UPDATE

There was a significant change in the condition of the sealant since the 2003 review, with many of the cracks observed now showing signs of sidewall adhesion failure. The two primary reasons for the failures are thought to be traffic and weather. Because the sealant was applied over a previously sealed crack or joint, it basically has no shape factor to it. Instead, it is typically a thin band of sealant spread over the crack and therefore susceptible to traffic wear and tear. That may explain some of the failures seen, but one would expect the failures to be more common in the wheelpaths of the cracks or joints, and this was not the case.

The failures seen tended to be across the entire crack or joint, and weather related stresses might be the reason. The winter of ’03 – ’04 was colder than the previous winter, when an extended cold spell in January 2004 had 3 straight days with temperatures never reaching 0°F (-18°C) and bottoming out at -22°F (-30°C) on consecutive nights. There was also a stretch from late January to early February where 15 out of 19 nights had below 0°F (-18°C) temperatures. With the thin band of sealant placed over the cracks or joints, these temperature extremes could be the primary reason so many adhesion failures were seen.

BACKGROUND INFORMATION

LRRB 770

Local road authorities have used crack sealing as a method to reduce water infiltration in hot mix asphalt (HMA) pavements for many years. The original rubberized crack and joint sealants work well for 3 to 7 years, then they begin to fail. There is no accepted method of how to reseal these cracks and joints after they begin to fail. Working with the assumption that reducing water infiltration in HMA pavements extend the life of these pavements, it is imperative that an acceptable method of resealing these cracks and joints be determined.

The goal of LRRB 770 is to develop a list of acceptable sealant types and methods of resealing previously sealed cracks or joints. The final product will be a ‘User
Guideline on how and when and what to do to reseal or repair previously sealed cracks or joints. This guideline will address cracks and joints in various states of disrepair.

**STEEL COUNTY EXPERIMENT**

In May 2002, CSAH 3 and CSAH 7 were resealed with five different Crafco sealants to gage their effectiveness in resealing sealed cracks. The following products were used:

**PRODUCT – CRAFTCO SEALANTS DATA**

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Trade Name</th>
<th>Mn/DOT Spec</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>241</td>
<td>Asphalt Rubber Plus</td>
<td>3719</td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>Asphalt Rubber Plus II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>249</td>
<td>Poly Fiber Type 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>516</td>
<td>Poly Flex Type 1</td>
<td>“Old MN blend”</td>
<td></td>
</tr>
<tr>
<td>535</td>
<td>Roadsaver</td>
<td>3723</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 2: SEALANT CONFORMANCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>TEST</th>
<th>241¹</th>
<th>244²</th>
<th>249³</th>
<th>516⁴</th>
<th>535⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration, 77°F</td>
<td>90 max</td>
<td>50-90</td>
<td>50 max</td>
<td>50-70</td>
<td>60-90</td>
</tr>
<tr>
<td>Flow, 140°F</td>
<td>5 mm max</td>
<td>5.0 mm max</td>
<td>-</td>
<td>3 mm max</td>
<td>3.0 mm max</td>
</tr>
<tr>
<td>Resilience, 77°F</td>
<td>-</td>
<td>25-60%</td>
<td>-</td>
<td>40% min</td>
<td>40% min</td>
</tr>
<tr>
<td>Bond, 0°F, 200% ext.</td>
<td>Pass 5 cycles</td>
<td>NA</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bond, -20°F, 200% ext.</td>
<td>-</td>
<td>Pass 3 cycles</td>
<td>-</td>
<td>-</td>
<td>Pass 3 cycles</td>
</tr>
<tr>
<td>Softening Point</td>
<td>-</td>
<td>-</td>
<td>195°F min</td>
<td>190°F min</td>
<td>-</td>
</tr>
<tr>
<td>Ductility, 77°F</td>
<td>-</td>
<td>-</td>
<td>10 cm min</td>
<td>30 cm min</td>
<td>-</td>
</tr>
<tr>
<td>Flexibility, -29°F, 1”, 90°, 10 sec</td>
<td>-</td>
<td>Pass</td>
<td>Pass at -20°F</td>
<td>Pass at 0°F</td>
<td>-</td>
</tr>
<tr>
<td>Brookfield Viscosity</td>
<td>-</td>
<td>NA</td>
<td>-</td>
<td>100 Poise max</td>
<td>-</td>
</tr>
<tr>
<td>Asphalt Compatibility</td>
<td>-</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>Recommended Pour Temperature</td>
<td>380°F</td>
<td>-</td>
<td>350°F</td>
<td>380°F</td>
<td>380°F</td>
</tr>
<tr>
<td>Safe Heating Temperature</td>
<td>410°F</td>
<td>-</td>
<td>400°F</td>
<td>400°F</td>
<td>410°F</td>
</tr>
<tr>
<td>Bitumen Content</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>60% min</td>
<td>-</td>
</tr>
<tr>
<td>Tensile Adhesion</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>500% min</td>
<td>-</td>
</tr>
</tbody>
</table>

**INSTALLATION INFORMATION: CSAH 7 – STEELE COUNTY**

The project starts at the intersection of CSAH 7 & 32 and goes east. Each test section is ½ mile long with roadside signs mark the beginning of each section. Control sections are ½ mile sections on each end of the project.
### SECTION 1: PRODUCT 535 (ROADSAVER)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/14/02</td>
<td>58°F</td>
<td>10:00</td>
<td>12:00</td>
<td>870 $0.28/LB</td>
</tr>
</tbody>
</table>

### SECTION 2: PRODUCT 516 (POLYFLEX TYPE 1)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/15/02</td>
<td>57°F</td>
<td>09:30</td>
<td>12:30</td>
<td>840 $0.30/LB</td>
</tr>
</tbody>
</table>

### SECTION 3: PRODUCT 241 (ASPHALT RUBBER PLUS)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16/02</td>
<td>37°F</td>
<td>09:00</td>
<td>11:00</td>
<td>660 $0.30/LB</td>
</tr>
</tbody>
</table>

### SECTION 4: PRODUCT 244 (ASPHALT RUBBER PLUS 2)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/17/02</td>
<td>51°F</td>
<td>09:30</td>
<td>12:00</td>
<td>840 $0.30/LB</td>
</tr>
</tbody>
</table>

### SECTION 5: PRODUCT 249 (POLYFIBER TYPE 2)

**TOTALS: CSAH 7**

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/14 to 5/20</td>
<td>58°F to 37°F</td>
<td></td>
<td></td>
<td>4,050 $1,196.60</td>
</tr>
</tbody>
</table>

A Cimline kettle and heat lance was rented for the work. The County’s maintenance crews installed the material.

**INSTALLATION INFORMATION: CSAH 3 – STEELE COUNTY**

The project starts at the intersection of CSAH 3 & TH 218 and goes west. Each test section is ¼ mile long and roadside signs mark the beginning of each section. The control section is the west end 2,250 feet at the intersection of CSAH 45.

### SECTION 1: PRODUCT 535 (ROADSAVER)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/14/02</td>
<td>58°F</td>
<td>08:15</td>
<td>09:30</td>
<td>450 $0.28/LB</td>
</tr>
</tbody>
</table>

### SECTION 2: PRODUCT 516 (POLYFLEX TYPE 1)

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/15/02</td>
<td>57°F</td>
<td>08:30</td>
<td>09:05</td>
<td>420 $0.30/LB</td>
</tr>
<tr>
<td>Date</td>
<td>Air Temperature</td>
<td>Begin</td>
<td>End</td>
<td>Pounds &amp; Cost of Sealant</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------</td>
<td>-------</td>
<td>-----</td>
<td>--------------------------</td>
</tr>
<tr>
<td>5/16/02</td>
<td>37°F</td>
<td>08:00</td>
<td>08:30</td>
<td>330 $0.30/LB</td>
</tr>
</tbody>
</table>

**SECTION 4: PRODUCT 244 (ASPHALT RUBBER PLUS 2)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/17/02</td>
<td>51°F</td>
<td>08:30</td>
<td>09:00</td>
<td>420 $0.30/LB</td>
</tr>
</tbody>
</table>

**SECTION 5: PRODUCT 249 (POLYFIBER TYPE 2)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/20/02</td>
<td>43°F</td>
<td>09:30</td>
<td>10:30</td>
<td>390 $0.30/LB</td>
</tr>
</tbody>
</table>

Comments: This product took a long time to bring to temperature. It was very thick and the crew has concerns on how far into the cracks the product could penetrate (seep). They had to wait several times for the blocks to melt before resuming operations. None of the other products caused delays.

**TOTALS: CSAH 3**

<table>
<thead>
<tr>
<th>Date</th>
<th>Air Temperature</th>
<th>Begin</th>
<th>End</th>
<th>Pounds &amp; Cost of Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/14 to 5/20</td>
<td>58°F to 37°F</td>
<td></td>
<td></td>
<td>2,010 $594.00</td>
</tr>
</tbody>
</table>

A Cimline kettle and heat lance was rented for the work. The County’s maintenance crews installed the material.

**CSAH 3 & 7: PROJECT TOTALS**

**TOTAL PROJECT COSTS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kettle Lease</td>
<td>Lump Sum</td>
<td>$1,171.50</td>
<td>$1,171.50</td>
</tr>
<tr>
<td>Heat Lance rental</td>
<td>Lump Sum</td>
<td>$356.78</td>
<td>$356.48</td>
</tr>
<tr>
<td>Crafco 535</td>
<td>1,320 lbs.</td>
<td>$0.28 / lb.</td>
<td>$369.60</td>
</tr>
<tr>
<td>Crafco 516</td>
<td>1,260 lbs.</td>
<td>$0.30 / lb.</td>
<td>$378.00</td>
</tr>
<tr>
<td>Crafco 241</td>
<td>990 lbs.</td>
<td>$0.30 / lb.</td>
<td>$297.00</td>
</tr>
<tr>
<td>Crafco 244</td>
<td>1,260 lbs.</td>
<td>$0.30 / lb.</td>
<td>$378.00</td>
</tr>
<tr>
<td>Crafco 249</td>
<td>1,230 lbs.</td>
<td>$0.30 / lb.</td>
<td>$369.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6,060 lbs.</strong></td>
<td><strong>5 miles</strong></td>
<td><strong>$3,319.88</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>$664 / mile</strong></td>
</tr>
</tbody>
</table>
2004 UPDATE

CSAH 7 – STEELE COUNTY EXPERIMENT

Mn/DOT visited CSAH 7 on November 5, to perform a visual observation of the test site. The air temperature was around 40°F, mostly sunny skies and light winds.

There was a notable difference in cracking along the sidewall of the routed crack for all five sections. The amount of failure is estimated to the nearest 25%. (It would require traffic control to get a more accurate degree of failure). It is not certain if the crack remains watertight or not. A few cracks were probed with a putty knife, and the putty knife did not penetrate far into the crack. This indicates that the crack may still be watertight, at least for this year.

This test site begins at the intersection of CSAH 32 and 7 and proceeds west to east. A picture of the first crack was taken in each of the sections. The first crack is defined as the first crack east of the sign placed along the side of the road.

SECTION 1: PRODUCT 535 (ROADSAVER)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 535 sign LRRB770C7A</td>
<td>44°00.461' 093°21.942'</td>
<td>0 %</td>
<td>25 %</td>
</tr>
<tr>
<td>2 None LRRB770C7B</td>
<td>44°00.462' 093°21.921'</td>
<td>5 %</td>
<td>25 %</td>
</tr>
<tr>
<td>3 No Passing Sign LRRB770C7C</td>
<td>44°00.463' 093°21.783'</td>
<td>2 %</td>
<td>25 %</td>
</tr>
</tbody>
</table>

2004 Observations – section 1
✓ Some failure was seen at the sidewalls along the crack (adhesion failure), not sure if crack remains watertight.
✓ More sealant is missing in the wheelpaths, primarily in the eastbound lane.

2003 Observations – section 1
✓ Some pullout was observed in the wheelpaths, both directions, in crack #2 and in the eastbound lane of crack #3.
✓ Some air bubbles were observed in the sealant – see picture in Appendix.

SECTION 2: PRODUCT 516 (POLYFLEX TYPE 1)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 516 sign LRRB770C7D</td>
<td>44°00.463' 093°21.388'</td>
<td>0 %</td>
<td>100 %</td>
</tr>
<tr>
<td>2 None LRRB770C7E</td>
<td>44°00.463' 093°21.217’</td>
<td>0 %</td>
<td>100 %</td>
</tr>
<tr>
<td>3 No Passing Sign LRRB770C7F</td>
<td>44°00.466’ 093°21.101’</td>
<td>0 %</td>
<td>75 %</td>
</tr>
</tbody>
</table>

2004 Observations – section 2
✓ A lot of sidewall (adhesion failure) cracking noted along both sides of routed crack. A putty knife was placed inside crack but stopped millimeters down.
✓ Appears that the overband has worn off and if no longer providing any degree of sealing to the crack.

2003 Observations – section 2
✓ Some depressions were seen, indicating that the sealant was placed in a deep crack. The depressions are trapping dirt and water – see pictures in Appendix.

### SECTION 3: PRODUCT 244 (ASPHALT RUBBER PLUS 2)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 244 sign</td>
<td>LRRB770C7G</td>
<td>44°00.455'</td>
<td>093°20.778'</td>
</tr>
<tr>
<td>2 No Passing Sign</td>
<td>LRRB770C7H</td>
<td>44°00.473'</td>
<td>093°20.680'</td>
</tr>
<tr>
<td>3 Address 7051</td>
<td>LRRB770C7I</td>
<td>44°00.502'</td>
<td>093°20.555'</td>
</tr>
</tbody>
</table>

#### 2004 Observations – section 3
✓ A lot of sidewall (adhesion failure) cracking noted along both sides of routed crack.
✓ The adhesion failures did not seem as extreme as sections 1 and 2.
✓ One section outside of the 500-ft test had a lot of missing sealant that pulled out of the crack, snowplow damage?

#### 2003 Observations – section 3
✓ Some depressions were seen, indicating that the sealant was placed in a deep crack. The depressions are trapping dirt and water – see pictures in Appendix.

### SECTION 4: PRODUCT 241 (ASPHALT RUBBER PLUS)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 241 sign</td>
<td>LRRB770C7J</td>
<td>44°00.617'</td>
<td>093°20.229'</td>
</tr>
<tr>
<td>2 Telephone pole</td>
<td>LRRB770C7K</td>
<td>44°00.653'</td>
<td>093°20.124'</td>
</tr>
<tr>
<td>3 Address 6602</td>
<td>LRRB770C7L</td>
<td>44°00.684'</td>
<td>093°20.019'</td>
</tr>
</tbody>
</table>

#### 2004 Observations – section 4
✓ Sidewall (adhesion failure) seen, although the cracks do not appear as wide as in the previous sections.

#### 2003 Observations – section 4
✓ Some overbanding of the sealant is worn out - see pictures in Appendix.

### SECTION 5: PRODUCT 249 (POLYFIBER TYPE 2)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 249 sign</td>
<td>LRRB770C7M</td>
<td>44°00.680'</td>
<td>093°19.640'</td>
</tr>
<tr>
<td>2 Telephone pole</td>
<td>LRRB770C7N</td>
<td>44°00.681'</td>
<td>093°19.541'</td>
</tr>
<tr>
<td>3 Address sign</td>
<td>LRRB770C7O</td>
<td>44°00.713'</td>
<td>093°19.361'</td>
</tr>
</tbody>
</table>

#### 2004 Observations – section 5
✓ All three cracks being tracked have 100% sidewall (adhesion failure) cracks although probing with putty knife did not show the sidewalls have separated from the sealant.

#### 2003 Observations – section 5
The small amount of failure observed in crack #2 is adhesion failure between the sealant and sidewall of the crack - see pictures in Appendix A.

**CONTROL – EAST END: CSAH 7**

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 Control sign</td>
<td>LRRB770C7P</td>
<td>44°00.817'</td>
<td>093°19.088'</td>
</tr>
<tr>
<td>2 Curve Arrow</td>
<td>LRRB770C7Q</td>
<td>44°00.874'</td>
<td>093°18.943'</td>
</tr>
<tr>
<td>3 End Test sign</td>
<td>LRRB770C7R</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**2004 Observations – Control**

A third crack was added in 2004 (crack R) just east of an intersection where a lot a gravel trucks head east towards Owatonna. This crack was added to see if the heavy truck traffic accelerates the deterioration of the cracks.

**2004 SUMMARY of CSAH 7**

Of the twelve cracks being tracked, eleven of them now have sidewall (adhesion failure) cracking. Of the four products being evaluated, the Roadsaver 515 product is performing the best. The rating of cracks was not performed under traffic control. Rather, the amount of sidewall cracking was estimated to the nearest 25%. It was felt that this was adequate as the study was to gage the relative effectiveness of the re-sealing material.

Whether or not the joint remained sealed was not determined. Some cracks were probed with a putty knife, and each time the knife did not penetrate very far into the crack. This seems to indicate that the crack may still be watertight. It will be interesting to see if the sidewalls remain tight next year after a year of being cracked.
2004 UPDATE

CSAH 3 – STEELE COUNTY EXPERIMENT

Mn/DOT visited CSAH 3 on November 5, to perform a visual observation of the test site. The air temperature was around 40°F, with sunny skies and light winds.

There was a notable difference in cracking along the sidewall of the routed crack for all five sections. The amount of failure is estimated to the nearest 25%. (It would require traffic control to get a more accurate degree of failure). It is not certain if the crack remains watertight or not.

This test site begins at the intersection of CSAH 28 and 3 and proceeds east to west. A picture of the first crack was taken in each of the sections, with the exception of the control section. The first crack is defined as the first crack west of the sign placed along the side of the road. The control section begins at a farmhouse, and two yellow labs prevented me from taking a picture of the first crack in the control section. Two cracks further west were taken and their location is documented below.

SECTION 1: PRODUCT 535 (ROADSAVER)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 535 sign</td>
<td>LRRB770C3A</td>
<td>43°59.621’</td>
<td>093°08.248’</td>
</tr>
<tr>
<td>2 Stop Ahead Sign</td>
<td>LRRB770C3B</td>
<td>43°59.624’</td>
<td>093°08.405’</td>
</tr>
<tr>
<td>3 Do Not Pass Sign</td>
<td>LRRB770C3C</td>
<td>43°59.619’</td>
<td>093°08.605’</td>
</tr>
</tbody>
</table>

2004 Observations – section 1
✓ Some minor sidewall cracking (adhesion failures) seen.

2003 Observations – section 1
✓ Some minor pullout was observed in the wheelpaths of the westbound lane.
✓ Some air bubbles were observed in the sealant – see picture in Appendix B.
✓ Overall condition was very good.

SECTION 2: PRODUCT 516 (POLYFLEX TYPE 1)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>West</td>
</tr>
<tr>
<td>1 516 sign</td>
<td>LRRB770C3D</td>
<td>43°59.621’</td>
<td>093°08.750’</td>
</tr>
<tr>
<td>2 11th Crack</td>
<td>LRRB770C3E</td>
<td>43°59.620’</td>
<td>093°08.852’</td>
</tr>
<tr>
<td>3 No Passing Sign</td>
<td>LRRB770C3F</td>
<td>43°59.618’</td>
<td>093°08.976’</td>
</tr>
</tbody>
</table>

2004 Observations – section 2
✓ Some minor sidewall cracking (adhesion failures) seen.

2003 Observations – section 2
✓ Some minor pullout was observed in the wheelpaths of the eastbound lane.
✓ Overall condition was excellent.

SECTION 3: PRODUCT 244 (ASPHALT RUBBER PLUS 2)
### SECTION 4: PRODUCT 241 (ASPHALT RUBBER PLUS)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landmark</td>
<td>North</td>
<td>West</td>
<td>2003</td>
</tr>
<tr>
<td>1 241 sign</td>
<td>LRRB770C3J</td>
<td>43°59.616’</td>
<td>093°09.750’</td>
</tr>
<tr>
<td>2 Do Not Pass sign</td>
<td>LRRB770C3K</td>
<td>43°59.614’</td>
<td>093°09.841’</td>
</tr>
<tr>
<td>3 CSAH 3 sign</td>
<td>LRRB770C3L</td>
<td>43°59.615’</td>
<td>093°10.016’</td>
</tr>
</tbody>
</table>

**2004 Observations – section 4**

- Some minor sidewall cracking (adhesion failure) seen.

**2003 Observations – section 4**

- Overall condition was excellent.

### SECTION 5: PRODUCT 249 (POLYFIBER TYPE 2)

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landmark</td>
<td>North</td>
<td>West</td>
<td>2003</td>
</tr>
<tr>
<td>1 249 sign</td>
<td>LRRB770C3M</td>
<td>43°59.615’</td>
<td>093°10.257’</td>
</tr>
<tr>
<td>2 No Passing sign</td>
<td>LRRB770C3N</td>
<td>43°59.615’</td>
<td>093°10.399’</td>
</tr>
<tr>
<td>3 Do Not Pass sign</td>
<td>LRRB770C3O</td>
<td>43°59.615’</td>
<td>093°10.582’</td>
</tr>
</tbody>
</table>

**2004 Observations – section 5**

- No apparent change from last year, joints look very good.

**2003 Observations – section 5**

- Overall condition was excellent.

### CONTROL – WEST END: CSAH 3

<table>
<thead>
<tr>
<th>Crack No. &amp; Landmark</th>
<th>Waypoint Name</th>
<th>Waypoints</th>
<th>% Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landmark</td>
<td>North</td>
<td>West</td>
<td>2003</td>
</tr>
<tr>
<td>Control sign</td>
<td>-</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>1 Do Not Pass sign</td>
<td>LRRB770C3P</td>
<td>43°59.615’</td>
<td>093°10.892’</td>
</tr>
<tr>
<td>2 East of culvert</td>
<td>LRRB770C3Q</td>
<td>43°59.617’</td>
<td>093°11.045’</td>
</tr>
<tr>
<td>3 East of Test sign</td>
<td>LRRB770C3R</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**2004 Observations – control section**

- The only missing sealant seen in the original saw and seal is in the wheelpaths, and even then it is minor.
✓ Sidewalls are cracked indicating adhesion failure.
✓ Debris (small stones) are between the sidewall and sealant, creating a path for water.

2003 Observations – control section
✓ Waypoint could not be located at control sign because of two dogs at farmhouse did not think it was a good idea. See picture in Appendix B.
✓ The control section ends at the intersection of CSAH 45 (SE 24th Ave) and CSAH 3.

2004 SUMMARY of CSAH 3

Overall the re-sealed joints remain in good to very good condition, with very little adhesion failure seen after 31 months of installation. The Roadsaver material (#535) may have a bit more pullout than the other sections, but overall, it remains in good condition.

The rating of cracks was not performed under traffic control. Rather, the amount of sidewall cracking was estimated to the nearest 25%. It was felt that this was adequate as the study was to gage the relative effectiveness of the re-sealing material.

The next site visit will occur in the fall of 2006.
APPENDIX A

LRRB 770

STEELE COUNTY

LOCATION MAPS

CSAH 7

CSAH 3
STEELE COUNTY - CSAH 7
LRRB 770
RESEAL ROUT AND SEAL CRACKS
✓ CRAFCO 241 (ASPHALT RUBBER PLUS)
✓ CRAFCO 244 (ASPHALT RUBBER PLUS 2)
✓ CRAFCO 249 (POLYFIBER TYPE 2)
✓ CRAFCO 516 (POLY FLEX TYPE 1)
✓ CRAFCO 535 (ROADSAVER 515)
✓ CONTROL
STEELE COUNTY - CSAH 3
LRRB 770
RESEAL SAW AND SEAL JOINTS
✓ CRAFCO 241 (ASPHALT RUBBER PLUS)
✓ CRAFCO 244 (ASPHALT RUBBER PLUS 2)
✓ CRAFCO 249 (POLYFIBER TYPE 2)
✓ CRAFCO 516 (POLY FLEX TYPE 1)
✓ CRAFCO 535 (ROADSAVER 515)
✓ CONTROL
APPENDIX B

LRRB 770

STEELE COUNTY

CSAH 7

PICTURES

2003

2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Marker, CRAFCO Product 535 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7A, CRAFCO 535 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7B, CRAFCO 535 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7B, CRAFCO 535 – Nov 5, 2004
Steele Co. CSAH 7: CRAFCO 535 – Oct 20, 2003
Note: Bumps (Air Bubbles) In Sealant That Is 17 Months Old
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7C, CRAFCO 535 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7C, Close-Up – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: CRAFCO Product 516 – Oct 20, 2003
GRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7D, CRAFCO 516 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7D, CRAFCO 516 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7D, Close-Up – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7E, CRAFCO 516 – Oct 20, 2003
Steele Co. CSAH 7: Crack 7E, CRAFCO 516 – Oct 20, 2003
Enlarged View @ Centerline of Road.
Note Chip Seal Aggregate Pooled in Recessed Sealant
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7E, Depression – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7E, Putty Knife – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7F, CRAFCO 516 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7F, CRAFCO 516 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: CRAFCO 244 – Nov 5, 2004
Steele Co. CSAH 7: Crack 7G, CRAFCO 244 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7G, CRAFCO 244 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7H, CRAFCO 244 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7I, CRAFCO 244 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7I, CRAFCO 244 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7J, CRAFCO 241 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7J, CRAFCO 241 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7K, CRAFCO 241 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7K, CRAFCO 241 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7L, CRAFCO 241 – Oct 20, 2003
Steele Co. CSAH 7: Crack 7L, CRAFCO 241 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7M, CRAFCO 249 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7N, CRAFCO 249 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7N, CRAFCO 249 – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7N, Close-Up – Nov 5, 2004

Steele Co. CSAH 7: Crack 7N, Putty Knife – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Control Section - East End of Project – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7P, East Control – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7Q, East Control – Oct 20, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7

Steele Co. CSAH 7: Crack 7Q, East Control – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 7
APPENDIX C

LRRB 770
STEEL COUNTY
CSAH 3
PICTURES
2003
2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Marker – Nov 5, 2004

Steele Co. CSAH 3: Marker, CRAFCO 535 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3A, South Side CRAFCO 535 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3B, Looking South – Nov 5, 2004
Steele Co. CSAH 3: Crack 3B, Looking North – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3C, CRAFCO 535 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Marker, CRAFCO 516 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3D, CRAFCO 516 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Marker, CRAFCO 244 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3G, CRAFCO 244 – Nov 5, 2004
Steele Co. CSAH 3: Crack 3H, CRAFCO 244 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3H, CRAFCO 244 – Nov 5, 2004
Steele Co. CSAH 3: Crack 31, CRAFCO 244 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3J, CRAFCO 241 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3K, CRAFCO 241 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3K, Close-Up – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Marker, CRAFCO 249 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3M, CRAFCO 249 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3N, CRAFCO 249 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3O, CRAFCO 249 – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3O, CRAFCO 249 – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3P, Control – Oct 28, 2003
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3P, Control – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3P, Close-Up – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Note: Crack 3Q - Dated Oct 28, 2003 Omitted due to poor focus

Steele Co. CSAH 3: Crack 3Q, Control – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Crack 3Q, Close-Up – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Culvert, Control – Nov 5, 2004
LRRB 770: Repair of Rubberized Crack & Joint Filler
Steele County – CSAH 3

Steele Co. CSAH 3: Culvert, Close-Up – Nov 5, 2004