Transmittal #1
Street Damage Restoration Fee Study

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Department of General Services
Bureau of Street Services
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SDRF Update
Study Objective

To Update the 1996 Street Damage Restoration Fees
Presentation Organization

1. Random Selection of Pavement sections (Test Sites)
2. Functional (Condition) Testing and Analysis
3. Structural Testing and Analysis
4. Determination of Annual Damage due to Utility Cut Patching
5. Determination of Street Damage Restoration Fees (SDRF)
6. Conclusions and Recommendations
1. Section Selection

Google Earth, along with BOE utility database were used extensively to validate candidate sections as follows:

- A referenced patch in the BOE database has to be seen in Google Earth.
- There is enough pavement without utility cut patching adjacent to the PAT area to allow for the establishment of the CTL.
- The PAT and CTL areas can’t be located in intersections or turning lanes to ensure they are subjected to the same traffic.
PAT and CTL Pavement Areas
Section Selection (Stratified Random Criterion)

Pavement Sections were randomly selected from stratified groups to insure:

- Sections are from different pavement age groups to allow for the development of the deterioration curve.
- Utility cut patch has been in the pavement long enough to allow for the patch to have its effect on pavement performance.
- Different utility companies are adequately represented.
Map of Selected Sections
2. Functional (Condition) Inspection

Distress type

Distress quantity

Sample PCI

Distress severity

PCI

0

55

70

100

Good

Fair

Poor
Select Sites

PCI = 62.8

PCI = 51.7

Wt Avg Condition

CTL

PAT
Alligator Cracking

% of Total Area

LO

10.1
3.5

SE

6.8
4.2

CTL  PAT
Critical PCI

- Preventive Maintenance
- Reconstruction

Critical PCI - $1 for Rehabilitation here
Will cost $4 to $5 here

TIME
PCI Family Model for Select – CTL Sites

![Graph showing correlation between age and an index, with a point indicating 15.44 Yrs.]
<table>
<thead>
<tr>
<th>Roads</th>
<th>CTL</th>
<th>PAT</th>
<th>Loss in Functional Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Roads</td>
<td>18.25 Yrs.</td>
<td>6.48 Yrs.</td>
<td>64%</td>
</tr>
<tr>
<td>Select Roads</td>
<td>15.44 Yrs.</td>
<td>5.29 Yrs.</td>
<td>66%</td>
</tr>
</tbody>
</table>
3. Structural Testing Program

Falling Weight Deflectometer:
- Eight deflections adjacent to patch joint
- One deflection in patch center
- Eight deflections in the Control area

Cores were taken:
- In the trench
- Outside the trench
- In the Control area

Piezocone Penetration Testing:
- In the trench
- Outside the trench
- In the Control area
Average Normalized Deflection, $D_0$ (mils) for Local & Select Sites

- **Local Sites**
  - Control: 13.26 mils
  - Trench: 18.68 mils

- **Select Sites**
  - Control: 6.95 mils
  - Trench: 10.50 mils
Comparison of Average Pavement Thickness Between Local & Select Sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Trench In</th>
<th>Trench Out</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>5.0</td>
<td>5.7</td>
<td>5.6</td>
</tr>
<tr>
<td>Select</td>
<td>8.7</td>
<td>10.6</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Average Thickness (in.)
AC Thickness Distribution
Trench In vs. Respective Trench Out for Select Sites

Select Site, Trench In vs. Trench Out
Comparison of Relative Soil Strength

Comparison of Average $N_{60}$ for Local and Select Sites
Average Overlay Thickness Design Required For Local & Select Sites

- **Local Sites**
  - Trench: 1.70
  - Control: 0.86

- **Select Sites**
  - Trench: 4.21
  - Control: 2.35

Legend:
- Local, Trench
- Local, Control
- Select, Trench
- Select, Control
## Loss in Structural Life due to Utility Cut Patching

<table>
<thead>
<tr>
<th></th>
<th>Mean Life Ratio</th>
<th>Loss in Structural Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>local Streets</td>
<td>0.45</td>
<td>55%</td>
</tr>
<tr>
<td>Select Streets</td>
<td>0.47</td>
<td>53%</td>
</tr>
</tbody>
</table>
4. Calculation of Annual Damage due to Utility Cuts

Used same approach as 1996 study;

- **Total Cost** = Overlay + Manhole Alignment + Milling + Profiling

- **Average Yearly Cost** = Total Cost / Pavement Life
The following unit costs are Direct Costs Provided by BOE based on Actual Bidding Costs:

- Asphalt Concrete Cost/ ton, $ = 100.00
- Manhole Alignment/ Each, $ = 1000.00
- Average Manholes/ mile = 5.00
- Cold Plane/ SF/ in, $ = 0.35
- 6 Ft Profile near gutter/ SF, $ = 1.00
# Annual Damage due to Utility Cuts

<table>
<thead>
<tr>
<th></th>
<th>Functional and Structural Effects</th>
<th>Functional Effect Only</th>
<th>Structural Effect Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>$82.74M</td>
<td>$40.59M</td>
<td>$18.71M</td>
</tr>
<tr>
<td><strong>Select</strong></td>
<td>$154.89M</td>
<td>$74.22M</td>
<td>$29.12M</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$237.63M</td>
<td>$114.81M</td>
<td>$47.83M</td>
</tr>
</tbody>
</table>
5. Calculation of Utility Cut Fees

- Determine Average Utility Cut Width of Influence

- Determine Annual SF of Utility Cuts – Last 5 Year Average from BoE Database:
  - Local  = 799,594 SF
  - Select = 760,443 SF
Utility Cut Patching Width of Influence
Deflection $D_0$ (Normalized to 9 kips & 68°F) vs. Distance from Trench

<table>
<thead>
<tr>
<th>Trench</th>
<th>Pavement</th>
</tr>
</thead>
</table>

Normalized Deflection $D_0$ (in.)

Distance from Trench (ft.)

- $S8$
- $S3$

Graph showing the deflection $D_0$ normalized to 9 kips and 68°F as a function of distance from the trench.
The deflection ratio around the edge of the patch compared to away from the patch ranges from 1.25 to 2.74 with an average of 1.59.

The Utility Cut Patch Width of influence ranges from 2.5 ft. to 10.0 ft. with an average of about 5 ft.
Sketch of Overlapping Area of Influence under pavement.
### Street Damage Restoration Fees (SDRF)

#### Functional ad Structural Effects

<table>
<thead>
<tr>
<th></th>
<th>0 ft. Width of Influence</th>
<th>2 ft. Width of Influence</th>
<th>5 ft. Width of Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>$103.48</td>
<td>$37.77</td>
<td>$16.80</td>
</tr>
<tr>
<td><strong>Select</strong></td>
<td>$203.69</td>
<td>$82.80</td>
<td>$40.58</td>
</tr>
</tbody>
</table>

#### Functional Only

<table>
<thead>
<tr>
<th></th>
<th>0 ft. Width of Influence</th>
<th>2 ft. Width of Influence</th>
<th>5 ft. Width of Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>$50.76</td>
<td>$18.53</td>
<td>$8.24</td>
</tr>
<tr>
<td><strong>Select</strong></td>
<td>$97.60</td>
<td>$39.68</td>
<td>$19.44</td>
</tr>
</tbody>
</table>

#### Structural Only

<table>
<thead>
<tr>
<th></th>
<th>0 ft. Width of Influence</th>
<th>2 ft. Width of Influence</th>
<th>5 ft. Width of Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>$23.40</td>
<td>$8.54</td>
<td>$3.80</td>
</tr>
<tr>
<td><strong>Select</strong></td>
<td>$38.30</td>
<td>$15.57</td>
<td>$7.63</td>
</tr>
</tbody>
</table>
6. Conclusions – Functional (Condition)Testing

- The PCI of the CTL areas is significantly higher than the PAT areas:
  - Local sites - 15 points.
  - Select Sites - 11 points.

- The pavement life to a PCI of 60 of the CTL areas is significantly higher than the PAT areas:
  - Local sites - 11.8 years.
  - Select Sites - 10.2 years.

- The percent loss in pavement life of the PAT vs the CTL areas was calculated as:
  - Local sites - 64%
  - Select Sites - 66%

- There is a higher percent of load related distresses (Alligator cracking and Rutting) in PAT vs CTL areas. Most of the differences are at the medium and high severity levels of the distresses.
Conclusions – Structural Testing

- The loss in structural life was estimated at 55% for Local sites and 53% for Select sites.

- The average overlay design thickness for the PAT areas is about twice as much as that needed for the CTL areas.

- The deflection ratio around the edge of the patch compared to away from the patch ranges from 1.25 to 2.74 with an average of 1.59.

- The weakened width around the patch (measured perpendicular to patch joint) varies from 2.5ft to 10ft. with an average of 5.2 ft.

- The average pavement thickness at the center of the patch is lower than around the patch.
## Minimum Annual Damage and Patching Fees

<table>
<thead>
<tr>
<th></th>
<th>Local Streets</th>
<th>Select Streets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Annual Damage</td>
<td>$40.59M</td>
<td>$74.22M</td>
</tr>
<tr>
<td>Minimum Patching Fees (5 ft. width of influence)</td>
<td>$8.24 per SF</td>
<td>$19.44 per SF</td>
</tr>
</tbody>
</table>
## Comparison of CTL and PAT Test Results

### Local Streets

<table>
<thead>
<tr>
<th>Year</th>
<th>Difference in Pavement Life, years</th>
<th>% Loss in Pavement life</th>
<th>Pavement Deflection Ratio: Trench Edge/CTL</th>
<th>Annual Damage, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>6</td>
<td>18</td>
<td>1.2</td>
<td>3.5 M (6.5 M with 3% inflation)</td>
</tr>
<tr>
<td>2017</td>
<td>11.77</td>
<td>64</td>
<td>1.41</td>
<td>82.7 M</td>
</tr>
</tbody>
</table>
## Comparison of CTL and PAT Test Results

Select Streets

<table>
<thead>
<tr>
<th>Year</th>
<th>Difference in Pavement Life, years</th>
<th>% Loss in Pavement life</th>
<th>Pavement Deflection Ratio: Trench Edge/CTL</th>
<th>Annual Damage, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>8.5</td>
<td>34</td>
<td>1.22</td>
<td>12.9 M (24 M with 3% inflation)</td>
</tr>
<tr>
<td>2017</td>
<td>10.15</td>
<td>66</td>
<td>1.51</td>
<td>154.9 M</td>
</tr>
</tbody>
</table>