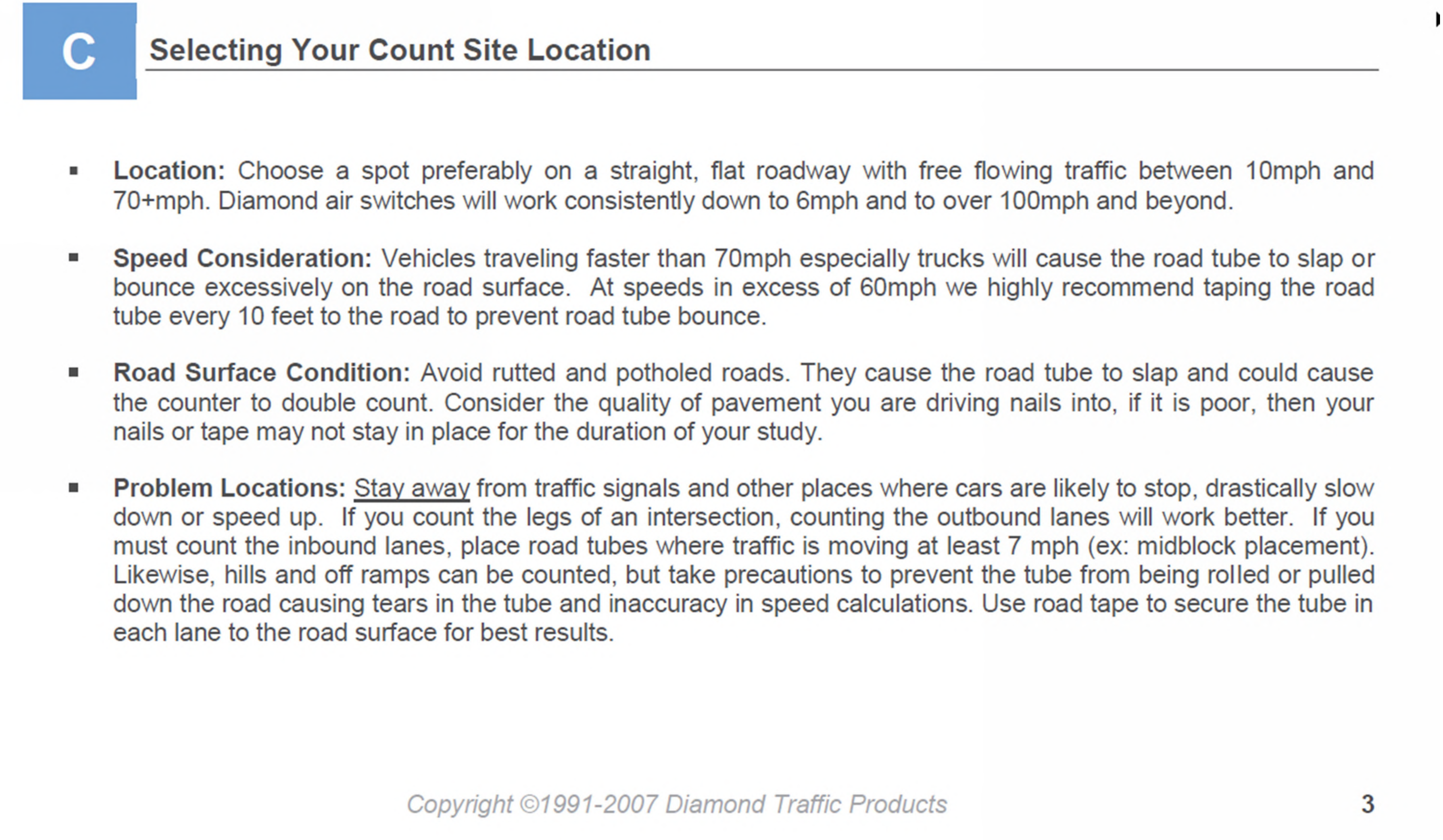
The total length of road tubes used in low speed applications should not exceed forty (40) feet. Shorter lengths may be used provided all traffic is travelling at low speeds.

### Tube Placement

The TRAX will record a count even if the front and rear tires on only one side of the vehicle passes over the tube. As a result, you may choose to extend the road tube only as far as is necessary to be hit by one side of the vehicle.

The above rules may be varied slightly since each tube installation for low speed traffic counting is unique. The tube length and DT may be adjusted to fit your specific parameters. Once you have decided on your settings, monitor incoming data to ensure accuracy.

With low speed data collection, we recommend that data be collected in the Basic mode. This allows you to make further adjustments in the TRAXPro software once your data has been downloaded.

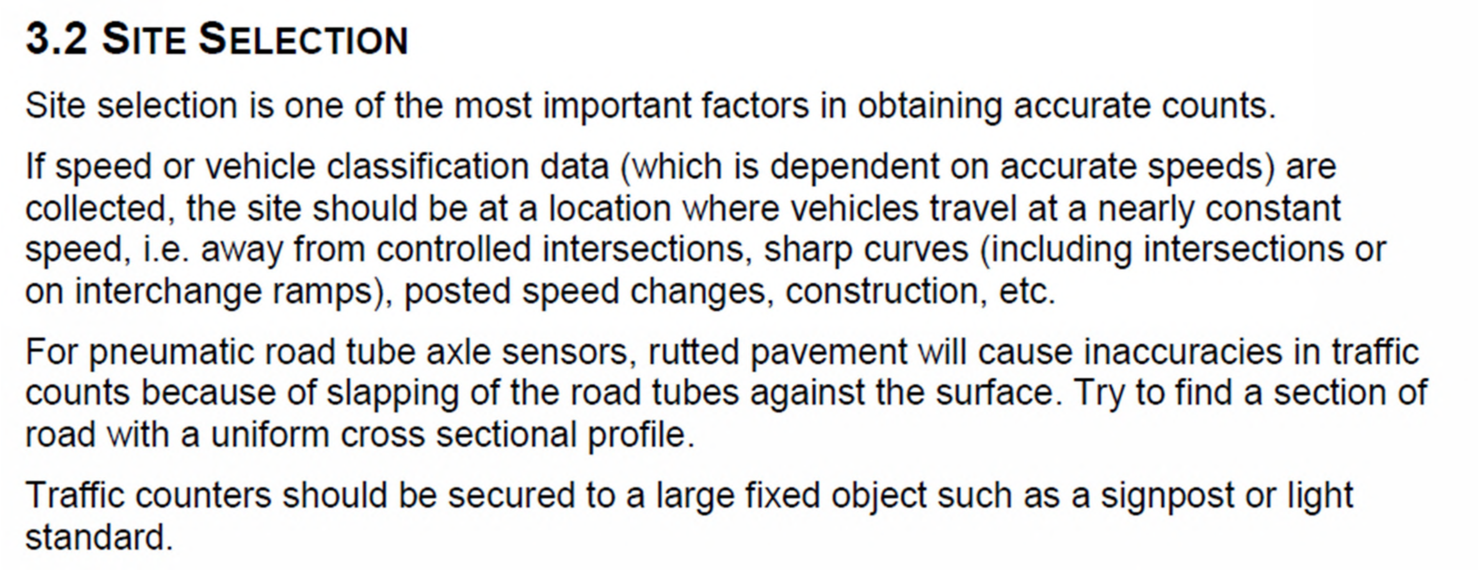


## C

## Selecting Your Count Site Location

- **Location:** Choose a spot preferably on a straight, flat roadway with free flowing traffic between 10mph and 70+mph. Diamond air switches will work consistently down to 6mph and to over 100mph and beyond.
- **Speed Consideration:** Vehicles traveling faster than 70mph especially trucks will cause the road tube to slap or bounce excessively on the road surface. At speeds in excess of 60mph we highly recommend taping the road tube every 10 feet to the road to prevent road tube bounce.
- **Road Surface Condition:** Avoid rutted and potholed roads. They cause the road tube to slap and could cause the counter to double count. Consider the quality of pavement you are driving nails into, if it is poor, then your nails or tape may not stay in place for the duration of your study.
- **Problem Locations:** Stay away from traffic signals and other places where cars are likely to stop, drastically slow down or speed up. If you count the legs of an intersection, counting the outbound lanes will work better. If you must count the inbound lanes, place road tubes where traffic is moving at least 7 mph (ex: midblock placement). Likewise, hills and off ramps can be counted, but take precautions to prevent the tube from being rolled or pulled down the road causing tears in the tube and inaccuracy in speed calculations. Use road tape to secure the tube in each lane to the road surface for best results.

International Road Dynamics Operator’s Guide, page 3-1



## 3.2 SITE SELECTION

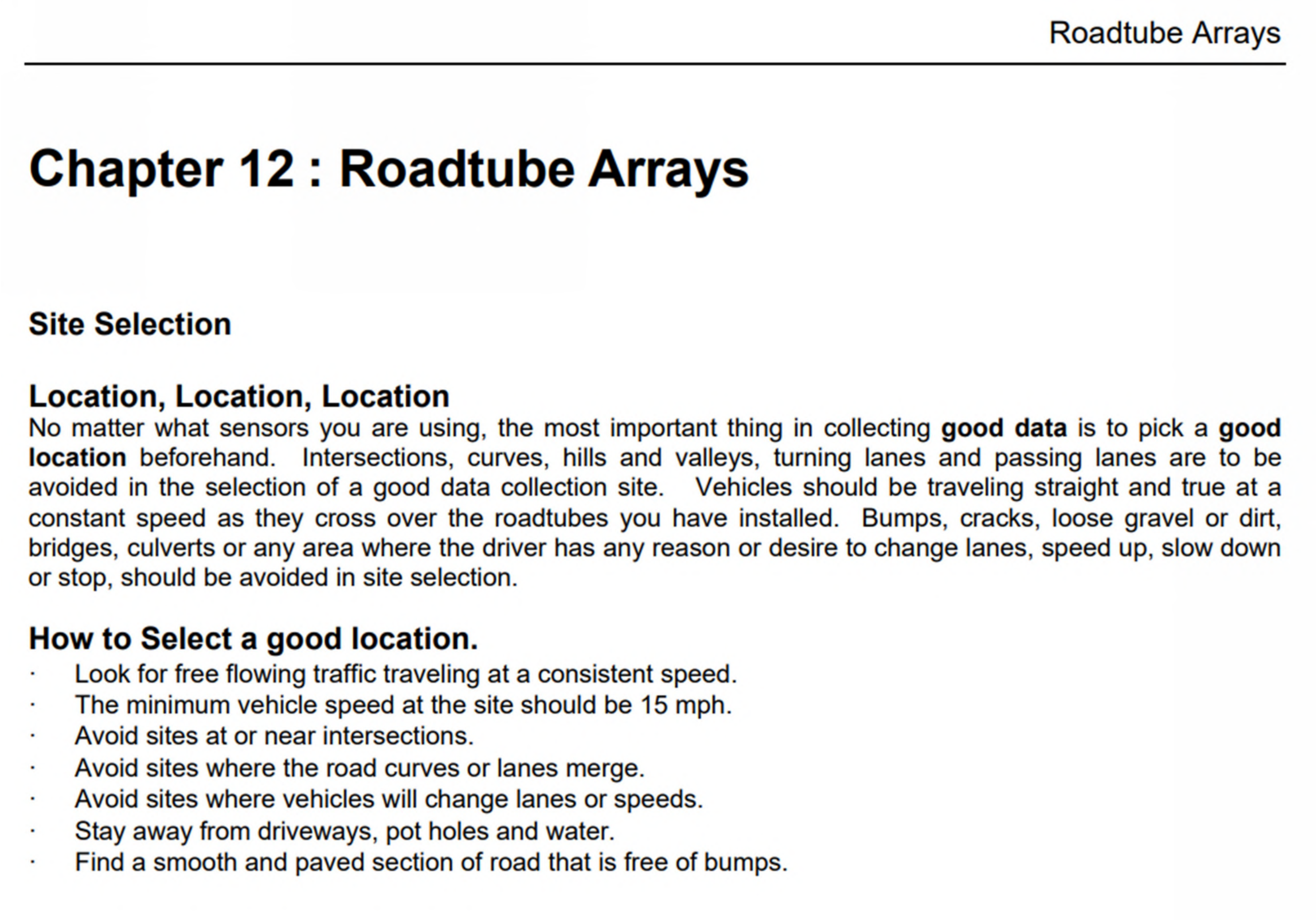
Site selection is one of the most important factors in obtaining accurate counts.

If speed or vehicle classification data (which is dependent on accurate speeds) are collected, the site should be at a location where vehicles travel at a nearly constant speed, i.e. away from controlled intersections, sharp curves (including intersections or on interchange ramps), posted speed changes, construction, etc.

For pneumatic road tube axle sensors, rutted pavement will cause inaccuracies in traffic counts because of slapping of the road tubes against the surface. Try to find a section of road with a uniform cross sectional profile.

Traffic counters should be secured to a large fixed object such as a signpost or light standard.

Peek Traffic ADR Plus Operating Manual, page 81



# Chapter 12 : Roadtube Arrays

## Site Selection

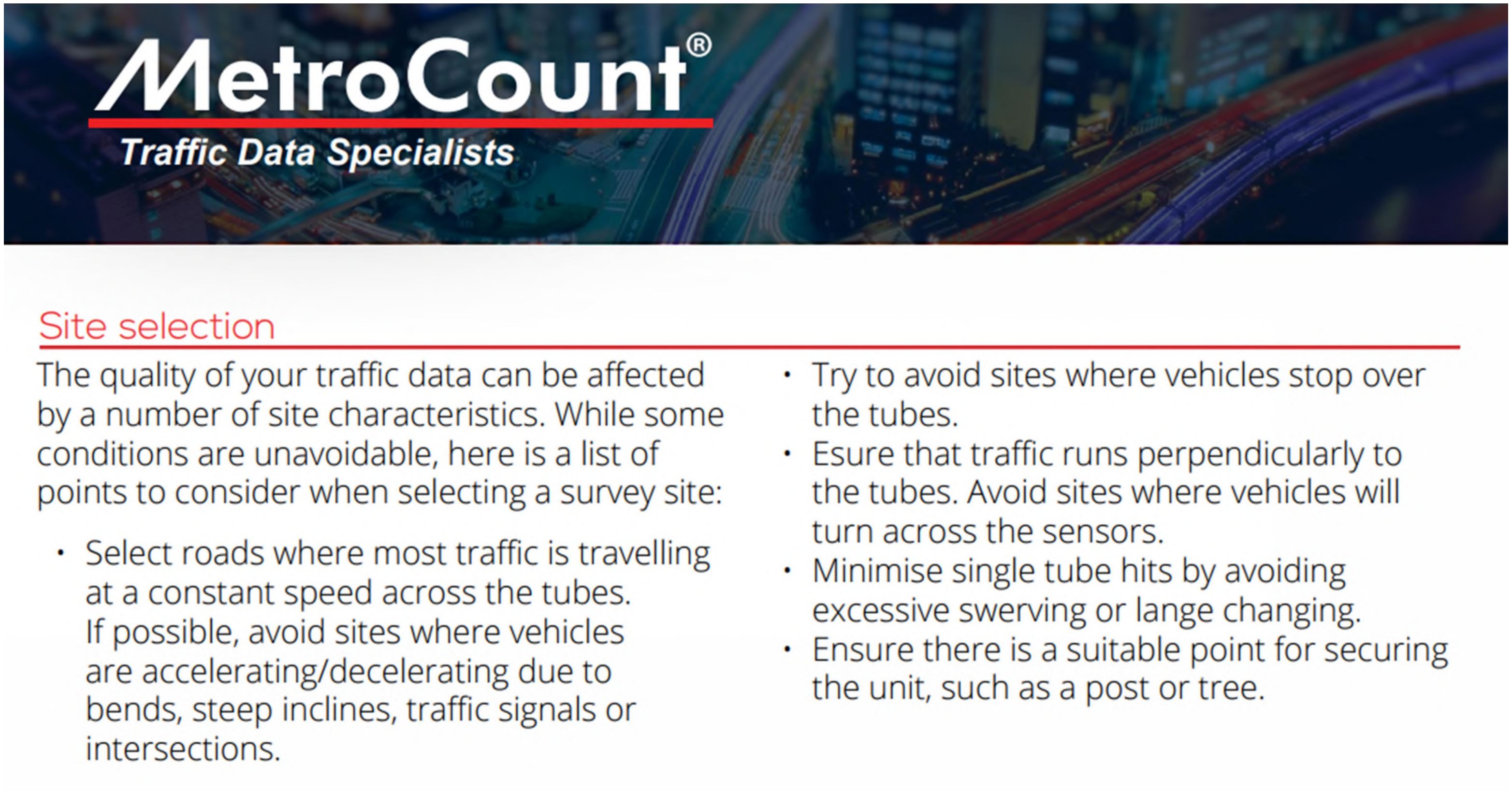
### Location, Location, Location

No matter what sensors you are using, the most important thing in collecting **good data** is to pick a **good location** beforehand. Intersections, curves, hills and valleys, turning lanes and passing lanes are to be avoided in the selection of a good data collection site. Vehicles should be traveling straight and true at a constant speed as they cross over the roadtubes you have installed. Bumps, cracks, loose gravel or dirt, bridges, culverts or any area where the driver has any reason or desire to change lanes, speed up, slow down or stop, should be avoided in site selection.

### How to Select a good location.

- Look for free flowing traffic traveling at a consistent speed.
- The minimum vehicle speed at the site should be 15 mph.
- Avoid sites at or near intersections.
- Avoid sites where the road curves or lanes merge.
- Avoid sites where vehicles will change lanes or speeds.
- Stay away from driveways, pot holes and water.
- Find a smooth and paved section of road that is free of bumps.

MetroCount RoadPod Operator Guide, page 4



MetroCount®
Traffic Data Specialists

## Site selection

The quality of your traffic data can be affected by a number of site characteristics. While some conditions are unavoidable, here is a list of points to consider when selecting a survey site:

- Select roads where most traffic is travelling at a constant speed across the tubes. If possible, avoid sites where vehicles are accelerating/decelerating due to bends, steep inclines, traffic signals or intersections.
- Try to avoid sites where vehicles stop over the tubes.
- Esure that traffic runs perpendicularly to the tubes. Avoid sites where vehicles will turn across the sensors.
- Minimise single tube hits by avoiding excessive swerving or lange changing.
- Ensure there is a suitable point for securing the unit, such as a post or tree.

# Setting Up For Low Speeds

For the sake of putting a number to it you can think of "low speed" as speeds under 15 MPH, but that is just a rule of thumb -- there really is no specific speed where these rules all of sudden need to be followed, just keep these in mind for anything you may consider low speed.

The biggest factor that causes problems at lower speeds is actually a consistant speed (remaining at a speed while crossing the hoses). At lower speeds vehicles tend to change speeds much more quickly, especially in terms of the vehicles overall speed... a vehicle that increases speed from 5MPH to 6MPH is a 20% speed increase, whereas the difference of a vehicle changing from 50MPH to 51MPH is only a 2% speed increase. And at lower speeds the vehicle can more dramatically change speed in the few feet between tires, especially when slowing.

It is fairly common to want counts in many low speed situations. These are not the most ideal situation to collect accurate counts with hose-based counters, so you will have to take some special steps to get the most accurate counts. If you follow these guidelines you should be able to collect usable count data. Note: You cannot collect accurate classification data with a hose-based counter at low speeds, so attempting to collect vehicle classification data should be avoided in these situations.

For low speeds what you will want to do is just get the total vehicles passing by since the counter will have a tough time getting accurate classifications at those low speeds. Calculating the speed and spacings at lower speeds is a problem because vehicles can easily be slowing or speeding up at quite a high percentage of the speed they are traveling at, so the two sets of tires may be at quite different speeds when they cross the hoses, making axle spacing calculations inaccurate.

An additional problem at these lower speeds is that there will be a lot more "noise" on the hose (especially when you are down closer to 5mph), because the tires will be on the hose longer there will actually be more air pulses bouncing around in the hose.

So, to get the total vehicles passing at these low speeds, you will need to play with the "dwell" setting (one of only a handful of settings you will see after you download the data). You will keep both A and B dwells the same value. The dwell is the amount of time (in milliseconds) to ignore any further "hits" on a hose before it will start seeing hits again... at low speeds we recommend you set this up at 1000 (1 second) or higher... perhaps several seconds so you can be sure all axles (including any trailers) have also passed over. Some time that is shorter than the normal spacing between vehicles, but long enough for an entire vehicle to pass over the hoses. You would then edit your "Axle Correction Factors" to divide by 1 (instead of the normal divide by 2) since you will have just 1 hit for each vehicle.

In this scenario, you won't set your hoses out with any specific spacing, you would set one hose across one lane and the other hose across the other lane (if you have a median), or you would set it up as a short hose/long hose (a short hose across one lane, ending in the center of the road, and the longer hose across both lanes). Either of these two counts-only setups will give you directional (lane) data.

Finally, you will want to choose a location to set up your hoses where vehicles will not be stopping (including parking) on the hose. Apart from the obvious problem of passing vehicles not being seen due to another vehicles tires being on the hose, you may also have extra air pulses that bounce around in the tubes after the vehicle's tire leaves the tube (causing an additional hose hit to be recorded). This will cause a higher vehicle count than what actually occurred.

**Quick summary**

- You cannot collect accurate classification data at low speeds, attempt to collect counts only.
- Set dwells to a high value, one or more seconds (1000+ ms) in length, to attempt to get only one "hit" per vehicle.
- Set your "Axle Correct Factors" to a value of 1, to indicate there is 1 hit per vehicle.
- Avoid setting up the hoses in a location where vehicles will stop on the hose.

# US Army Corps of Engineers:  Best Practices for Metering Vehicular Traffic

With technical support from U.S. Department of Transportation and Volpe National Transportation Systems Center

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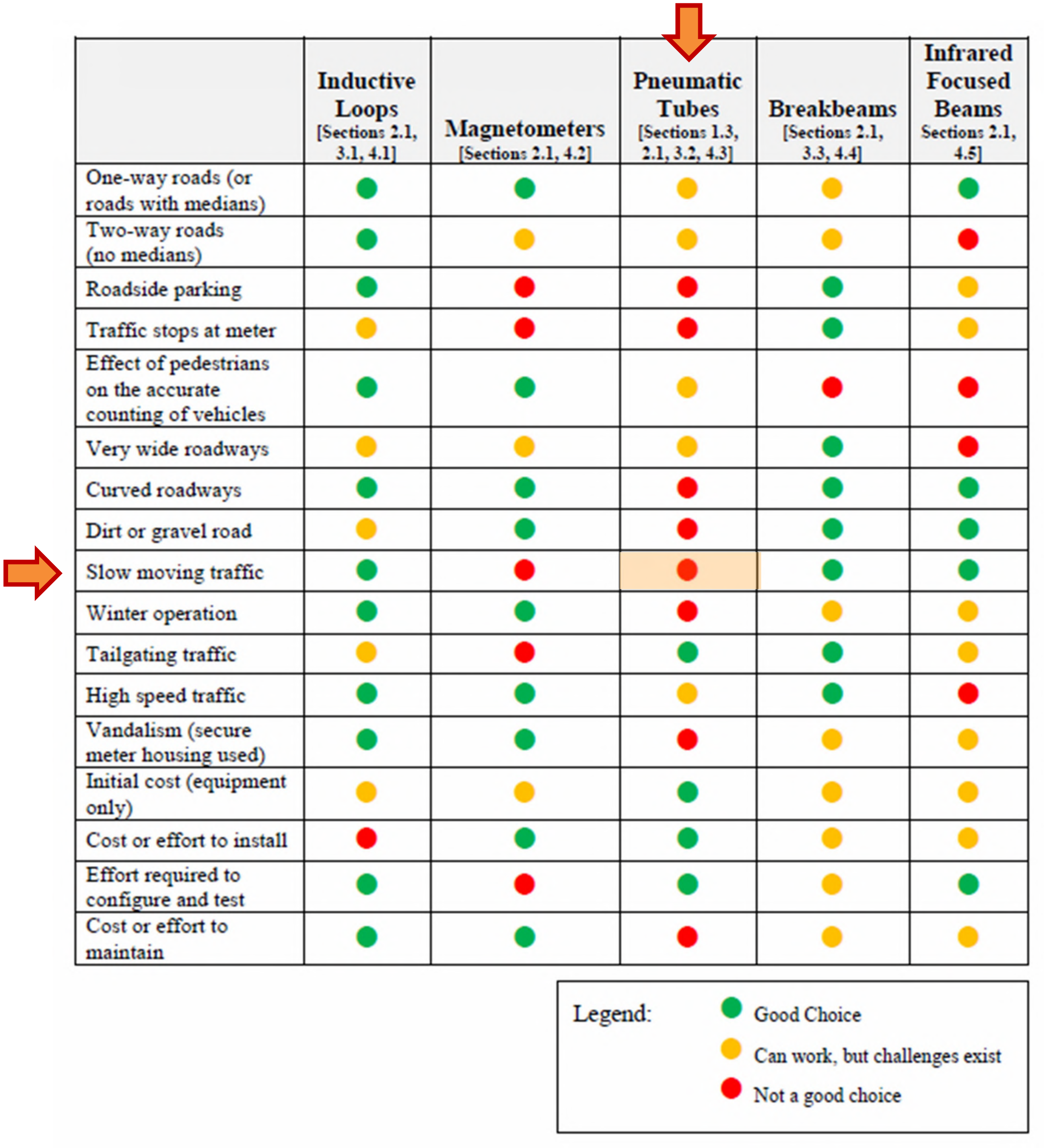
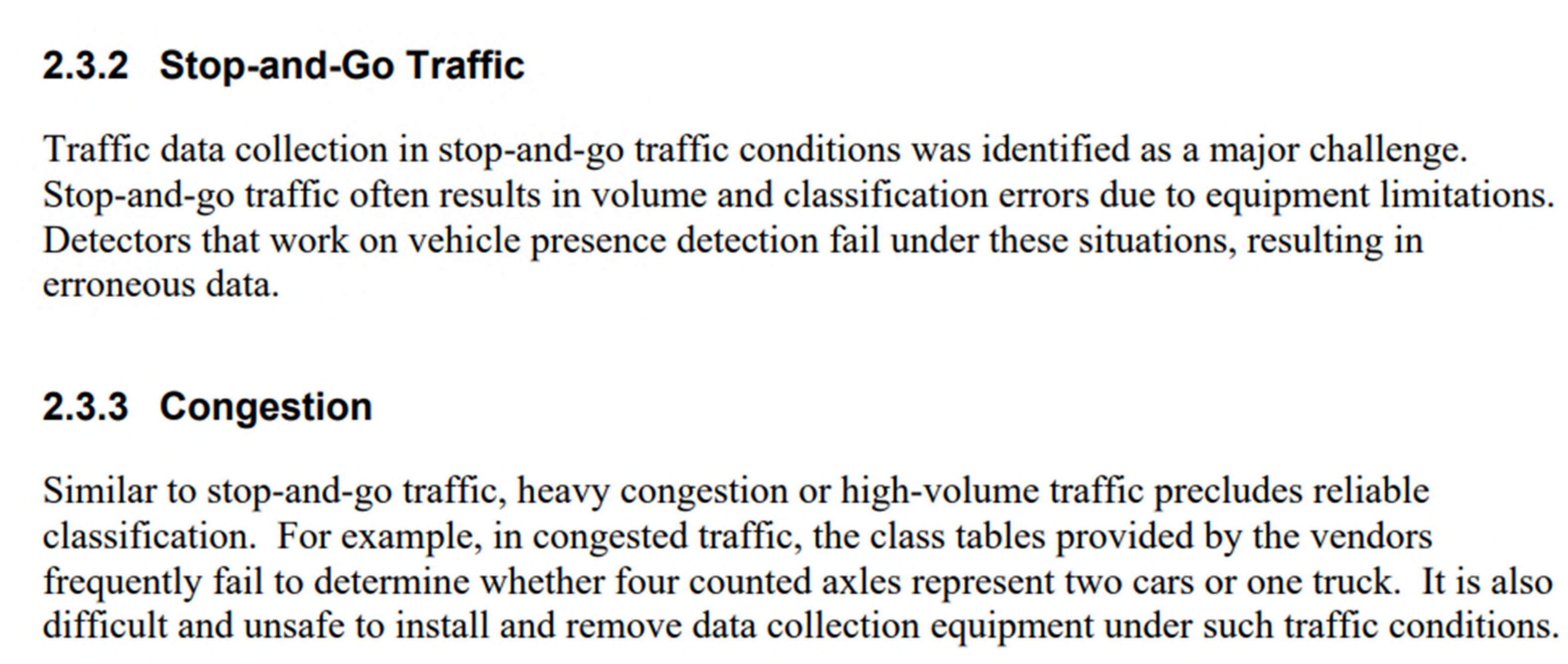


| | **Inductive Loops** [Sections 2.1, 3.1, 4.1] | **Magnetometers** [Sections 2.1, 4.2] | **Pneumatic Tubes** [Sections 1.3, 2.1, 3.2, 4.3] | **Breakbeams** [Sections 2.1, 3.3, 4.4] | **Infrared Focused Beams** Sections 2.1, 4.5] |
|---|---|---|---|---|---|
| One-way roads (or roads with medians) | 🟢 | 🟢 | 🟡 | 🟡 | 🟢 |
| Two-way roads (no medians) | 🟢 | 🟡 | 🟡 | 🟡 | 🔴 |
| Roadside parking | 🟢 | 🔴 | 🔴 | 🟢 | 🟡 |
| Traffic stops at meter | 🟡 | 🔴 | 🔴 | 🟢 | 🟡 |
| Effect of pedestrians on the accurate counting of vehicles | 🟢 | 🟢 | 🟡 | 🔴 | 🔴 |
| Very wide roadways | 🟡 | 🟡 | 🟡 | 🟢 | 🔴 |
| Curved roadways | 🟢 | 🟢 | 🔴 | 🟢 | 🟢 |
| Dirt or gravel road | 🟡 | 🟢 | 🔴 | 🟢 | 🟢 |
| Slow moving traffic | 🟢 | 🔴 | 🔴 | 🟢 | 🟢 |
| Winter operation | 🟢 | 🟢 | 🔴 | 🟡 | 🟡 |
| Tailgating traffic | 🟡 | 🔴 | 🟢 | 🟢 | 🟡 |
| High speed traffic | 🟢 | 🟢 | 🟡 | 🟢 | 🔴 |
| Vandalism (secure meter housing used) | 🟢 | 🟢 | 🔴 | 🟡 | 🟡 |
| Initial cost (equipment only) | 🟡 | 🟡 | 🟢 | 🟡 | 🟡 |
| Cost or effort to install | 🔴 | 🟢 | 🟢 | 🟡 | 🟡 |
| Effort required to configure and test | 🟢 | 🔴 | 🟢 | 🟡 | 🟢 |
| Cost or effort to maintain | 🟢 | 🟢 | 🔴 | 🟡 | 🟡 |

Legend:
🟢 Good Choice
🟡 Can work, but challenges exist
🔴 Not a good choice

## US Department of Transportation: Best Practices Guide for High Volume Routes

Page 10



### 2.3.2 Stop-and-Go Traffic

Traffic data collection in stop-and-go traffic conditions was identified as a major challenge. Stop-and-go traffic often results in volume and classification errors due to equipment limitations. Detectors that work on vehicle presence detection fail under these situations, resulting in erroneous data.

### 2.3.3 Congestion

Similar to stop-and-go traffic, heavy congestion or high-volume traffic precludes reliable classification. For example, in congested traffic, the class tables provided by the vendors frequently fail to determine whether four counted axles represent two cars or one truck. It is also difficult and unsafe to install and remove data collection equipment under such traffic conditions.

*Note: Road tubes detect vehicle presence, as described in 2.3.2*

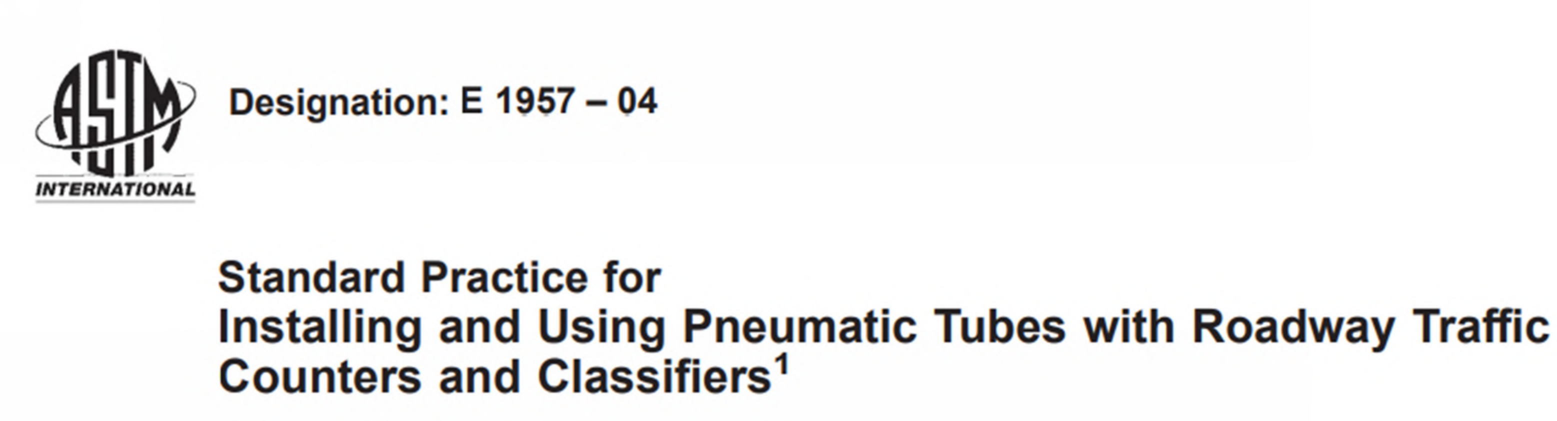
Source: www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/traffic-monitoring-theory.cfm

TABLE 1-2

STRENGTHS AND WEAKNESSES OF COMMERCIALLY AVAILABLE SENSOR TECHNOLOGIES FOR MOTORIZED TRAFFIC

| **Technology** | **Strengths** | **Weaknesses** |
|---|---|---|
| Air switch/ Road tube | ❍ Common standard for obtaining axle count and classification in portable applications<br>❍ Mature, well-understood technology | ❍ Installation may require lane closure<br>❍ Does not detect vehicle overall length<br>❍ Does not work well in high volume or slow or stopped traffic |

# ASTM E 1957 – 04: Standard Practice for Installing and Using Pneumatic Tubes with Roadway Traffic Counters and Classifiers



Designation: E 1957 – 04

Standard Practice for
Installing and Using Pneumatic Tubes with Roadway Traffic
Counters and Classifiers[1]

4.1.1 Select a relatively straight and smooth section of roadway with free flowing traffic throughout the duration of the data-collection session. For example, in selecting the roadway section, attention should be given to avoiding proximity to driveways and intersections. The availability of a place to anchor the traffic recording device is also important.

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