Queue Analysis for Work Zones

2004 Louisiana Pavement Conference

Peter A. Allain
Queue what?

- Lane closure delay
- Legal mandate
- Method selection
- Results to-date
- Policies
- Other solutions
Legislative Mandate

- Act 831 of 1999
- Act 77 of 2001
- Act 753 of 2003
ACT 831 OF 1999

1. Controlled access urban arterial highway

2. Populations greater than 200,000

3. Closures between 8:00 p.m. and 6 a.m.

4. Must report exceptions to the legislature
ACT 77 OF 2001

Contractors must follow closure restrictions to be eligible for incentives.
1. Changed scope to Interstate highways
2. Deleted population requirements
3. **Required a traffic queue analysis**
4. Changed to non-peak traffic hours
5. Still required report to legislature
6. Required signing in advance of the last exit prior to the traffic buildup
Method Selection

• Queue analysis
  – Theory-
    • HCM 2000
  – Software-
    • QuickZone, APA, Excel
  – Simulation-
    • Synchro/Simtraffic, Corsim
  – Data Requirements-
Knoxville, TN QuickZone Network
November 2000

Figure 8-2 Knoxville, TN Network

Figure 8-3 Knoxville, TN QuickZone Output

QuickZone
APA Method
ADT Data

- 100+ ADT Count station on Interstates
- 8 Automatic Traffic Recording (ATR)
- Monthly adjustment factors
- Axle adjustment factors
Is ADT enough for a queue analysis?

ADT on I-10, Jefferson Parish

Log Mile

<table>
<thead>
<tr>
<th>Parish Line</th>
<th>Loyola</th>
<th>Williams</th>
<th>Veterans</th>
<th>Clearview</th>
<th>Cleary</th>
<th>Causeway</th>
<th>Bennabel</th>
<th>Oaklawn</th>
<th>223211 Parish Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0</td>
<td>0.6</td>
<td>1.5</td>
<td>2.2</td>
<td>2.8</td>
<td>4.0</td>
<td>5.8</td>
<td>6.3</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>5.9</td>
<td>6.6</td>
<td>6.6</td>
<td>7.6</td>
<td>7.9</td>
<td>8.2</td>
<td>8.8</td>
<td>9.4</td>
<td>9.5</td>
</tr>
</tbody>
</table>

ADT (1,000)

<table>
<thead>
<tr>
<th>1997</th>
<th>1999</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DATA REQUIREMENT

• Count data for queue analysis
  – 7 days
  – 24 hours
  – 1 hour increments
  – Each direction separately
  – Typical non-holiday week
Parameters

- What is the capacity of a lane in a work zone?
- What is an acceptable delay?
Lane capacity in a work zone

- HCM 2000 – 1600 pc/ln/hr
- + or – 10% due to intensity of work
- 20% trucks = 0.909 adjustment
- Use 1309 pc/ln/hr
Maximum delay

• Initial assumption of 1 hr maximum
• Revised down to 20 minutes
• Recommended
  – 30 minute maximum delay
  – Equivalent to 1 ½ to 2 mile queue length
Results to date

• Data from
  – 25 project locations
  – 8 ATR locations
  – 60 data sets

• Adjustments for month and axles

• Excel spread sheet method
Monthly ADT Variations

Seasional Demand

<table>
<thead>
<tr>
<th>Month</th>
<th>HCM</th>
<th>DOTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>FEB</td>
<td>0.95</td>
<td>0.85</td>
</tr>
<tr>
<td>MAR</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>APR</td>
<td>1.05</td>
<td>0.95</td>
</tr>
<tr>
<td>MAY</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>JUN</td>
<td>1.15</td>
<td>1.05</td>
</tr>
<tr>
<td>JUL</td>
<td>1.2</td>
<td>1.15</td>
</tr>
<tr>
<td>AUG</td>
<td>1.25</td>
<td>1.2</td>
</tr>
<tr>
<td>SEP</td>
<td>1.3</td>
<td>1.25</td>
</tr>
<tr>
<td>OCT</td>
<td>1.35</td>
<td>1.3</td>
</tr>
<tr>
<td>NOV</td>
<td>1.4</td>
<td>1.35</td>
</tr>
<tr>
<td>DEC</td>
<td>1.45</td>
<td>1.4</td>
</tr>
</tbody>
</table>
## Excel Analysis

<table>
<thead>
<tr>
<th>Day</th>
<th>Hour</th>
<th>Hourly Vol (V&lt;sub&gt;H&lt;/sub&gt;)</th>
<th>Adjusted Hourly Vol</th>
<th>Excess Vol (V&lt;sub&gt;H&lt;/sub&gt; - C&lt;sub&gt;wz&lt;/sub&gt;)</th>
<th># of Vehicles in Queue (Q)</th>
<th>Queue Length (L) (ft)</th>
<th>Queue Length (miles)</th>
<th>Delay Time (Hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 - 0100</td>
<td>390</td>
<td>350</td>
<td>-959</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0100 - 0200</td>
<td>309</td>
<td>278</td>
<td>-1,031</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0200 - 0300</td>
<td>236</td>
<td>212</td>
<td>-1,097</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0300 - 0400</td>
<td>204</td>
<td>183</td>
<td>-1,126</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0400 - 0500</td>
<td>244</td>
<td>219</td>
<td>-1,090</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0500 - 0600</td>
<td>278</td>
<td>250</td>
<td>-1,059</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0600 - 0700</td>
<td>304</td>
<td>273</td>
<td>-1,036</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0700 - 0800</td>
<td>423</td>
<td>380</td>
<td>-929</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0800 - 0900</td>
<td>598</td>
<td>537</td>
<td>-772</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0900 - 1000</td>
<td>820</td>
<td>737</td>
<td>-572</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>955</td>
<td>858</td>
<td>-451</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>1047</td>
<td>941</td>
<td>-368</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>1166</td>
<td>1047</td>
<td>-262</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>1137</td>
<td>1021</td>
<td>-288</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>1169</td>
<td>1050</td>
<td>-259</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1500 - 1600</td>
<td>947</td>
<td>851</td>
<td>-458</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1600 - 1700</td>
<td>948</td>
<td>852</td>
<td>-457</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1700 - 1800</td>
<td>2359</td>
<td>2119</td>
<td>810</td>
<td>810</td>
<td>16621</td>
<td>3.15</td>
<td>0.62</td>
<td>0.00</td>
</tr>
<tr>
<td>1800 - 1900</td>
<td>1267</td>
<td>1138</td>
<td>-171</td>
<td>639</td>
<td>13203</td>
<td>2.50</td>
<td>0.49</td>
<td>0.00</td>
</tr>
<tr>
<td>1900 - 2000</td>
<td>1048</td>
<td>941</td>
<td>-368</td>
<td>272</td>
<td>5851</td>
<td>1.11</td>
<td>0.21</td>
<td>0.00</td>
</tr>
<tr>
<td>2000 - 2100</td>
<td>942</td>
<td>846</td>
<td>-463</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2100 - 2200</td>
<td>716</td>
<td>643</td>
<td>-666</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2200 - 2300</td>
<td>524</td>
<td>471</td>
<td>-838</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2300 - 2400</td>
<td>397</td>
<td>357</td>
<td>-952</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Sunday, February 2, 2003
Significant delays could occur on Fridays and Sundays due to lane closures.

Closures on any other days will not cause unacceptable delays.
ADT Data

I-10

ROUTE LOG MILE

ADT Data

ADT

ROUTE LOG MILE
Delays by Day of Week

- Monday-Thursday: Red
- Friday: Green
- Saturday: Yellow
- Sunday: Blue

Delay, Hours

ADT

22000 23000 25000 28000 30000 31000 34000 36000 40000 43000 60000
Policy

- Work zone lane capacity = 1309 vphpl
- Limit delay to 30 minute maximum
- ADT > 26,000 requires queue analysis
Type of Closures

Type A - Unlimited lane closures
Type B - Weekend or non peak closures only, including night work
Type C - Non peak only, including night work
Type D - Minimum of 2 Lanes per Direction Open
Type E - No Lane closures
Type F - Special Restricted Lane Closures
Other Solutions

- Always merge left
- Queue detection systems
- ITS and Traveler Information
- No reduction in capacity
Queue Detection and Warning Systems

I-10 New Orleans ITS

I-10 Acadia Parish Line to Egan
Special Provisions

- Test installation
- Detection
- Warning
- Web page with real time traffic information
- Data collection
The map indicates current traffic speeds through construction zones in two sections of the eastbound and westbound lanes of Interstate 10. The color key (above, right) indicates the speed through each section.

Alternate routes are indicated with blue and green.

You can read the text currently displayed on message boards in the area by clicking on the icon for each.
View of Project Area:
I-10 Construction - Acadia Parish Line to Egan
Revised: Wednesday, August 13, 2003

Legend:
- Construction Zone
- Alternate Route #1
- Alternate Route #2

Alternate Route #2: 132.2 miles
LA 102 South to US 90
LA 113 North to US 150
1-10 Project Limits: 685 miles

Construction Home | Update | Description | Schedule
The End