Texas Work Zone Performance Data

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Work Zone Performance Monitoring Needs

- Work Zone Safety and Mobility Final Rule (23 CFR 630 Subpart J)
  - State policy regarding work zone impacts
  - Use of safety and mobility data to assess and improve state policy and procedures
    - Project-level data
    - Process-level data

The Texas Situation

- Potential work zone impacts considered by all districts in project planning and design
- Safety and mobility impacts are monitored informally, not recorded for subsequent analysis
- Exposure data availability:
  - Project diaries, TCPs
  - AADT planning estimates

The Texas Situation (cont'd)

- Safety data availability:
  - State and district work zone reviews
  - Inspector traffic control review forms*
  - Statewide crash database
- Mobility data availability:
  - Real-time surveillance in some urban areas
  - Field monitoring, mitigation of "problems"

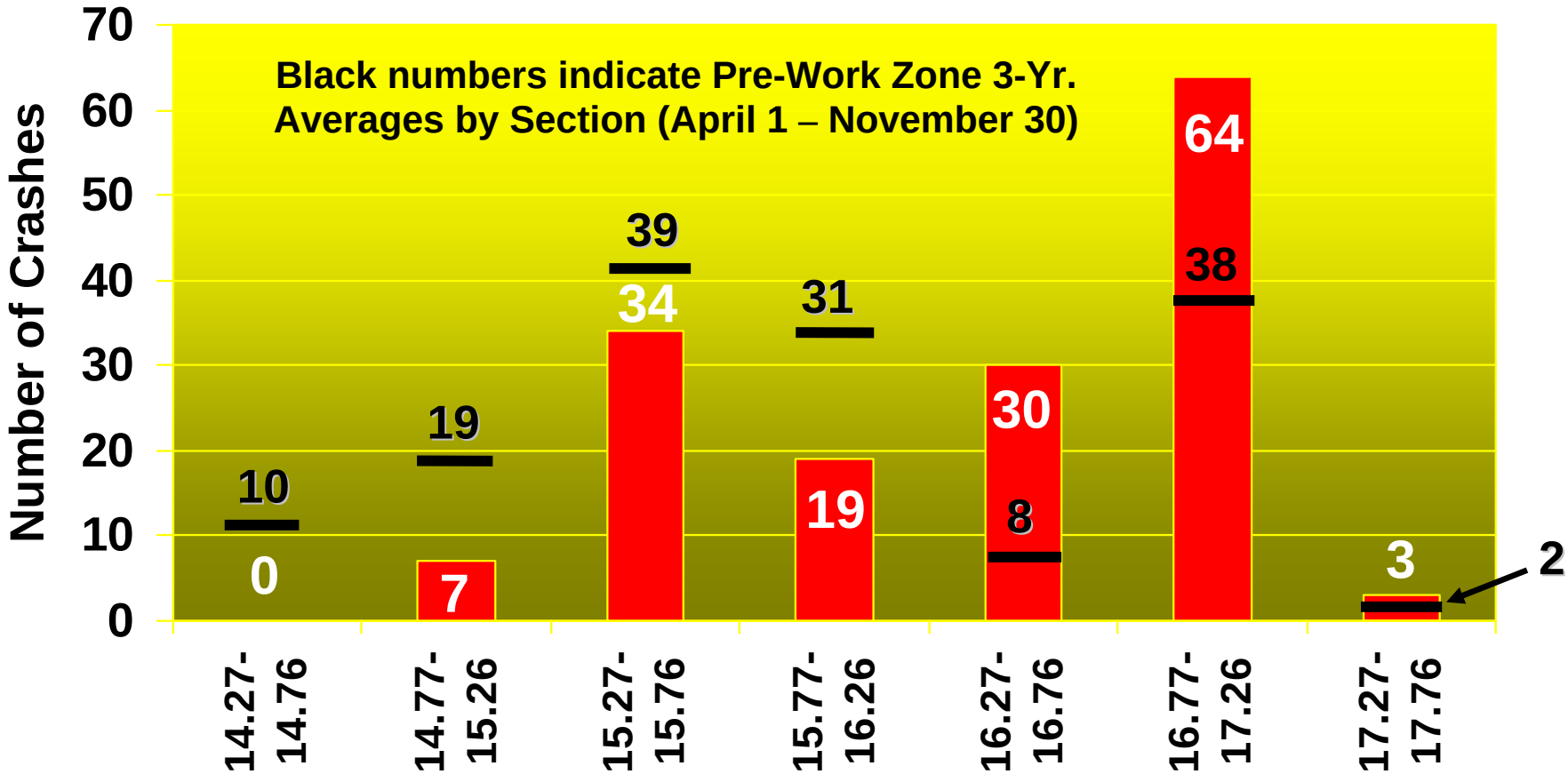
The Texas Situation (cont'd)

- Field personnel must serve a critical data collection function
- Field personnel must buy into the need for data collection and analysis
  - Averse to additional reporting requirements
  - Averse to "scores" about how things are handled for a particular project
  - Must offer project and/or district personnel a direct benefit (opportunity to improve)

Monitoring Needs of Project/District Personnel

- Safety
  - Which projects can be monitored?
  - At what level of detail can they be monitored?
  - When can I tell if a problem exists?
- Mobility
  - How long are the queues that develop during lane closures?
  - What is the total delay occurring during lane closures?

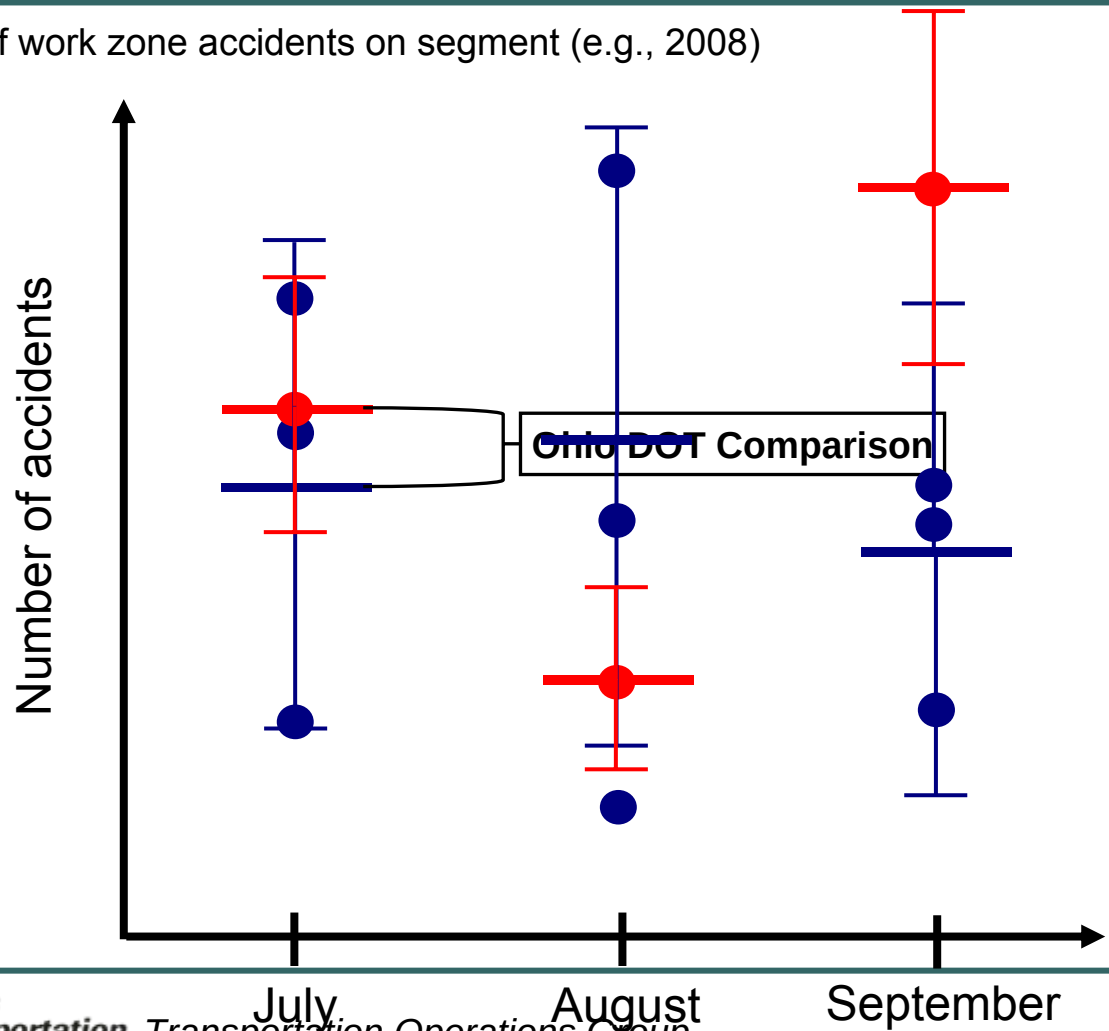
Work Zone Safety Monitoring: The Ohio DOT Approach



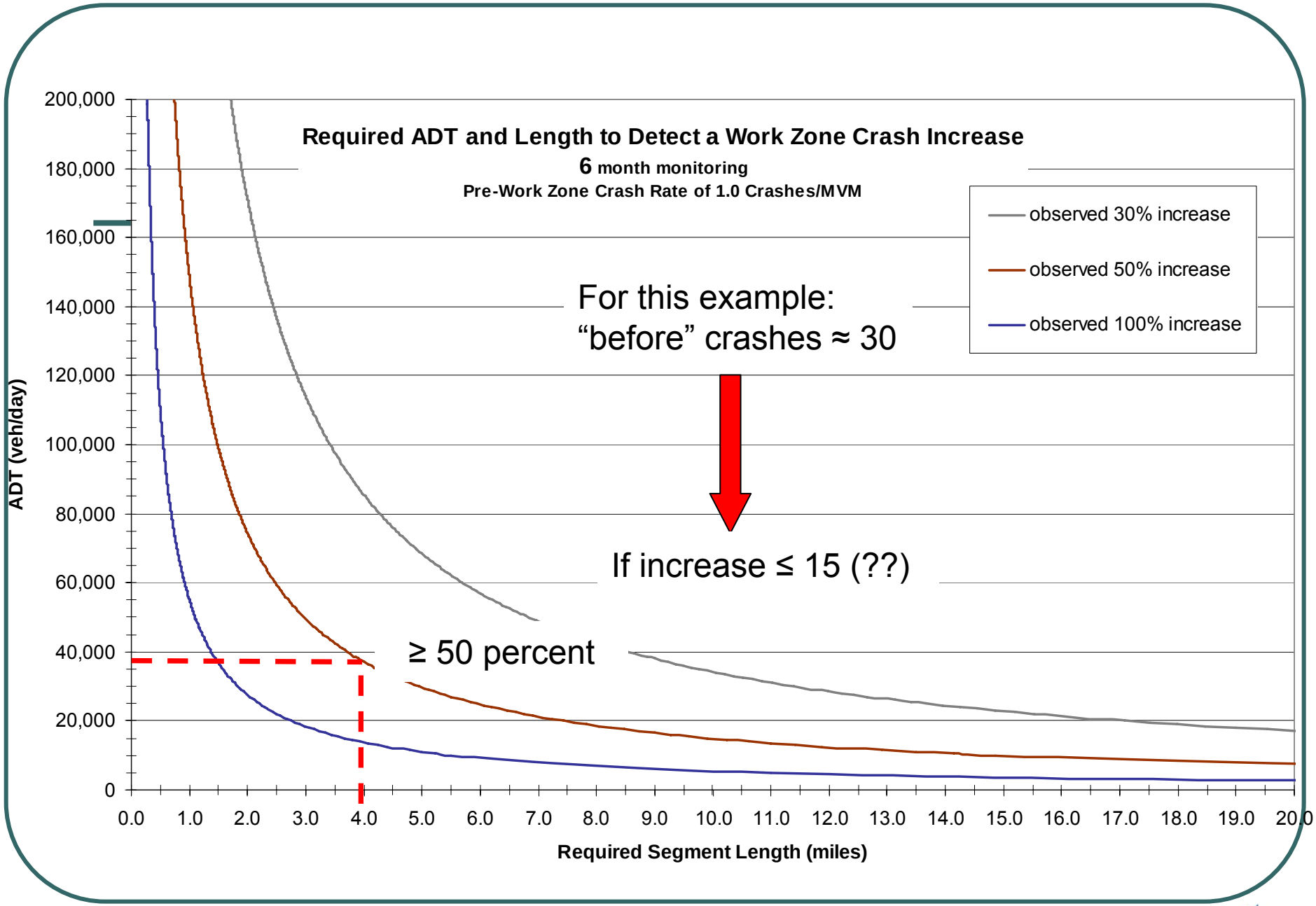
The Challenge

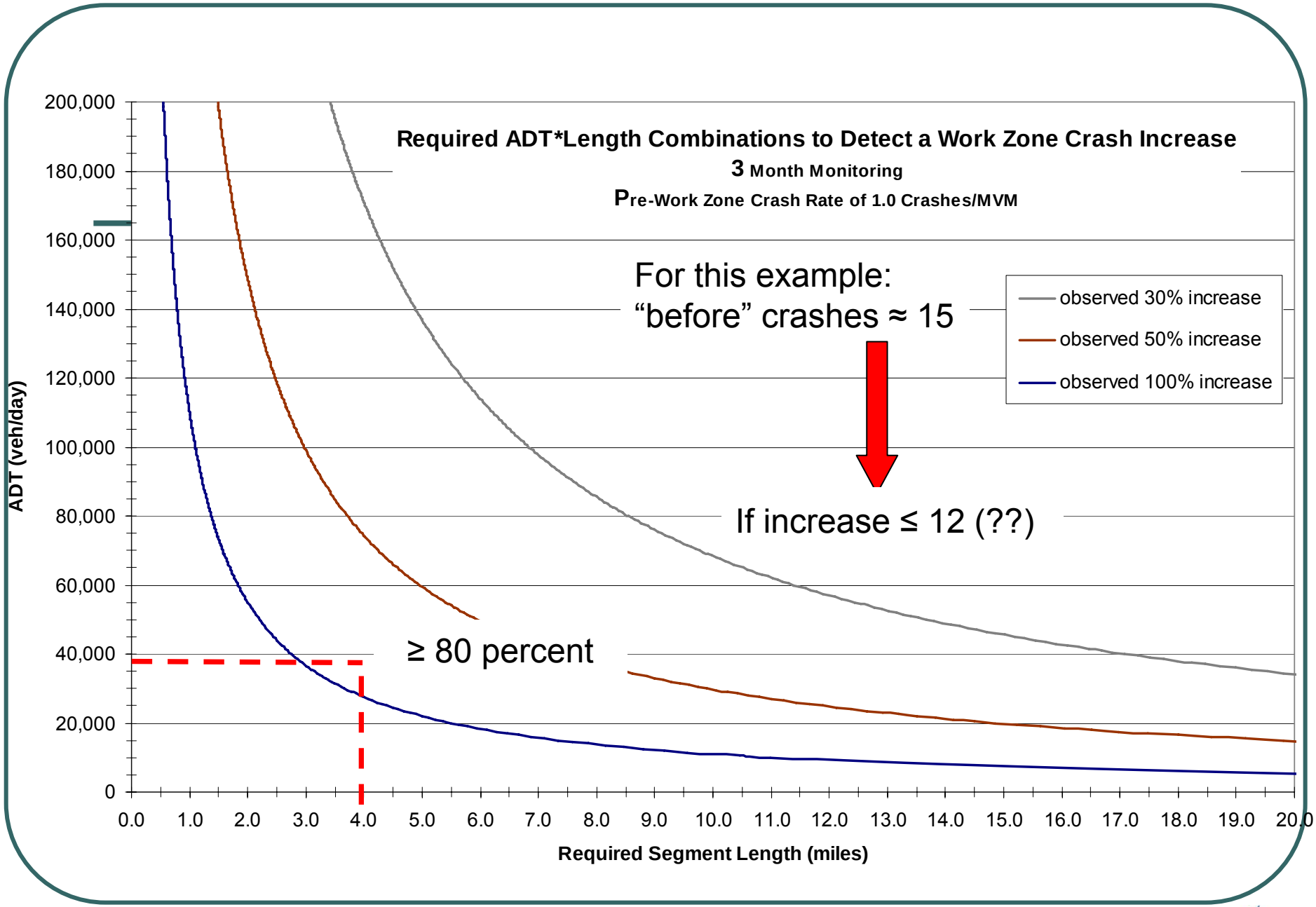
● = number of accidents on segment in each of 3 years prior to work zone (e.g., 2005 – 2007)

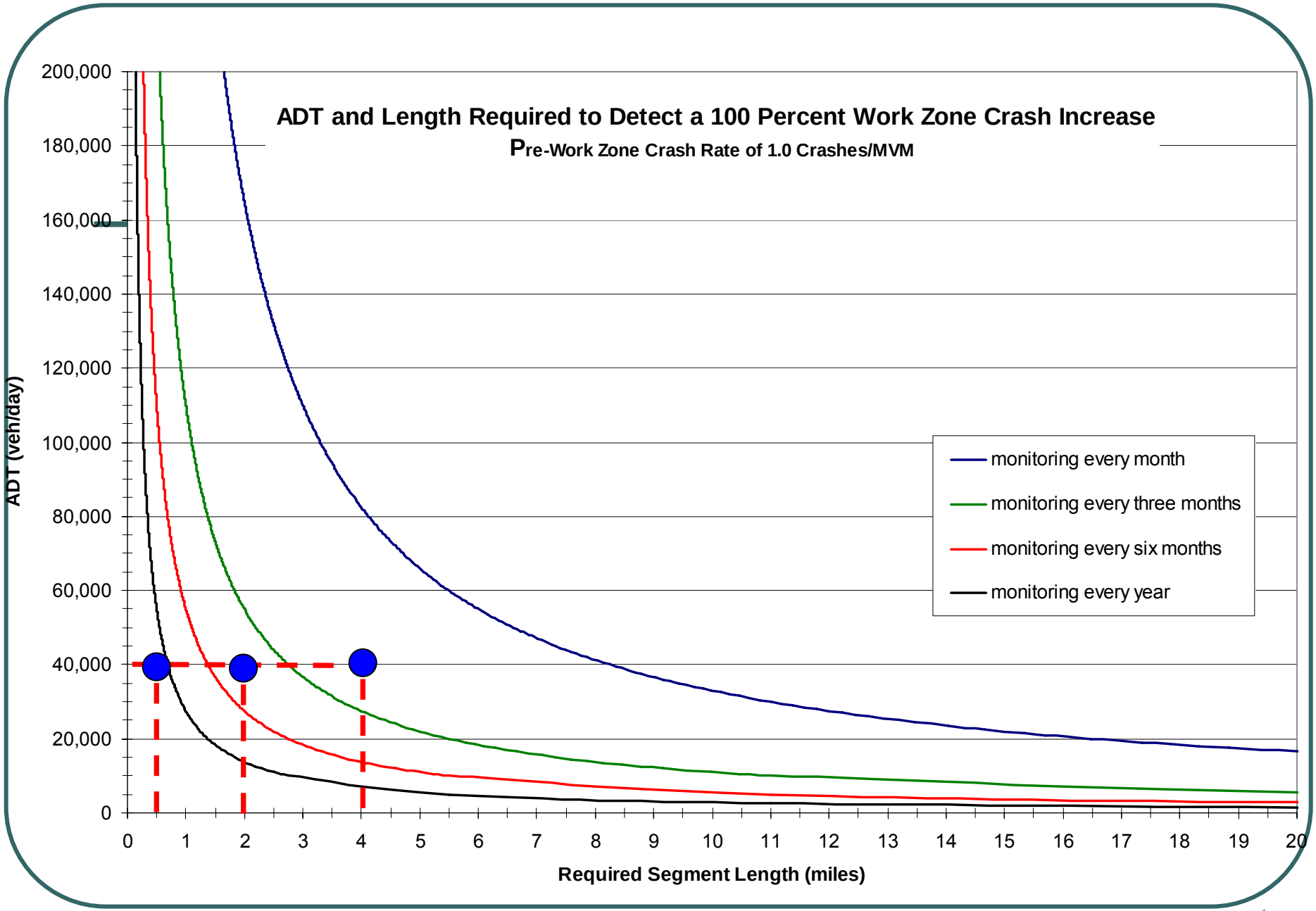
● = number of work zone accidents on segment (e.g., 2008)

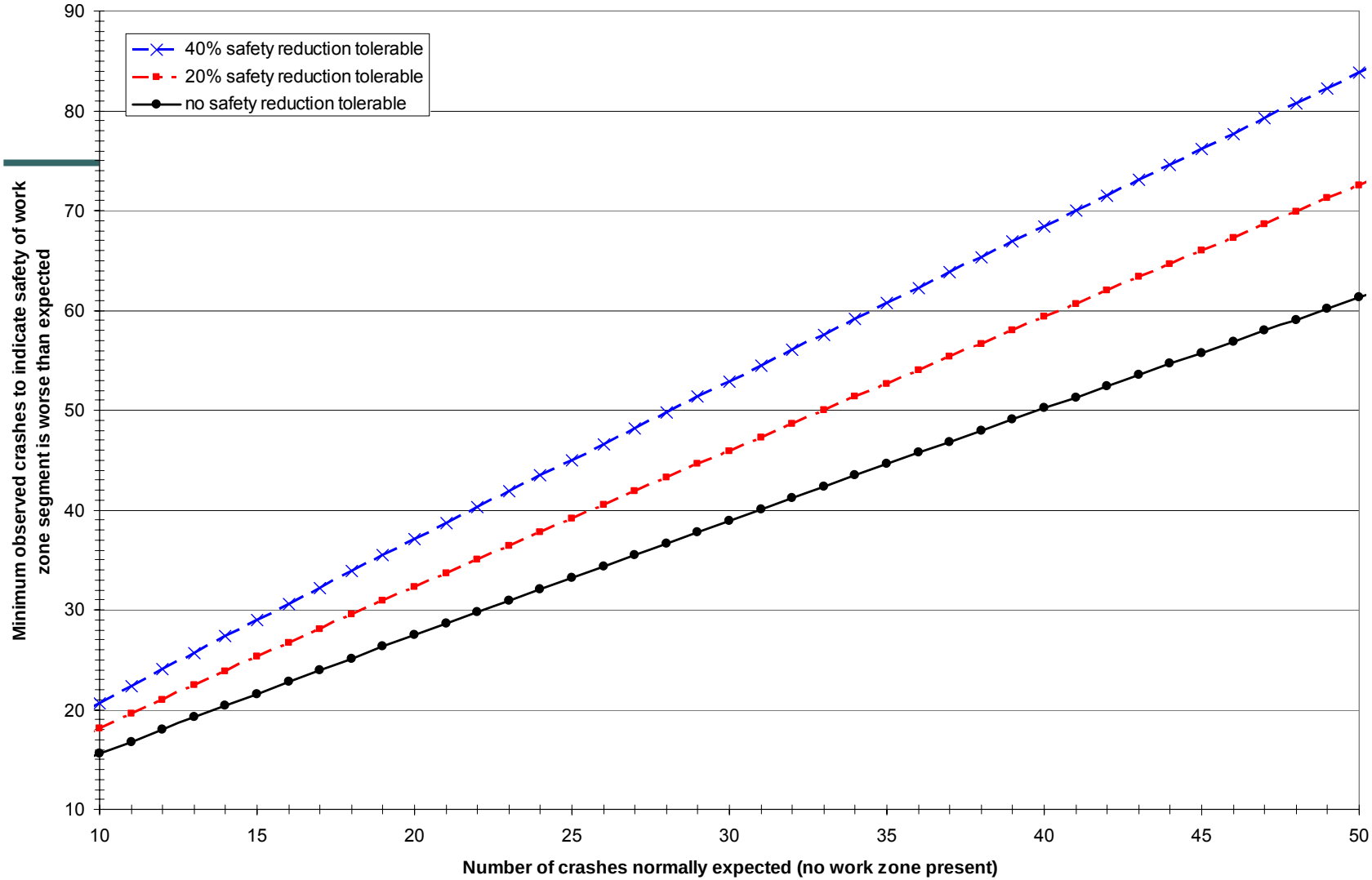


Is there a safety problem on this work zone segment?


Required ADT and Length to Detect a Work Zone Crash Increase
6 month monitoring
Pre-Work Zone Crash Rate of 1.0 Crashes/MVM
observed 30% increase
observed 50% increase
observed 100% increase
For this example:
"before" crashes ≈ 30
If increase ≤ 15 (??)
≥ 50 percent
ADT (veh/day)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
Required Segment Length (miles)


Required ADT*Length Combinations to Detect a Work Zone Crash Increase
3 Month Monitoring
Pre-Work Zone Crash Rate of 1.0 Crashes/MVM
For this example:
"before" crashes ≈ 15
If increase ≤ 12 (??)
≥ 80 percent
observed 30% increase
observed 50% increase
observed 100% increase
ADT (veh/day)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
Required Segment Length (miles)


ADT and Length Required to Detect a 100 Percent Work Zone Crash Increase
Pre-Work Zone Crash Rate of 1.0 Crashes/MVM
ADT (veh/day)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Required Segment Length (miles)
monitoring every month
monitoring every three months
monitoring every six months
monitoring every year

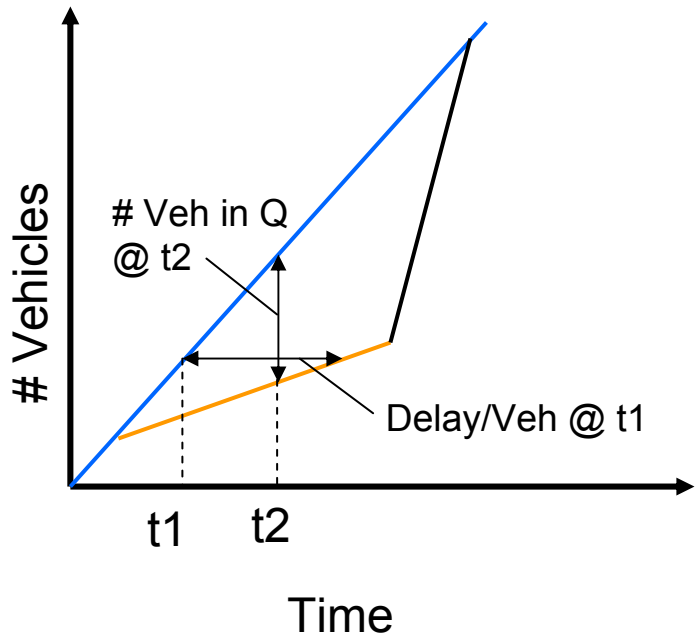

40% safety reduction tolerable
20% safety reduction tolerable
no safety reduction tolerable
Minimum observed crashes to indicate safety of work zone segment is worse than expected
Number of crashes normally expected (no work zone present)
90
80
70
60
50
40
30
20
10
10
15
20
25
30
35
40
45
50

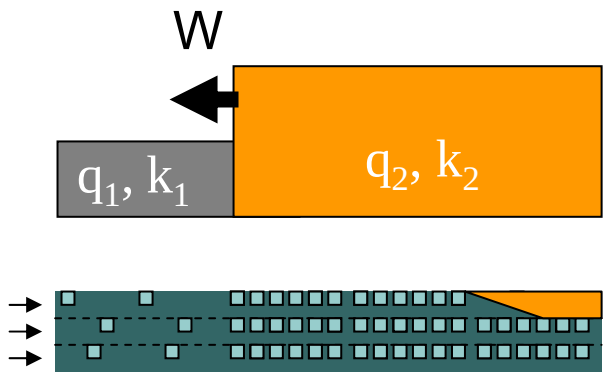
Work Zone Mobility Monitoring: Temporary Lane Closure Impacts

- Queue lengths:
  - Ensuring that advance warning signs are provided far enough upstream
  - Mitigating upstream conflicts (intersections, interchanges)
- Total delays:
  - Realistic user cost estimates
  - Adopting measurement-based lane rental, lane closure restriction penalties

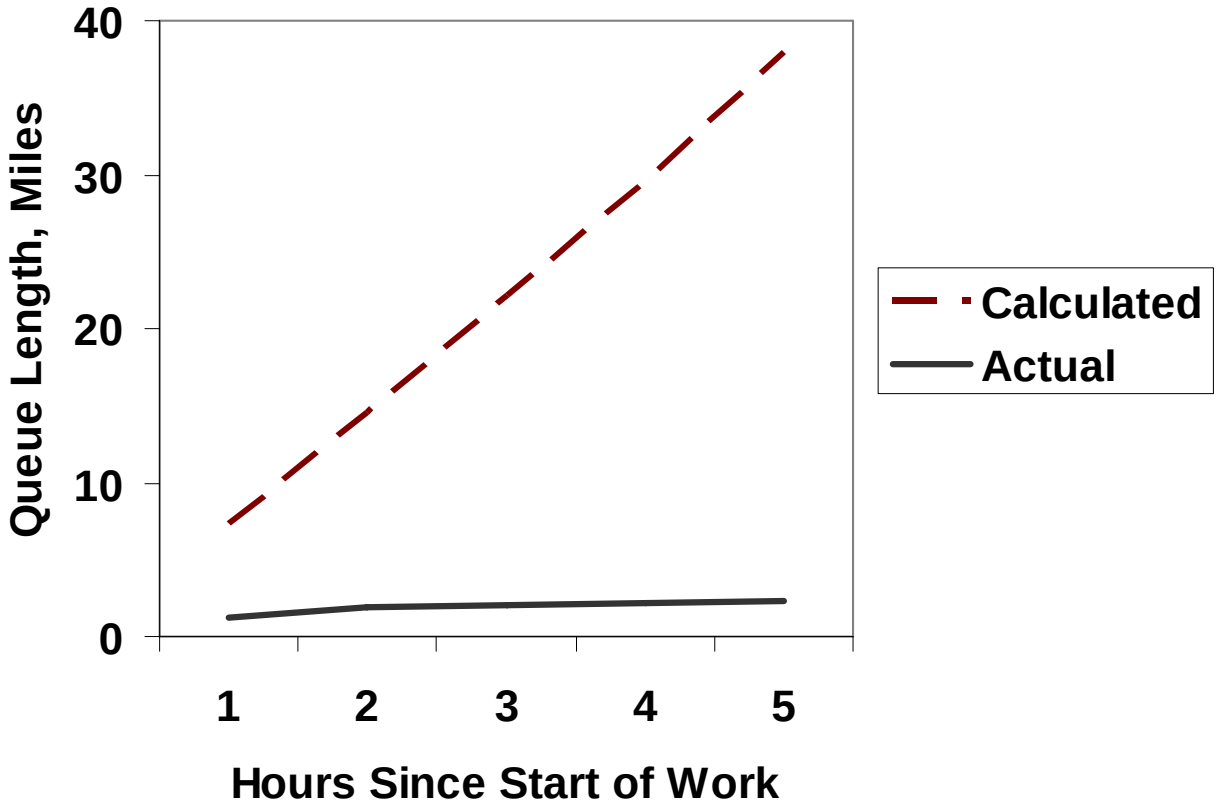
Traditional Queue and Delay Estimation Techniques

- Input-output analysis
- Shockwave theory



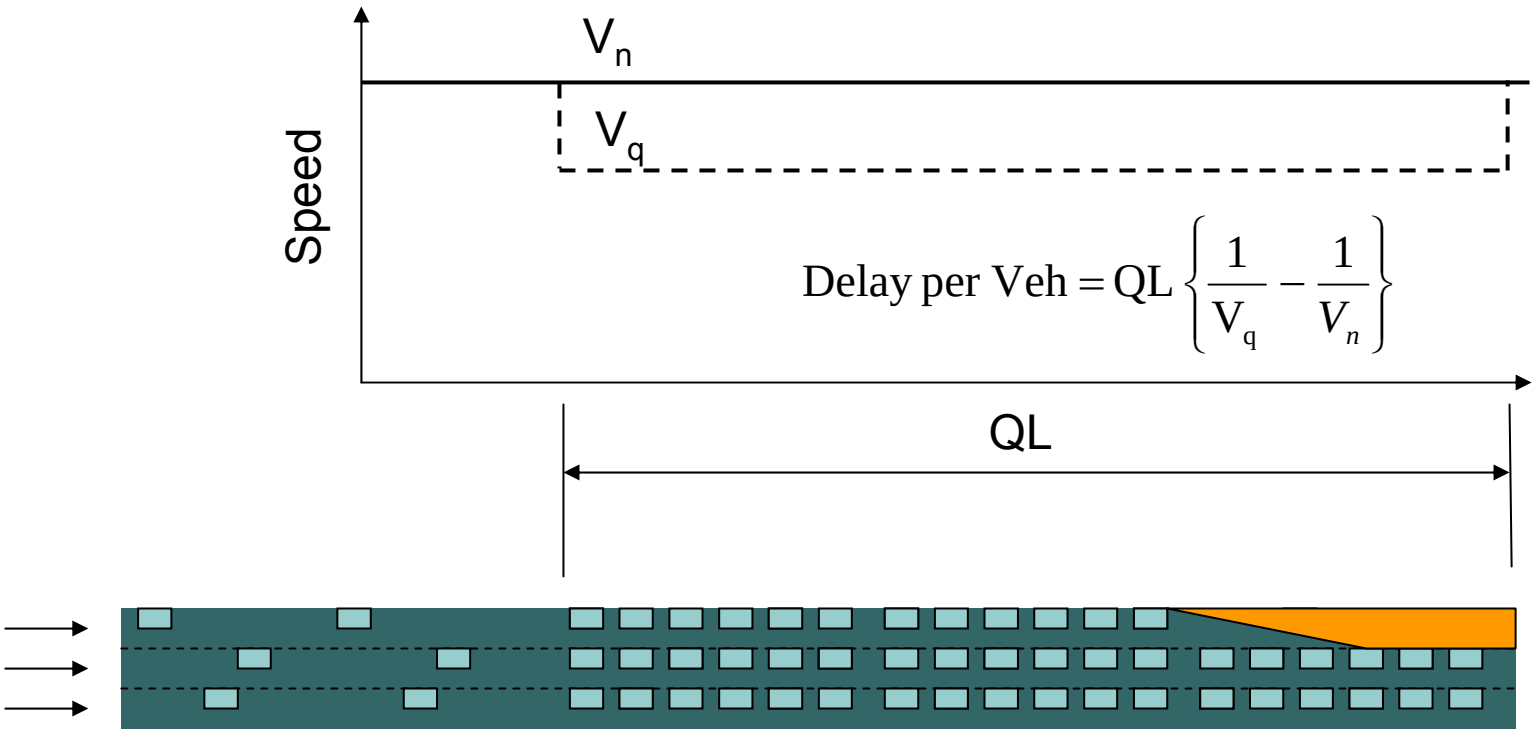


The Problem….


40
30
20
10
0
Queue Length, Miles
1
2
3
4
5
Hours Since Start of Work
Calculated
Actual

What if we start with queue length measurements directly?

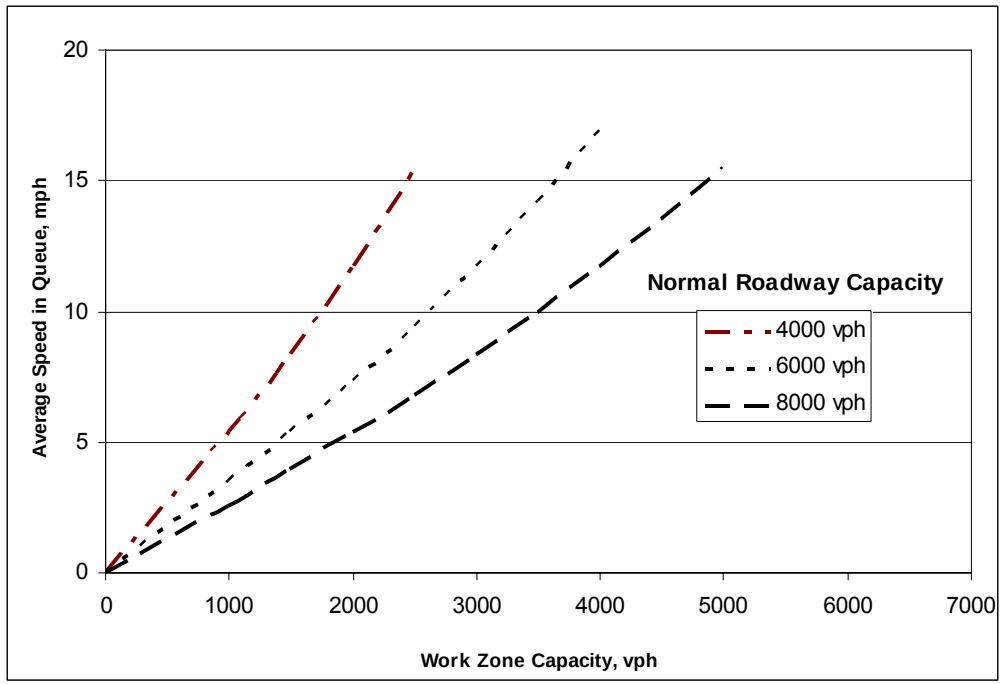
Queue-Length Estimate of Delay



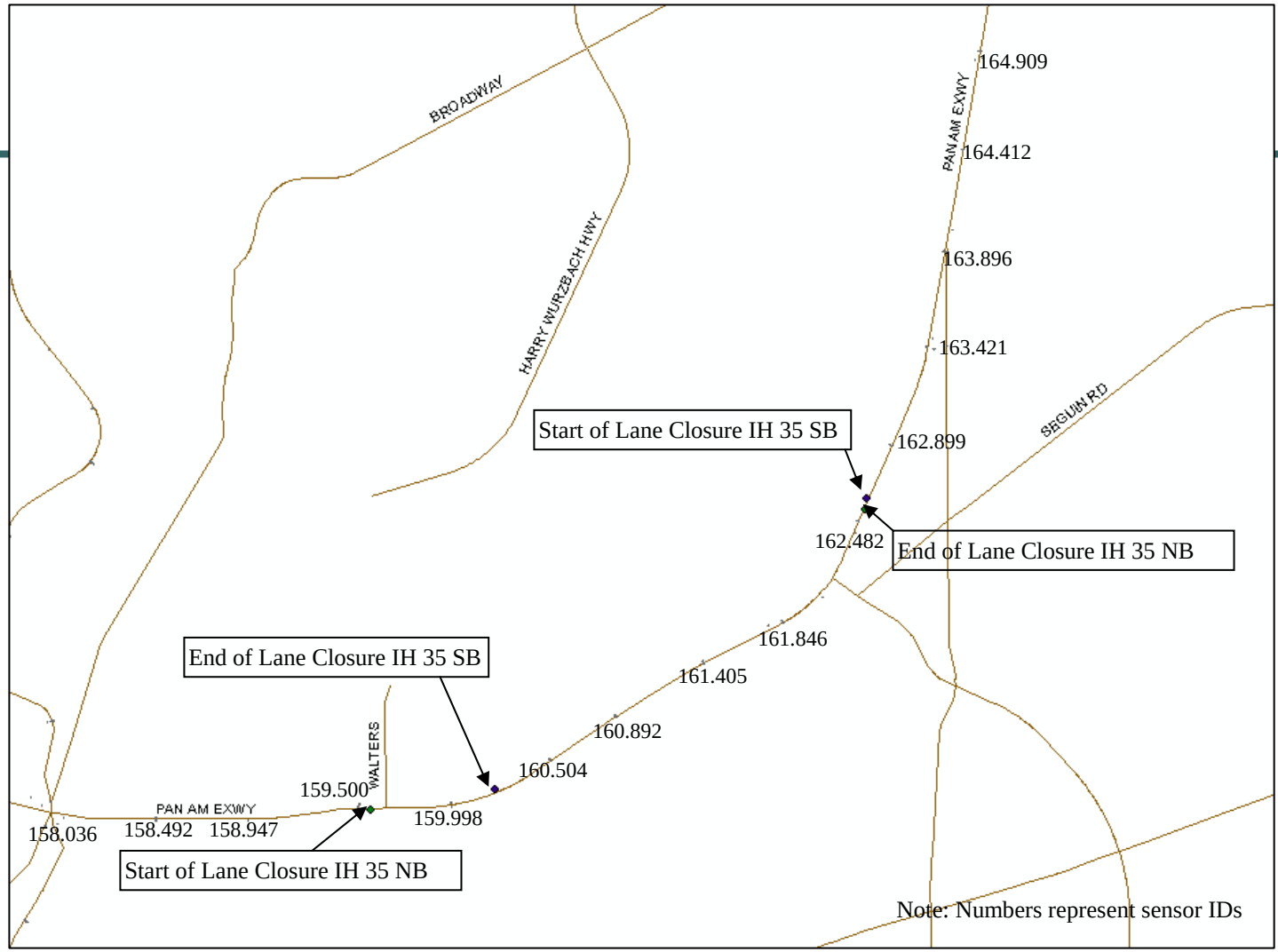
$$\text{Delay per Veh} = \text{QL}\left\{\frac{1}{\text{V}_\text{q}} - \frac{1}{V_n}\right\}$$

Estimating the Average Speed in Queue

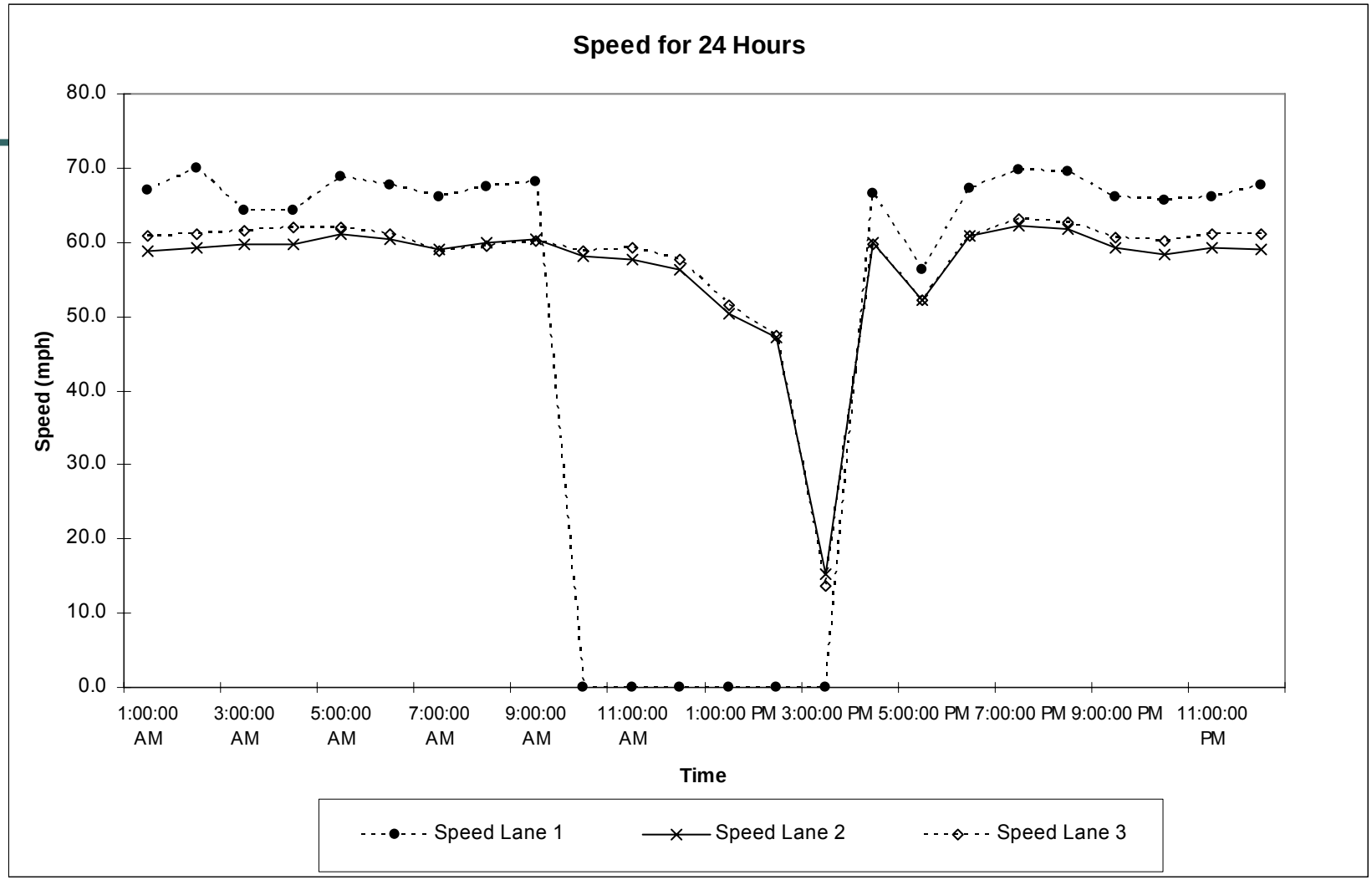
$$\text{Average Speed in Queue} = \left(\frac{\textit{Free Flow Speed}}{2}\right)\left(1 - \left(1 - \frac{\textit{Work Zone Capacity}}{\textit{Normal Roadway Capacity}}\right)^{\frac{1}{2}}\right)$$



Work Zone Layout – San Antonio



IH 35 NB 159.500 (4/14/2008)



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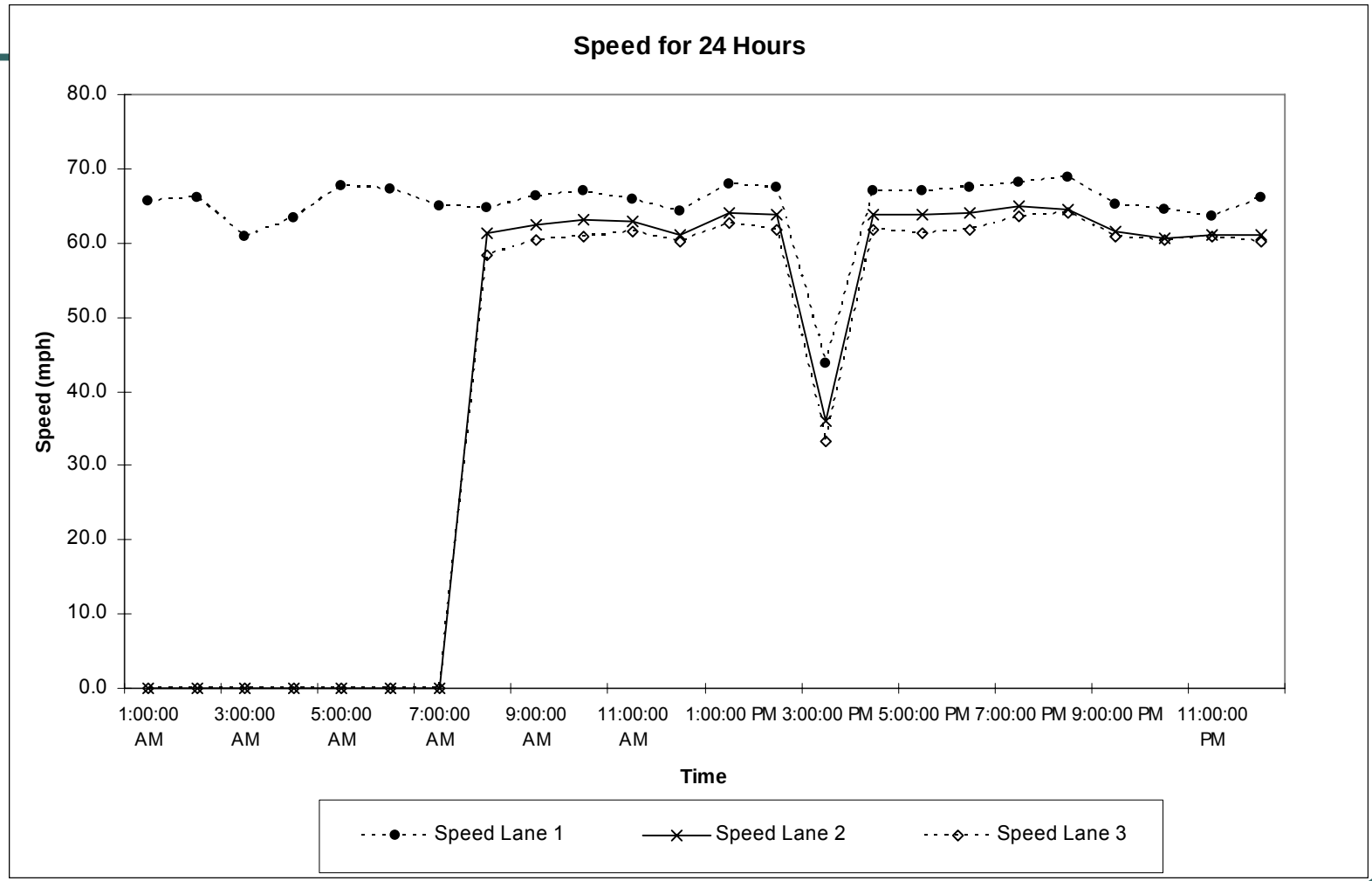

Comparison of Estimated Impacts (4/14/2008)

- Queue lengths
  - Manual estimation – 1 hour up to 1.5 mi
  - Traffic surveillance – 1 hour, 1.25 mi*
- Average Speed in Queue
  - Manual estimation – 15 mph
  - Traffic surveillance – 15-35 mph (25 mph)

Comparison of Estimated Impacts (4/14/2008) (cont'd)

- Maximum individual vehicle delay
  - Manual estimation – 6.7 min/veh
  - Traffic surveillance – 5.2 min/veh
- Total vehicle delay during Q
  - Manual estimation – 178.7 veh-hours
  - Traffic surveillance – 138.7 veh-hours