AASHTO Technology Implementation Group
Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Connecticut</th>
</tr>
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<table>
<thead>
<tr>
<th>Primary Technical Contact</th>
<th>2. Name: James M. Sime, P.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization: Connecticut Department of Transportation</td>
<td></td>
</tr>
<tr>
<td>Address: Division of Research, 280 West Street</td>
<td></td>
</tr>
<tr>
<td>City: Rocky Hill</td>
<td>State: CT</td>
</tr>
<tr>
<td>Zipcode: 06067-3502</td>
<td>E-mail: <a href="mailto:james.sime@po.state.ct.us">james.sime@po.state.ct.us</a></td>
</tr>
<tr>
<td>E-mail: <a href="mailto:james.sime@po.state.ct.us">james.sime@po.state.ct.us</a></td>
<td>Phone: (860) 258-0309</td>
</tr>
<tr>
<td>Phone: (860) 258-0309</td>
<td>Fax: (860) 258-0399</td>
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<tr>
<th>Technology Description</th>
<th>3. Name of Technology: Narrow Connecticut Impact Attenuation System (NCIAS)</th>
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<tr>
<th>Technology Description</th>
<th>4. Briefly describe the technology.</th>
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<tr>
<td>As a roadside highway safety feature, the NCIAS was designed as an end treatment for concrete safety shape barriers and other narrow hazards. Typical narrow roadside hazards that may require the placement of an impact-attenuation system such as the NCIAS include bridge piers, bridge parapets, and exposed ends of concrete barriers. The goal of the NCIAS is to provide a forgiving roadway and roadside for an errant motorist. It consists of eight steel cylinders, three feet (1.2 m) in diameter, placed in a row with two wire ropes on either side. It rests on a concrete pad, has several anchored components, and a vinyl cover.</td>
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<tr>
<th>Technology Description</th>
<th>5. Briefly describe the history of its development.</th>
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<tr>
<td>In 1985, the Connecticut Department of Transportation (ConnDOT) initiated a research effort to design, build, and crash test the Narrow Connecticut Impact-Attenuation System (NCIAS). The NCIAS is the third in a series of cylindrical steel impact-attenuation devices that have been designed by John F. Carney III and developed by ConnDOT in cooperation with FHWA.</td>
<td></td>
</tr>
<tr>
<td>In 1993, NCHRP Report 350 entitled &quot;Recommended Procedures for the Safety Performance Evaluation of Highway Features&quot;, was published. Connecticut requested that the NCIAS be tested under these new standards at Test Level 3 for redirective/ non-gating devices. Testing began in October 1997 and was completed by June 1998. In a letter dated March 26, 1999, FHWA approved the use of the NCIAS on the National Highway System with the limitation that it be placed in locations where reverse-direction impacts are not likely. The federal government mandated that only highway safety appurtenances that have met the criteria set forth in NCHRP Report 350 be constructed along the National Highway System after October 1998.</td>
<td></td>
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<tr>
<th>State of Development</th>
<th>6. For how long and in approximately how many applications has your organization used this technology?</th>
</tr>
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<tr>
<td>Five locations in Connecticut were originally selected for field evaluation. These locations have had the systems in place for over 13 years. Since these first installations, one additional location in Connecticut, two locations in Tennessee, and one in New Zealand have had the system installed. There may be additional locations we are not aware of, since the plans can be downloaded and used from our website.</td>
<td></td>
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<tr>
<th>State of Development</th>
<th>7. What additional development is necessary to enable routine deployment of the technology?</th>
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</thead>
<tbody>
<tr>
<td>No additional development is necessary. The system is approved for use on the National Highway System.</td>
<td></td>
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<tr>
<th>8. Have other organizations used this technology? If so, please list organization names and contacts.</th>
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<tr>
<td>Organization</td>
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<td>---------------</td>
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<tr>
<td>Tennessee DOT</td>
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<tr>
<td>New Zealand</td>
</tr>
<tr>
<td>Potential for Payoff</td>
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</tbody>
</table>
10. Please describe what actions another transportation agency would need to take to adopt this technology.
Fabrication plans are able to be downloaded from our website at [www.ct.gov/dot/research](http://www.ct.gov/dot/research). These plans can be brought to local steel contractors for fabrication of the system. States are invited to include this narrow crash attenuator in their highway projects as a non-proprietary alternative to commercially available systems.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?
The cost of the initial installation of the NCIAS in 1990 was $17,280, which consisted of $7,280 for the unit and $10,000 for the pad construction and the NCIAS installation. A recent bid indicated a cost of $17,800 for the complete unit, which does not include the cost of the pad construction or installation of the device. Although manufacturing time may vary, once a local contractor is in place, the process of installation can proceed.

12. What organization(s) currently supply and provide technical support for this technology?
The Connecticut Department of Transportation, Division of Research located in Rocky Hill, CT

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.
Although there is a patent on the product described herein, the device is not proprietary. The plans can be used by others to reproduce the system.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?  Yes ☒ No

15. Date:

16. Please include image(s) of sketches or photographs, if available 2 Image(s) are attached

Figure 1. Field installation of NCIAS

Please E-mail or Fax by August 27, 2004 to:

<table>
<thead>
<tr>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Manager for Engineering</td>
<td>Fax: 202.624.5469</td>
</tr>
<tr>
<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
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Page 3
Figure 2. Plan and elevation view of the system

This form is available electronically at http://www.aashtotig.org/solicitation/
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Organization: Connecticut Department of Transportation  
Address: Division of Research, 280 West Street  
City: Rocky Hill  
State: CT  
Zipcode: 06067  
E-mail: james.sime@po.state.ct.us  
Phone: (860) 258-0309  
Fax: (860) 258-0399 |
| Technology Description | 3. Name of Technology:  
Connecticut Truck Mounted Attenuator (CTMA) |
| | 4. Briefly describe the technology.  
The CTMA is used to protect maintenance and construction personnel performing field duties. It is placed on the back of service vehicles that are used along the roadways where errant vehicles may come in contact with the service vehicles. It has three major components; the service vehicle guidance frame, the energy-absorbing cylinders, and the impacting plate assembly. |
| | 5. Briefly describe the history of its development.  
In May of 1975, the Connecticut Department of Transportation (ConnDOT), initiated a research effort to design, build, and crash test the CTMA. In 1993, NCHRP Report 350 entitled “Recommended Procedures for the Safety Performance Evaluation of Highway Features”, was published. Connecticut requested the CTMA be tested under these new standards for a Test Level 2 device. Test Level 2, the basic level, considers crash test conditions for impact speeds of 70 km/h. On July 13, 1995, FHWA approved the use of the CTMA as a Test Level 2 truck mounted attenuator. Starting in October of 1998, the federal government mandated that only highway safety appurtenances that have met the criteria set forth in NCHRP Report 350 be constructed along the National Highway System. |
| State of Development | 6. For how long and in approximately how many applications has your organization used this technology?  
The system has been used in Connecticut for over 24 years. There are currently 134 units in use in Connecticut. |
| | 7. What additional development is necessary to enable routine deployment of the technology?  
No additional development is necessary. The system is approved as a Test Level 2 device for use on the National Highway System. |
| | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
We know Massachusetts has used this technology, but do not currently have contact information for them. Several other agencies have requested information, but we do not know if they have actually fabricated the device.  
<table>
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| 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Cost savings is realized by producing the CTMA's by our own personnel. The average cost to fabricate is $5,000 versus $12,000 to $16,000 to purchase comparable commercial units. Connecticut has realized savings of over $1 million dollars so far. The system is also relatively inexpensive to repair. The average repair cost in Connecticut is $1,375.  
Safety improvements are attained because the CTMA can absorb the impacting energy in such a way that the accelerations to which the automobile and service vehicle are subjected are acceptably safe for the occupants of both vehicles.  
The CTMA is easily attached to and removed from the carrying vehicle. It is compact and designed for use in curved and hilly roads. |
### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology. Fabrication plans are able to be downloaded from our website at [www.ct.gov/dot/research](http://www.ct.gov/dot/research). These plans can be used to assemble the system in-house or can be brought to local steel contractors for fabrication.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? Once an agency obtains the fabrication plans, production can take place through either a local contractor or by obtaining materials for assembly by their own personnel.

12. What organization(s) currently supply and provide technical support for this technology? The Connecticut Department of Transportation, Division of Research located in Rocky Hill, CT.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. The device is not a proprietary item and therefore plans can be used by others to reproduce the system.

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☒ Yes ☐ No

### Date Submitted

15. Date: August 27, 2004

16. Please include image(s) of sketches or photographs, if available 1 Image(s) are attached

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This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)

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<td>2. Name: James M. Sime, P.E. Organization: Connecticut Department of Transportation Address: Division of Research, 280 West Street City: Rocky Hill State: CT Zipcode: 06067</td>
</tr>
<tr>
<td>E-mail: <a href="mailto:james.sime@po.state.ct.us">james.sime@po.state.ct.us</a> Phone: (860) 258-0309 Fax: (860) 258-0399</td>
<td></td>
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<tr>
<td>Technology Description</td>
<td>3. Name of Technology: Connecticut Impact-Attenuation System (CIAS)</td>
</tr>
<tr>
<td></td>
<td>4. Briefly describe the technology. The CIAS was designed and developed to provide roadside safety in areas deemed high-hazard locations. Typical locations for placement include the gore areas of freeways. The CIAS is made up of four basic components; fourteen (14) steel cylinders, skid rails, a concrete base pad and backup wall, and a vinyl cover.</td>
</tr>
<tr>
<td></td>
<td>5. Briefly describe the history of its development. In 1984, the Connecticut Department of Transportation initiated a research effort to design, build, and crash test the CIAS. The CIAS was developed after successful deployment of the Connecticut Truck Mounted Attenuator (CTMA). In 1993, NCHRP Report 350 entitled “Recommended Procedures for the Safety Performance Evaluation of Highway Features”, was published. Connecticut requested the CIAS be tested under these new standards at Test Level 3 for redirective/ gating devices. Testing began in May 1996 and was completed by April of 1999. In a letter dated, April 9, 2002, the FHWA approved the use of the CIAS on the National Highway System with the exception that it should be placed in locations where reverse-direction impacts are not likely. The federal government mandated that only highway safety appurtenances that have met the criteria set forth in NCHRP Report 350 be constructed along the National Highway System after October 1998.</td>
</tr>
<tr>
<td></td>
<td>6. For how long and in approximately how many applications has your organization used this technology? Four locations were initially selected for field evaluation in Connecticut. The systems have been in place for twenty (20) years.</td>
</tr>
<tr>
<td></td>
<td>7. What additional development is necessary to enable routine deployment of the technology? No additional development is necessary. The system is approved for use on the National Highway System.</td>
</tr>
<tr>
<td></td>
<td>8. Have other organizations used this technology? If so, please list organization names and contacts. We are not currently aware of other agencies that have used this technology. Agencies have requested fabrication plans and information.</td>
</tr>
<tr>
<td>Organization</td>
<td>Name</td>
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| Potential for Payoff | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. Due to its nonproprietary status, the CIAS can be purchased through competitive bids for a cost at or below that of other similar devices. Additionally, the use of this approved highway safety feature can potentially decrease the amount of injury and fatal accidents along the National Highway System. During the three years after installation of these systems in Connecticut, no serious injuries were reported with many vehicles leaving the scene under their own power. The maintenance of the system was also found to be minimal over the three years after the initial installations with repairs only required after the system had been impacted. |


### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology. Fabrication plans are able to be downloaded from our website at [www.ct.gov/dot/research](http://www.ct.gov/dot/research). These plans can be brought to local steel contractors for fabrication.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? Once an agency obtains the fabrication plans, production can take place through a local contractor.

12. What organization(s) currently supply and provide technical support for this technology? The Connecticut Department of Transportation, Division of Research located in Rocky Hill, CT.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. The device is not a proprietary item and therefore plans can be used by others to reproduce the system.

| Willingness to Champion | 14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?  
Yes ☒ No ☐ |
<table>
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<tr>
<td>Date Submitted</td>
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AASHTO Technology Implementation Group  
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<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): CT</th>
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</table>
| Primary Technical Contact | 2. Name: Gerald M. McCarthy  
Organization: New England Transportation Consortium  
Address: University of Connecticut, U-5202  
City: Storrs  
State: CT  
Zipcode: 06269-5202  
E-mail: mccarthy@engr.uconn.edu  
Phone: 860-486-1195  
Fax: 860-486-2399 |
| Technology Description | 3. Name of Technology:  
Design Recommendations for the Use of Tire Shreds/Soil Mixtures to Limit Frost Heaves and Damage of Secondary Roads |
| | 4. Briefly describe the technology.  
The insulating properties of tire shreds can reduce frost heave-induced damage to paved roads. The free-draining properties of tire shreds can strengthen the subgrade and subbase during the spring thaw by allowing excess water to drain. The use of tire shreds will also remove large quantities of whole tires from stockpiles. |
| | 5. Briefly describe the history of its development.  
Recommended material properties (thermal conductivity and permeability) and design methods for the design of tire shred insulation/drainage layers for asphalt pavements on secondary roads are documented in NETC Report No. NETCR-12, "Use of Tire Chip/Soil Mixtures to Limit Frost Heave and Pavement Damage to Paved Roads," available from the New England Transportation Consortium at www.netc.uconn.edu. |
| State of Development | 6. For how long and in approximately how many applications has your organization used this technology?  
It has been used successfully by the Maine Department of Transportation. |
| | 7. What additional development is necessary to enable routine deployment of the technology?  
None. It is ready to be applied |
| Potential for Payoff | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
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<tr>
<th>Organization</th>
<th>Name</th>
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<tbody>
<tr>
<td>Maine DOT</td>
<td>Dale Peabody</td>
<td>207-624-3305</td>
<td><a href="mailto:dale.peabody@maine.gov">dale.peabody@maine.gov</a></td>
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9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Cost savings though the use of this inexpensive material, reduction in damage to pavements on secondary roads from frost heave, improving subbase drainage, and the reduction of stockpiles of whole tires.
### Implementation Potential

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
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<tbody>
<tr>
<td>10. Please describe what actions another transportation agency would need to take to adopt this technology.</td>
<td>Request a copy of NETC Report No. NETCR-12, &quot;Use of Tire Chip/Soil Mixtures to Limit Frost Heave and Pavement Damage to Paved Roads,&quot; from the contact listed in box 1. above.</td>
</tr>
<tr>
<td>11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?</td>
<td>Cost = $0; Procurement = 7 days.</td>
</tr>
<tr>
<td>12. What organization(s) currently supply and provide technical support for this technology?</td>
<td>The New England Transportation Consortium.</td>
</tr>
<tr>
<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.</td>
<td>None</td>
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### Willingness to Champion

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<td>14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?</td>
<td>Yes</td>
</tr>
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</table>

### Date Submitted

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<tr>
<th>Question</th>
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<td>15. Date: 8/26/04</td>
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16. Please include image(s) of sketches or photographs, if available □Image(s) are attached

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Organization: New England Transportation Consortium  
Address: University of Connecticut, U-5202  
City: Storrs  
State: CT  
Zipcode: 06269-5202  
E-mail: mccarthy@engr.uconn.edu  
Phone: 860-486-1195  
Fax: 860-486-2399 |
| Technology Description | 3. Name of Technology: The New England Transportation Consortium 4-Bar, Sidewalk-Mounted Bridge Rail |
| | 4. Briefly describe the technology.  
A non-proprietary, 4-bar, steel post-and-beam, sidewalk-mounted bridge rail designed and crash tested to NCHRP 350 requirements by the New England Transportation Consortium. |
| | 5. Briefly describe the history of its development.  
The New England Transportation Consortium designed and crash tested the rail system. The design and crash tests are documented in NETC Report 14. The bridge rail system met all appropriate evaluation criteria for an NCHRP Report 350 traffic barrier at test level TL-4. The FHWA Office of Highway Safety Infrastructure has approved the bridge rail system for use on the NHS. |
| State of Development | 6. For how long and in approximately how many applications has your organization used this technology?  
It has been used in numerous applications by DOTs in New England for a number of years |
| | 7. What additional development is necessary to enable routine deployment of the technology?  
None |
| Potential for Payoff | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
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<tr>
<td>New Hampshire DOT</td>
<td>James Moore</td>
<td>603-271-1486</td>
<td><a href="mailto:jmoore@dot.state.nh.us">jmoore@dot.state.nh.us</a></td>
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</tbody>
</table>
| | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Cost savings through the use of a non-proprietary item. Additionally, it has been approved by FHWA for use on the National Highway System and can potentially decrease the the amount of injury and fatal accidents along roadways. |
**Implementation Potential**

10. Please describe what actions another transportation agency would need to take to adopt this technology. Request copy of NETC Report 14 and plans from the contact listed in box 1. above.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? Cost = $0; Procurement Time = 7 days to acquire plans from the New England Transportation Consortium (see box 1. for contact)

12. What organization(s) currently supply and provide technical support for this technology? The New England Transportation Consortium.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. None

**Willingness to Champion**

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes

**Date Submitted**

15. Date: 8/26/04

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached
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E-mail: mccarthy@engr.uconn.edu  
Phone: 860-486-1195  
Fax: 860-486-2399 |
| **Technology Description** | 3. Name of Technology:  
The New England Transportation Consortium 2-Bar, Curb-Mounted Bridge Rail |
|  | 4. Briefly describe the technology.  
A non-proprietary, 2-bar, steel post-and-beam bridge rail with concrete curb has been designed and crash tested to NCHRP requirements by the New England Transportation Consortium. |
|  | 5. Briefly describe the history of its development.  
The 2-bar, curb-mounted bridge rail system, was designed by the New England Transportation Consortium and crash tested to Performance Level 2 (PL-2) in accordance with the AASHTO Guide Specifications for Bridge Railings. A description of the rail system and documentation of the crash tests are given in NETC Report 10. The rail system has been accepted as an NCHRP Report 350 Test Level 4 (TL-4) railing. This is a nonproprietary item. The FHWA Office of Highway Safety Infrastructure has approved the bridge rail system for use on the NHS. |
|  | 6. For how long and in approximately how many applications has your organization used this technology?  
It has been used in numerous applications by DOTs in New England for a number of years. |
|  | 7. What additional development is necessary to enable routine deployment of the technology?  
None. |
|  | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maine DOT</td>
<td>Dale Peabody</td>
<td>207-624-3305</td>
<td><a href="mailto:dale.peabody@maine.gov">dale.peabody@maine.gov</a></td>
</tr>
<tr>
<td>New Hampshire DOT</td>
<td>James Moore</td>
<td>603-271-1486</td>
<td><a href="mailto:jmoore@dot.state.nh.us">jmoore@dot.state.nh.us</a></td>
</tr>
</tbody>
</table>
|  | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Cost savings through the use of a non-proprietary item. Additionally, it has been approved by FHWA for use on the National Highway System and can potentially decrease the the amount of injury and fatal accidents along roadways. |
### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology. Request copy of NETC Report 10 and plans from the contact listed in box 1. above.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? Cost = $0; Procurement Time = 7 days to acquire plans from the New England Transportation Consortium (see box 1. for contact)

12. What organization(s) currently supply and provide technical support for this technology? The New England Transportation Consortium

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. None. This is a nonproprietary item.

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes

### Date Submitted

15. Date: 8/26/04

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached

---

Please E-mail or Fax by August 27, 2004 to:

Jeremy Fissel  
Program Manager for Engineering  
AASHTO  

Phone: 202.624.3640  
Fax: 202.624.5469  
jfissel@aashto.org
<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): CT</th>
</tr>
</thead>
</table>
| Primary Technical Contact | 2. Name: Gerald M. McCarthy  
Organization: New England Transportation Consortium  
Address: University of Connecticut, U-5202  
City: Storrs  
State: CT  
Zipcode: 06269-5202  
E-mail: mccarthy@engr.uconn.edu  
Phone: 860-486-1195  
Fax: 860-486-2399 |
| Technology Description | 3. Name of Technology:  
Performance Specifications for Wood Waste Materials As An Erosion Control Mulch and As a Filter Berm  
4. Briefly describe the technology.  
Field tests have shown that wood waste materials can be effective as mulch for erosion control or as a filter berm at construction sites to prevent eroded soil from leaving the site.  
5. Briefly describe the history of its development.  
Model procurement specifications, based on physical properties of wood waste materials, were developed to insure that the proper effect is achieved. These specifications, essential for the effective use of wood waste materials as mulch for erosion control or as a filter berm at construction sites, are documented in NETC Report No. NETCR-25, "Performance Specifications for Wood Waste Materials as An Erosion Control Mulch and as A Filter Berm," available from the New England Transportation Consortium at www.netc.uconn.edu.  
6. For how long and in approximately how many applications has your organization used this technology?  
It has been successfully field tested on a Connecticut state highway.  
7. What additional development is necessary to enable routine deployment of the technology?  
None  
8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConnDOT</td>
<td>James M. Sime</td>
<td>860-258-2561</td>
<td><a href="mailto:James.sime@po.state.ct.us">James.sime@po.state.ct.us</a></td>
</tr>
<tr>
<td>Potential for Payoff</td>
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<td></td>
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<tr>
<td>9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. The reuse of material is an important component in solid waste management. The processes of turning timber into lumber or paper as well as the operations of processing tree stumps removed from construction sites, produce voluminous waste products that can now be put to worthwhile use in erosion control and filter berms at construction sites.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Implementation Potential</th>
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</thead>
<tbody>
<tr>
<td>10. Please describe what actions another transportation agency would need to take to adopt this technology. Request copy of NETC Report No. NETCR-25, &quot;Performance Specifications for Wood Waste Materials as An Erosion Control Mulch and as A Filter Berm,&quot; available from the New England Transportation Consortium at <a href="http://www.netc@uconn.edu">www.netc@uconn.edu</a>, or the contact listed in box 1. above.</td>
</tr>
<tr>
<td>11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? Cost = none; Procurement = 7 days</td>
</tr>
<tr>
<td>12. What organization(s) currently supply and provide technical support for this technology? The New England Transportation Consortium.</td>
</tr>
<tr>
<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. None</td>
</tr>
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</table>

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<thead>
<tr>
<th>Willingness to Champion</th>
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<tbody>
<tr>
<td>14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes</td>
</tr>
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<tr>
<th>Date Submitted</th>
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<tr>
<td>15. Date: 8/26/04</td>
</tr>
</tbody>
</table>

16. Please include image(s) of sketches or photographs, if available. Image(s) are attached

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Please E-mail or Fax by August 27, 2004 to:

Jeremy Fissel
Program Manager for Engineering
AASHTO

Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org
### Sponsoring DOT

1. Sponsoring DOT (State): CT

### Primary Technical Contact

<table>
<thead>
<tr>
<th>Name: Gerald M. McCarthy</th>
<th>Organization: New England Transportation Consortium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address: University of Connecticut, U-5202</td>
<td></td>
</tr>
<tr>
<td>City: Storrs</td>
<td>State: CT</td>
</tr>
<tr>
<td>E-mail: <a href="mailto:mccarthy@engr.uconn.edu">mccarthy@engr.uconn.edu</a></td>
<td>Phone: 860-486-1195</td>
</tr>
<tr>
<td></td>
<td>Fax: 860-486-2399</td>
</tr>
</tbody>
</table>

### Name of Technology:

Design Criteria for Using Tire Shreds as Lightweight Backfill for Retaining Walls

### Briefly describe the technology.

Waste tires cut into 25 to 305 mm (1 to 12 in.) pieces yield a material that is coarse-grained, free-draining, and has a low unit weight, thus offering significant advantages for use as a retaining wall backfill.

### Briefly describe the history of its development.

Design criteria for using tire shreds as lightweight retaining wall backfill were developed and are documented in NETC Report No. NETCR-8, "Tire Chips as Lightweight Backfill for Retaining Walls-Phase II," available from the New England Transportation Consortium at www.netc.uconn.edu. The criteria include parameters for: horizontal stress, interface shear, and settlement. They apply to retaining walls up to approximately 4.5 meters (15 feet) in height and with surcharges of 35.9 kPa (750 psf) or less.

### For how long and in approximately how many applications has your organization used this technology?

It has been used successfully by the Maine Department of Transportation.

### What additional development is necessary to enable routine deployment of the technology?

None

### Have other organizations used this technology? If so, please list organization names and contacts.

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<th>Organization</th>
<th>Name</th>
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<th>E-mail</th>
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<tbody>
<tr>
<td>Maine DOT</td>
<td>Dale Peabody</td>
<td>207-624-3305</td>
<td><a href="mailto:dale.peabody@maine.gov">dale.peabody@maine.gov</a></td>
</tr>
</tbody>
</table>
### Potential for Payoff

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

The use of tire shreds as lightweight backfill for retaining walls has several potential benefits. They are inexpensive compared to other types of lightweight fill. In areas where the underlying soil is weak or compressible, tire shreds, with their low unit weight, would apply a smaller vertical stress than conventional backfill leading to lower settlement. The horizontal stress on a retaining wall would be lower than with conventional backfill, resulting in less expensive retaining wall design. The insulation qualities of tire shreds would reduce frost penetration. Finally, their high permeability would provide good drainage.

### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology.

Request a copy of NETC Report No. NETCR-8, "Tire Chips as Lightweight Backfill for Retaining Walls-Phase II," available from the New England Transportation Consortium at [www.netc@uconn.edu](http://www.netc@uconn.edu) or see contact in box 1.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

Cost = $0; Procurement Time = 7 days.

12. What organization(s) currently supply and provide technical support for this technology?

The New England Transportation Consortium

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

None

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes

### Date Submitted

15. Date: 8/26/04

16. Please include image(s) of sketches or photographs, if available

| Image(s) are attached | Yes |

---

| Jeremy Fissel | Phone: 202.624.3640 |
| Program Manager for Engineering | Fax: 202.624.5469 |
| AASHTO | jfissel@aashto.org |

---

**Please E-mail or Fax by August 27, 2004 to:**

AASHTO Technology Implementation Group

Nomination of Technology Ready for Implementation
<table>
<thead>
<tr>
<th><strong>Sponsoring DOT</strong></th>
<th>1. Sponsoring DOT (State): Iowa Department of Transportation</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | Name: Mark Dunn, Research Engineer  
Organization: Iowa Department of Transportation  
Address: 800 Lincoln Way  
City: Ames  
State: Iowa  
Zipcode: 50010  
E-mail: mark.dunn@dot.iowa.gov  
Phone: 515-239-1447  
Fax: 515-817-6597 |
| **Technology Description** | Name of Technology: 
Longitudinal Joint Former for PCC paving |
|  | Briefly describe the technology. 
Development of a knife mounted beneath the paver to form a longitudinal joint in the PCC. As the knife passes through the plastic concrete, it forces the large aggregate to the right or left and leaves a vertical plane of weakness (paste). That is the weakest plane in the concrete and it becomes the longitudinal joint, leaving only a hairline crack visible. |
|  | Briefly describe the history of its development. 
• Late 1990s - Development of idea/sketches 
• 1999 - built small prototype 
• 2000 - lab tests 
• 2001 - approximately 3,000 feet of joint formed 
• 2002 - approximately 150,000 feet of joint formed 
• 2003 and 2004 - widely used throughout the state of Iowa |
|  | For how long and in approximately how many applications has your organization used this technology? 
• 2001 - 7 projects  
• 2002 - 9 projects  
• 2003 and 2004 - numerous county and state projects |
|  | What additional development is necessary to enable routine deployment of the technology? 
Standard Specifications are currently being written. |
|  | Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa Concrete Paving Association</td>
<td>Gordon Smith</td>
<td>515-963-0606</td>
<td><a href="mailto:icpa@iowaconcretepaving.org">icpa@iowaconcretepaving.org</a></td>
</tr>
<tr>
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</tbody>
</table>
| **Potential for Payoff** | What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. 
• Cost savings of $.50 to $1.00 per linear foot for eliminating centerline sawing and sealing.  
• Cost savings of resealing joint after approximately 7 years.  
• Environmental - eliminating the sawing noise, dust (4000 pounds of dust per joint per mile) and engine Pollution. |
10. Please describe what actions another transportation agency would need to take to adopt this technology. Oversight and coordination between the construction office and the contractors to ensure optimal placement of the joint forming knife on the paver.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?
   - Contractor - Equipment and assembly cost should be less than $1,000 per paver. (Versus $10,000 to $20,000 for a conventional concrete saw.)
   - Agency - no additional costs, oversight is part of normal operations.

12. What organization(s) currently supply and provide technical support for this technology?
   Iowa Department of Transportation and Iowa Concrete Paving Association

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.
   Patent application was filed on October 17, 2003.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☒ Yes ☐ No

15. Date Submitted: 08-26-04

16. Please include image(s) of sketches or photographs, if available ☒ Image(s) are attached

This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)
<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>Michigan</th>
</tr>
</thead>
</table>

| Primary Technical Contact | Name: Timothy E. Stallard  
Organization: Michigan Department of Transportation  
Address: 8885 Ricks Road, P.O. Box 30049  
City: Lansing  
State: MI  
Zipcode: 48909  
E-mail: stallardt@michigan.gov  
Phone: 517-322-6448  
Fax: 517-322-5664 |

| Name of Technology: | Wireless Concrete Maturity Monitoring System |

| Technology Description | Name of Technology: Wireless Concrete Maturity Monitoring System |

| Briefly describe the technology. |
Temperature monitoring sensors are embedded into fresh concrete. These sensors log the concrete temperatures at user defined intervals. The temperature logs are downloaded from the sensors using wireless, radio frequency communication. The provided software uses the data to calculate maturity values based on either the time-temperature factor (Nurse-Saul equation) or the equivalent age (Arrhenius equation). The system is designed to meet the requirements of ASTM C1074. |

| Briefly describe the history of its development. |
The maturity testing concept has been around since the 1940’s, but a lack of appropriate equipment prevented its use in field conditions. Thermocouple and thermistor based maturity testing systems have been around for at least ten years, but they have several difficulties related to running the wire to a test unit and protecting that wire from construction activities. Using a wireless system speeds installation time and makes damage to the temperature logger very unlikely. Construction activities have little effect on this system, except as they apply to temperature development. |

| For how long and in approximately how many applications has your organization used this technology? |
Our first installation was in September, 2001. We have three trial installations that were done prior to having a commercial software. We have 5 trial installations using the software. Two contractors have each used the system on one project, and are planning future projects. |

| What additional development is necessary to enable routine deployment of the technology? |
It should be ready to implement, but unforeseen circumstances may prompt future developments. |

| Have other organizations used this technology? If so, please list organization names and contacts. |
| --- | --- | --- | --- |
| Organization | Name | Phone | E-mail |
| Kentucky Transportation Center | David Allen | 859-257-4513 | dallen@engr.uky.edu |
| FHWA mobile lab | Jon Anderson | 202-493-3148 | jon.anderson@fhwa.dot.gov |
| Port of Authority, NY & NJ | David Potts | 201-216-2981 | dpotts@panynj.gov |

| What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. |
Cost savings could come in the form of reduced bid prices because the contractors have less risk. The first MDOT project to use the wireless system also had a $4000/hour lane rental fee. It was very important that the contractor be able to open the roadway at the specified time. Safety improvements and increased transportation efficiency both result by accelerating construction schedules, getting the traveling public back onto fully functional roads as quickly as possible. |
<table>
<thead>
<tr>
<th><strong>Implementation Potential</strong></th>
<th>10. Please describe what actions another transportation agency would need to take to adopt this technology. The system is ready for commercial use.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? System cost is $5000, including 20 sensors. Delivery time is 2 to 3 weeks. With on-site training, 2 days is recommended for adoption of the system.</td>
</tr>
<tr>
<td></td>
<td>12. What organization(s) currently supply and provide technical support for this technology? Wake, Inc. distributes the system and provides technical support. MDOT can also provide technical support.</td>
</tr>
<tr>
<td></td>
<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. None.</td>
</tr>
<tr>
<td><strong>Willingness to Champion</strong></td>
<td>14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☑ Yes ☐ No</td>
</tr>
<tr>
<td><strong>Date Submitted</strong></td>
<td>15. Date: 5/20/04</td>
</tr>
</tbody>
</table>

16. Please include image(s) of sketches or photographs, if available ☑ Image(s) are attached

This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)

Please E-mail or Fax by August 27, 2004 to: Jeremy Fissel
Program Manager for Engineering
AASHTO

Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org
### AASHTO Technology Implementation Group
#### Nomination of Technology Ready for Implementation

|----------------|------------------------------------------------------------------------------------------|
| Primary Technical Contact | 2. Name: Charles H Dowding  
Organization: Infrastructure Technology Institute (DOT Transportation Research Center)  
Address: Northwestern University  
City: Evanston  
State: IL  
Zipcode: 60208  
E-mail: c-dowding@northwestern.edu  
Phone: 847-491-4338  
Fax: 847-491-4011 |
| Technology Description | 3. Name of Technology: Automated Crack Monitoring (ACM) |
|  | 4. Briefly describe the technology.  
ACM autonomously collects and graphically presents -- on the internet -- crack response to both environmental and vibratory effects. This technology is an effective communication tool to educate neighbors about the true effects of vibrations caused by traffic, roadway construction, and aggregate production. The same sensor -- placed across the crack-- collects both the long term – environmental and dynamic -- vibratory effects. Currently this technology is deployed by Eastern Federal Lands to document the effects of roadway construction on a historic structure and to communicate these results in real time to the managers. |
|  | 5. Briefly describe the history of its development.  
This project is some 4 years old and was begun by ITI as part of its effort to develop advanced tools for remote monitoring of critical transportation infrastructure. Articles about the technology and archived examples can be seen at http://iti.northwestern.edu/acm. |
|  | 6. For how long and in approximately how many applications has your organization used this technology?  
ACM has been deployed in a semi autonomous state for projects in Conn. New Mexico (NMDOT), Penn, Nevada (Clark County RTA), Indiana, Illinois, and Washington, DC (EFL) |
|  | 7. What additional development is necessary to enable routine deployment of the technology?  
Commercialization of the sensor and data acquisition monitors has yet to be accomplished. Currently two OEMs are in alpha and beta stage testing of the hardware and software. ITI is performing the validation tests for these two organizations. |
|  | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Federal Lands</td>
<td>Jorge Alvarez</td>
<td>202-393-5583</td>
<td><a href="mailto:jorge.alvarez@fhwa.dot.gov">jorge.alvarez@fhwa.dot.gov</a></td>
</tr>
<tr>
<td>Clark County RTA</td>
<td>Gary Johnson</td>
<td>702-676-1500</td>
<td></td>
</tr>
<tr>
<td>Office of Surface Mining</td>
<td>Ken Eltschlager</td>
<td>412-937-2169</td>
<td><a href="mailto:keitsch@osmre.gov">keitsch@osmre.gov</a></td>
</tr>
<tr>
<td>MNDOT</td>
<td>Chuck Howe</td>
<td>612-779-5602</td>
<td><a href="mailto:charles.howe@dot.state.mn.us">charles.howe@dot.state.mn.us</a></td>
</tr>
</tbody>
</table>
|  | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Technology provides a radically new communication and public education too that was previously not available. It avoids downstream lawsuits and overcomes project delays. It is not a new type of “hammer”. As such the advantages are so great that the two OEMs have invested their own funds to develop commercial versions of this semi autonomous versions of this technology. |

Page 1
### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology.

Other agencies need only call ITI and provide a letter describing “in-kind” project expenditures for vibration monitoring, control and public relations as matching funds. ITI will then install the equipment to demonstrate its use in real time basically without cost to the agency.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

Eastern Federal Lands was able to deploy this technology within 1 month of its call to ITI. The cost to them has been zero – other than manager’s time to attend meetings. In the future, agencies should be able to rent equipment for some $500 to $1000 per month to obtain the measurements. Internet display costs would be an additional $1800 installation charge and $600/month display charge for organizations that do not provide “in-kind” matching funds.

12. What organization(s) currently supply and provide technical support for this technology?

ITI – the original developer. GeoSonics and Instantel are the two OEMs currently developing commercial versions of the field hardware and software. Civil Data Systems is a spin off company, currently incubated by ITI, which supplies autonomous Internet display.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

The most difficult problem would be installation of the equipment – but that is the case with all instrumentation. There are no intellectual property issues as the two OEM’s are in sole possession of their technology.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? **Yes**

15. Date Submitted: 27 Aug 2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached. See http://iti.northwestern.edu/acm

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<table>
<thead>
<tr>
<th>Please E-mail or Fax by August 27, 2004 to:</th>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Program Manager for Engineering</td>
<td>Fax: 202.624.5469</td>
</tr>
<tr>
<td></td>
<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
</tr>
</tbody>
</table>
### Sponsoring DOT
1. Sponsoring DOT (State): FDOT

### Primary Technical Contact
2. Name: Bouzid Choubane  
   Organization: FDOT, State Materials Office  
   Address: State Materials Office, Materials Research Park  
   City: Gainesville  
   State: FL  
   Zipcode: 32605  
   E-mail: Bouzid.Choubane@dot.state.fl.us  
   Phone: (352) 955-6302  
   Fax: (352) 955-6345

### Technology Description
3. Name of Technology: Automated High Speed Pavement Cross-Slope Measurement

4. Briefly describe the technology.  
   This technology uses a high-speed laser profiler equipped with a Position Orientation System for Land vehicle (POS/LV). The POS/LV system provides navigation data such as geographic position (latitude, longitude and attitude), velocity, acceleration, angular rate, and heading. These data may be used to measure roadway geometrics such as cross-slope, grade, and curvature at highway speed. The vehicle is also equipped a Global Positioning System for georeferencing purposes.

5. Briefly describe the history of its development.  
   Many states have used vendors to provide roadway geometrics data from three primary vendors: Mandli, Roadware, ICC, and Dynatest.

6. For how long and in approximately how many applications has your organization used this technology?  
   For the past two years, the Florida Department of Transportation (FDOT) has been working on probing and evaluating the functionality, field worthiness, and reliability of this complex system. This has led to a number of improvements, thus improving the overall system from 56% to an estimated 95% reliability.

7. What additional development is necessary to enable routine deployment of the technology?  
   The next step is to perform a full scale system validation through designed experiments. Recent analysis of raw data from the Inertial Measurement Unit (IMU) seem to indicate that using accelerometer data for measuring roadway curvature leads to inconsistent results, which appear to be oscillatory in nature. It is hypothesized that use of velocity data for measuring roadway geometrics provides more consistency and stability than using accelerometer data.

### State of Development
8. Have other organizations used this technology? If so, please list organization names and contacts.  

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
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</thead>
<tbody>
<tr>
<td>Connecticut DOT</td>
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<td>Maryland DOT</td>
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<td>Missouri DOT</td>
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<td>Puerto Rico DOT</td>
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<td>Kansas DOT</td>
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<td>Ohio DOT</td>
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<td>Wisconsin DOT</td>
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<tr>
<td>Iowa DOT</td>
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<tr>
<td>Utah DOT</td>
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</table>

### Potential for Payoff
9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
   We were able to identify 1) a location on a portion of interstate where drivers were loosing control of their vehicles due to inadequate cross-slope; and 2) identify locations on a highway with potential water ponding problems.
10. Please describe what actions another transportation agency would need to take to adopt this technology.
   1) Capitalize on the experience of other states before committing to any one system
   2) Ensure that equipment and subsystems have passed validation tests.
   3) Select a system based on needs of the Agency and identify data storage needs
   4) Evaluate the benefits and costs of implementing the system in-house versus outsourcing

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?
   1) Cost is estimated at about $120,000 Outsourcing: 6 months
   2) 6 to 12 months

12. What organization(s) currently supply and provide technical support for this technology?
    - Applanix Corporation.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.
    1) Accuracy of the system is dependent on the laser profiler manufacturer’s adopted bundled proprietary software solution.
    2) The POS/LV system to some extent allows the user to develop own output “solution” by accessing the sensor data.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? √ Yes □ No

15. Date: May 31, 2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached
POS / LV System

- Internal Measurement Unit (IMU)
- POS Computer System (PCS)
- Distance Measurement Indicator / Encoder
- L1 Primary GPS Receiver and Antennas
### AASHTO Technology Implementation Group
#### Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): California Department of Transportation</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Michael Samadian  
                                    Organization: California Department of Transportation / Division of Research and Innovation  
                                    Address: 1101 R Street  
                                    City: Sacramento  
                                    State: CA  
                                    Zipcode: 95814  
                                    E-mail: michael_samadian@dot.ca.gov  
                                    Phone: (916) 324-2048  
                                    Fax: |
| **Technology Description** | 3. Name of Technology: Construction Analysis for Pavement Rehabilitation Strategies (CA4PRS) Software |
| | 4. Briefly describe the technology. |
| | *CA4PRS* estimates the optimized distance and duration of highway rehabilitation or reconstruction projects under a given set of constraints such as scheduling interfaces, pavement materials and design, contractor logistics and resources, and traffic operations. As a knowledge-based computer system (Windows-base) on a Microsoft Access database, it uses Monte Carlo simulation, critical path method (CPM) analysis, and linear scheduling technique. *CA4PRS* is designed to help highway agencies and paving contractors make construction schedule decisions that balance rehabilitation productivity, traffic inconvenience, and agency cost. Added benefit comes when *CA4PRS* results are integrated with macroscopic and microscopic traffic simulation tools for estimating road user delay cost due to construction work zone closures. |
| | 5. Briefly describe the history of its development. |
| | The original concept of the *CA4PRS* model and partial funding of the field case studies was funded by the California Department of Transportation through the Partnered Pavement Research program. *CA4PRS* was developed by the Institute of Transportation Studies in the University of California at Berkeley (UCB) with support from an FHWA pooled-fund (SPR-3(098)) sponsored by the State Pavement Technology Consortium (California, Florida, Minnesota, Texas, and Washington). The American Concrete Pavement Association (ACPA) and the National Asphalt Pavement Association (NAPA) have contributed partial funding for the field case studies in the validation process. |
| | 6. For how long and in approximately how many applications has your organization used this technology? |
| | *CA4PRS* has been validated and successfully implemented on several urban freeway rehabilitation / reconstruction projects with high traffic volume in California since 1999. The software was validated on the I-10 Pomona project (Caltrans first concrete long-life pavement rehabilitation strategy (LLPRS) project) during one 55-hour weekend closure. The software was then used to develop the construction staging-plan for the I-710 Long Beach project (the first asphalt LLPRS project). The *CA4PRS* software was used in conjunction with traffic simulation models to select the most economic rehabilitation scenario during the initial planning and design stages of a reconstruction project on I-15 San Bernardino. |
| | 7. What additional development is necessary to enable routine deployment of the technology? |
| | The current version 1.0 of *CA4PRS* is ready for deployment without any further development. |
| State of Development | 8. Have other organizations used this technology? If so, please list organization names and contacts. |
| | Organization  
| | Name  
| | Phone  
| | E-mail  
| Caltrans | Michael Samadian (916) 324-2048 michael_samadian@dot.ca.gov  
| TXDOT | Michael Murphy (512) 465-3686 mmurphy@dot.state.tx.us  
| MnDOT | Paul Keranen (651) 779-5608 paul.keranen@dot.state.mn.us  
| WSDOT | Linda Pierce 360-709-5470 piercel@wsdot.wa.gov  
| FLDOT | Bouzid Choubane 352-955-6302 bouzid.choubane@dot.state.fl.us |
AASHTO Technology Implementation Group
Nomination of Technology Ready for Implementation

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

Application of the CA4PRS model to urban freeway rehabilitation projects in California, including the I-10 Pomona, I-710 Long Beach, and I-15 San Bernardino projects, has demonstrated its value in saving millions of dollars for both Caltrans and road users.

CA4PRS can evaluate various traffic lane closure strategies and pavement design alternatives for highway rehabilitation with the goal of maximizing new pavement life expectancy and construction production and minimizing traffic delay and agency costs. The CA4PRS model can also facilitate teambuilding among engineers from design, construction, and traffic operations to mutually arrive at an optimal solution in their decision making process. Paving contractors and consultants will find CA4PRS useful for checking construction staging-plans, identifying critical resources constraining production, and quantifying the probability of meeting incentives/disincentives and cost (A) plus schedule (B) contracts.

CA4PRS can be incorporated with traffic simulation and life-cycle cost analysis models to maximize on-schedule construction production and minimize costs for the agency and road users for highway rehabilitation and reconstruction projects, especially in urban areas. It can save time in construction and the opening of the road to the public in a fastest time and the least traffic delays.

10. Please describe what actions another transportation agency would need to take to adopt this technology.

Another agencies might contact the Office of Technology Licensing (Tel: (510)643-7201, Email: vlanker@berkeley.edu) in the University of California at Berkeley for more information about the CA4PRS software including purchasing.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

The software is available from the University of California at Berkeley with the cost of about $3,000 per license.

Minimum 2-day hands-on training class is recommended for the end users with the approximate cost of $6,000 per training (for about 15 trainees).

12. What organization(s) currently supply and provide technical support for this technology?

Limited technical support is provided by the Institute of Transportation Studies in the University of California at Berkeley.

Training is available from EBL Consulting, Inc. (Dr. E.B. Lee, the CA4PRS model developer)

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

Purchasing of the software license (sole source) is available through the Office of Technology Licensing in the University of California at Berkeley. The 5-State DOTs (CAFUMN/TX/WA) have a privilege of unlimited license. ACPA distributes the CA4PRS software license to its member.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☒ Yes ☐ No

15. Date: July 29, 2004

16. Please include image(s) of sketches or photographs, if available X image(s) are attached. (See more information attached)

This form is available electronically at http://www.aashtotig.org/solicitation/

Please E-mail or Fax by August 27, 2004 to:

| Jeremy Fissel |
| Program Manager for Engineering |
| AASHTO |

Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org
Table 1: Categorized Comparison Alternatives Included in the CA4PRS Model.

<table>
<thead>
<tr>
<th>Comparison Categories</th>
<th>Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehabilitation types</td>
<td>Reconstruction with Portland cement concrete (PCC)</td>
</tr>
<tr>
<td></td>
<td>Crack and Seat PCC and Overlay with AC (CSOL)</td>
</tr>
<tr>
<td></td>
<td>Full-depth replacement with AC (FDAC)</td>
</tr>
<tr>
<td>Construction windows</td>
<td>Nighttime closure</td>
</tr>
<tr>
<td></td>
<td>Extended weekend closure</td>
</tr>
<tr>
<td></td>
<td>Continuous weekday closure</td>
</tr>
<tr>
<td>Design cross-section</td>
<td>Total thickness (PCC)</td>
</tr>
<tr>
<td></td>
<td>Lift profile (AC)</td>
</tr>
<tr>
<td>Material properties</td>
<td>Concrete curing time (PCC)</td>
</tr>
<tr>
<td></td>
<td>Cooling time (AC)</td>
</tr>
<tr>
<td>Lane closure tactics</td>
<td>Full-closure (Concurrent-method)</td>
</tr>
<tr>
<td></td>
<td>Partial-closure (Sequential-method)</td>
</tr>
<tr>
<td>Pavement base types</td>
<td>AC base</td>
</tr>
<tr>
<td></td>
<td>Lean concrete base</td>
</tr>
<tr>
<td>Scheduling constraints</td>
<td>Mobilization</td>
</tr>
<tr>
<td>(activity lead-lag time</td>
<td>Demobilization</td>
</tr>
<tr>
<td>relationships)</td>
<td>Traffic control time</td>
</tr>
<tr>
<td>Logistical resources</td>
<td>Location of plants and dumping areas</td>
</tr>
<tr>
<td>(plants and equipment)</td>
<td>Capacity of equipment</td>
</tr>
<tr>
<td></td>
<td>Hourly number of equipment</td>
</tr>
</tbody>
</table>
Figure 1: CAAPRS menu structure and analysis hierarchy.
Figure 2: Resource Profile input window in the concrete probabilistic mode.
Figure 4: *Analysis* input window in the concrete module.
Fig. 4. Output screens for the Full-depth AC replacement module.
### AASHTO Technology Implementation Group
**Nomination of Technology Ready for Implementation**

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): CALIFORNIA &amp; NEW YORK</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Lauren Kemp  
Organization: California DOT  
Address: 2829 Juan Street  
City: San Diego  
State: CA  
Zip code: 92110  
E-mail: Lauren_Kemp@dot.ca.gov  
Phone: 858.688.1498  
Fax: 619.688.6848 |
| **Additional Contact** | Name: Frank Hartley, P.E.  
Organization: New York DOT  
Address: 80 Wolf Road  
City: Albany  
State: NY  
Zip code: 12232  
E-mail: fhartley@dot.state.ny.us  
Phone: 518.457.4369  
Fax: 518.485.8948 |
| **Technology Description** | 3. Name of Technology: Field Automated Communication System (FACS) |
| | 4. Briefly describe the technology. |

The Field Automated Communication System (FACS) consists of a wireless work tablet computer that is constantly synchronized with a central project information database server to be used by the DOT and contractor’s staff working on State highway construction projects.

The importance of the wireless technology with input to a central database is to allow all project relevant personnel to constantly be in contact with each other working on the project(s) to readily evaluate project schedule(s) and immediately analyze issues that may cause delay to public traffic. The DOT field and contractor’s staff working on the project will use the ruggedized work tablets in the field while at the same time allowing office staff or other agencies involved to view the latest information from the field site through the Internet. Each user of the system will have access to project information including contract plans and specifications, standard plans and specifications, Prevailing Wage Rates, Labor Compliance, project schedules and other project relevant information. The levels of access shall be secure and specifically tailored to the project hierarchy and any sensitive information shall be encrypted.

FACS incorporates existing DOT programs and email access to interface with the work tablets thereby allowing input electronically to versions of the daily diary field records in coordination with the contractor’s staff for contract work and changed work that can be compared with certified payroll records for assurance of correct and efficient accounting. Additionally, the FACS ability for real-time input shall provide timely evaluation of any potential impacts or delays to the overall project schedule.

The FACS database system is not just an electronic filing system but provides the tools to analyze and evaluate the project information without delay of input by having ready access from the field location. By using the FACS database system it creates virtually a paperless project and at the completion of the contract all project data can be accessed from the database and evaluated for timely resolution of possible disputes or claims that previously required substantial research time of the paper records.
5. Briefly describe the history of its development.

The FACS database system has been used on two California DOT projects as a pilot for developing the technology starting with the daily diaries and submittal of extra work billing. The first project is contract 07-1760U4 which started in April 2002 and the second contract 12-1257U4 which started in October 2003.

During this time the system has been continually updated to meet the field staff needs to simplify submittal of project information thereby reducing staff costs. The additional benefit of real-time submittal at the project field location reduces the field staff exposure to traffic safety issues and reduces driving time back and forth to the project location. The two ongoing contracts have used portions of the database system to prepare for full use on future contracts so that any conflicts can be worked out on a smaller scale usage.

The vendor ShareChive LLC is working with IBM and Northrup Grumman to develop the equipment and software to duplicate the current paper filing system of DOT’s and improve efficiency of data input and effective output for analysis of project information.
6. For how long and in approximately how many applications has your organization used this technology?

**CalTrans**
- Contract 07-1760U4 started in April 2002,
  - Contractor: MCM Contractors
  - Total Portable Units: 12
  - Desktops: 5
  - Construction Value: $34M
  - Construction Duration: 3 Years
- Contract 12-1257U4 started in October 2003
  - Contractor: C. C. Myers, Inc.
  - Total Portable Units: 22
  - Desktops: 7
  - Construction Value: $58M
  - Construction Duration: 5 Years

**NYDOT**
- Region 4: Rochester – $40+ million replacement of the Troup Howell Bridge on I-490 in Rochester.
  - Contract started in April 2004,
  - Total Portable Units: 6
  - Desktops: 2
  - Construction Duration: 3 Years
- The following projects are proposed to start:
  - **CalTrans**
    - Contract 11-080914
      - Contractor: FCI Constructors, Inc.
      - Total Portable Units: 15
      - Desktops: 5
      - Construction Value: $68M
      - Construction Duration: 4 Years
    - Contract 11-080924
      - Contractor: FCI Constructors, Inc.
      - Total Portable Units: 18
      - Desktops: 5
      - Construction Value: $85M
      - Construction Duration: 3 Years
  - **NYDOT**
    - Region 11: New York City – $90+ million rehabilitation of the FDR Drive in Manhattan
      - Phase 2 Contract starting in October 2004
      - Total Portable Units: 8
      - Desktops: 2
      - Construction Duration: 3 Years
    - Region 11: New York City – Region wide $10 million Mill and Fill Contract
      - Contract Starting Spring 2005
      - Total Portable Units: 2
      - Desktops: 1
      - Construction Duration: 1 Year
    - Region 1: Albany - $30+ million Highway Reconstruction Project
      - Contract Starting Spring 2005
      - Total Portable Units: 5
      - Desktops: 1
      - Construction Duration: 2.5 Year
7. What additional development is necessary to enable routine deployment of the technology?

Full integration with existing legacy systems, update to higher speed modem, confirm labor compliance security issues of sensitive information.

8. Have other organizations used this technology? If so, please list organization names and contacts.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
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</thead>
<tbody>
<tr>
<td>FLORIDA DOT</td>
<td>Jonathan M. Duazo</td>
<td>407.463.9101</td>
<td><a href="mailto:jonathan.duazo@dot.state.fl.us">jonathan.duazo@dot.state.fl.us</a></td>
</tr>
<tr>
<td>MARYLAND SHA</td>
<td>Michael Lynch</td>
<td>410.545.8018</td>
<td><a href="mailto:MLynch@sha.state.md.us">MLynch@sha.state.md.us</a></td>
</tr>
<tr>
<td>GRANITE CONSTRUCTION</td>
<td>Bob Stallard</td>
<td>831.724.1101</td>
<td><a href="mailto:Bob.Stallard@gcinc.com">Bob.Stallard@gcinc.com</a></td>
</tr>
</tbody>
</table>

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

It is anticipated that there may potentially be a 30% reduction in staff costs, including the contractor’s staff costs by one time submittal of information. Additionally the efficiency to electronically submit and retrieve project information in real-time shall also reduce travel time between project location, the field office and main DOT office for coordination with project management. The information should be more accurate due to one time submittal in lieu of redundant hard copy paper input. This shall allow for more inspection and review time for quality assurance of the actual construction work. A searchable database of all project records will be available which will facilitate research for dispute and claim resolution and other project needs. By automating the base lining, collection, integration, dissemination and management of all aspects of the project information process and providing real-time communication between all relevant personnel, a host of valuable efficiencies and savings are readily realized for all parties.

Additionally, projects are accelerated more often these days due to various political and/or environmental issues and also use alternative bidding methods that require the DOT to administer contracts with at-risk design. These accelerated or at-risk projects add additional construction administration burdens to analyze and prepare for contract changes. The tools that FACS provides will help expedite the review and analysis, thereby lessen the risk of delay to public traffic. The substantial benefit by using FACS to the public by reducing the risk of delay may offset some of the risk to proceed with projects that have an accelerated schedule.

Furthermore, the benefits realized so far by concurrent implementation by both the CA DOT and NY DOT have readily expedited the process for each participant with new and different approaches based on the unique needs and requirements that differ between both states. The sharing of information between two states has been an advantage and the ability to further the development by working with other state DOT's will increase the benefits for all.
### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology.

   Develop specifications unique to their State DOT construction administration process and incorporate them into the contract so that the contractor requirements of the database system can be considered within the scope of the contract.

11. What are the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

   Setup cost per project is based on the contract amount:
   - Projects $2 M to $15 M ____________ $10,000.00
   - Projects $15 M to $50 M ____________ $15,000.00
   - Projects $50 M to $150 M ____________ $20,000.00

   The cost per unit of work tablets is based on the project staff requirements:
   - $650.00 or less per units required.

   The cost per desktop user is based on the project staff requirements:
   - $150.00 or less per users required.

   Once the specifications are developed and incorporated into the scope then the ability to readily incorporate the system shall only be the necessary setup time of project information.

12. What organization(s) currently supply and provide technical support for this technology?

   IBM and Northrop Grumman

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

   None

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?

   ☑ Yes ☐ No

### Date Submitted

15. Date: 08/27/04

16. Please include image(s) of sketches or photographs, if available. ☑ Image(s) are attached

   ![CA_NY_DOT_TIG_FACS_slideshow.pdf]
AASHTO Technology Implementation Group  
Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Missouri</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Technical Contact</strong></td>
<td></td>
</tr>
</tbody>
</table>
2. Name: John Wenzlick, P.E.  
Organization: Missouri DOT  
Address: 1617 Missouri Blvd., P.O. Box 270  
City: Jefferson City  
State: MO  
Zipcode: 65102  
E-mail: John.Wenzlick@modot.mo.gov  
Phone: 573 751-1039  
Fax: 573 526-4337 |
| |  
3. Name of Technology:  
Digital Surface Roughness Meter (Laser Profilometer) |
| **Technology Description** |  
4. Briefly describe the technology.  
This is a field instrument that uses the principle of laser striping to measure the surface roughness of concrete and steel substrates. Surface profiles are illuminated by the laser lines, and these are imaged using the embedded camera, and transmitted to a laptop computer using wireless video transmission. The image in the computer is analyzed, and surface roughness characteristics are reported. The instrument is the first of its kind to provide a scientific record of surface roughness critical for quality control and inspection. |
| |  
5. Briefly describe the history of its development.  
This technology was originally developed by researchers at the University of Missouri-Rolla, funded by the Center of Infrastructure Engineering Studies and its University Transportation Center, and the American Concrete Research Institute. Field testing and calibration was undertaken in projects funded by the Missouri Department of Transportation. The technology has been licensed to Magana Instruments Inc., and is now commercially available. |
| **State of Development** |  
6. For how long and in approximately how many applications has your organization used this technology?  
This technology has been used over the past three years to characterize the effectiveness of sandblasting on concrete surface preparation of bridge superstructures. In this instance, the concrete surface was to be prepared for the adhesion of Fiber Reinforced Polymer (FPR) laminates for flexural and shear capacity upgrades. |
| |  
7. What additional development is necessary to enable routine deployment of the technology?  
None |
| **Potential for Payoff** |  
8. Have other organizations used this technology? If so, please list organization names and contacts.  
| Organization | Name | Phone | E-mail |
| Dugussa Construction Material (Switzerland) | Philipp Widmer | +41 1 438 23 72 | philipp.widmer@degussa.com |
| **Potential for Payoff** |  
9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Quality control and a record of quality control on surface preparation and optimum bonding of the FRP materials, leading to stronger and longer lasting repairs. |
10. Please describe what actions another transportation agency would need to take to adopt this technology. The technology is ready for deployment. No research investments are necessary.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? The Digital Surface Roughness Meter can be purchased for $15,000 and immediately used by contractors, engineers, and inspectors for field application.

12. What organization(s) currently supply and provide technical support for this technology? Magana Instruments Inc. 12255 Cedar Grove Rolla MO, 65401 http://www.magana-instruments.com

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. None

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? x  Yes  □  No

15. Date: Aug. 24/2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached

(see next page)
The DSRM (Laser Profilometer) is a field (or laboratory) instrument to measure concrete surface roughness.
The DSRM uses 5 laser lines to produce surface profiles, imaging them and analyzing them to generate surface roughness measures.
Nomination of Technology Ready for Implementation

Sponsoring DOT (State): Missouri DOT

Primary Technical Contact

Name: John Wenzlick, P.E.
Organization: MoDOT
Address: P.O. Box 270
City: Jefferson City
State: MO
Zipcode: 65102
E-mail: John.Wenzlick@modot.mo.gov
Phone: (573) 751-1039
Fax: (573) 526-4337

Name of Technology:
Microwave Detection and Evaluation of Disbond and Delamination in Carbon Fiber Reinforced Polymer (CFRP) Strengthened Structural Members

Briefly describe the technology.
Near-field microwave nondestructive testing and evaluation (NDT&E) methods are well-suited for evaluating the properties of layered composite structures. CFRP patches are increasingly used for providing additional shear and flexural strength to bridge and other structural members. However, the presence of defects such as disbond and delamination can significantly reduce the effectiveness of this strengthening technique. Near-field microwave NDT&E methods can provide robust detection of such disbands and delaminations in addition to providing critical information such as the area extent and severity of these defects. These methods can also provide valuable information about subsequent epoxy-injection repair of these defects. These microwave measurement systems are relatively small, readily portable, handheld, low-power, non-interfering with on-site wireless systems, relatively inexpensive and can easily be incorporated into scanning system to provide raster images of a disbond. These systems can also be autonomously operated with the resulting data being transferred via wireless to a central location for evaluation and temporal cataloging.

Briefly describe the history of its development.
Inspection of multi-layered composite structure for NDT&E purposes, using near-field microwave methods, dates back to early 1990’s (and even earlier). The utility of these methods for application to CFRP-strengthened structural members was first investigated in 2000. This preliminary investigation was later followed by a more comprehensive investigation in 2002. Currently, this method is being used for evaluating CFRP patches in a bridge in Dallas County, Missouri. The prototype microwave system has been significantly improved and expanded to perform measurements independent of changes in liftoff (distance between the probing device and a CFRP surface). A laboratory version of this new prototype system has been successfully tested during the past few months.

For how long and in approximately how many applications has your organization used this technology? This technology has been well-tested in the laboratory and this is the first time it has been used in a bridge (i.e., in-field testing).

What additional development is necessary to enable routine deployment of the technology? The technique is fully tested and the laboratory prototype microwave device is 95-100% complete. Additional work for making it completely in-field usable would require better packaging of the components so that it can be routinely used in the field.

Have other organizations used this technology? If so, please list organization names and contacts.
| Potential for Payoff | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. Since this technology is new and is just being considered to deployment and use in the field, the anticipated savings in cost, time and other resources is to be determined later. |
10. Please describe what actions another transportation agency would need to take to adopt this technology.

This prototype system is nearly complete and close to deployment (approximately in six months). Once a commercially suitable version is complete, another transportation agency would only need to procure and deploy it.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

Once a commercially suitable version is complete, another transportation agency would only need to procure and deploy it. Excluding a scanning mechanism required for producing images of a disbonded region, the cost of the microwave inspection system is estimated at $7,000-10,000.

12. What organization(s) currently supply and provide technical support for this technology?

Professor R. Zoughi at the Applied Microwave Nondestructive Testing Laboratory (amntl) in the Electrical and Computer Engineering at the University of Missouri-Rolla, zoughiri@umr.edu, (573) 341-4656.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

A disclosure of invention has been filed with the university for this technology for automatic removal of surface roughness and standoff distance variation. A subsequent patent application is expected to follow soon.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes ☒ No

15. Date Submitted: August 24, 2004

16. Please include image(s) of sketches or photographs, if available ☒ Image(s) are attached

(a) Near-field microwave NDT system deployed on the abutment of a bridge in Dallas County, Missouri and its scanning system,

(b) microwave image of three intentionally and one unintentionally produced disbands between a CFRP patch and the abutment.

Please E-mail or Fax by August 27, 2004 to:

Jeremy Fissel
Program Manager for Engineering
AASHTO

Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org
AASHTO Technology Implementation Group
Nomination of Technology Ready for Implementation

Sponsoring DOT (State): Pennsylvania  
Primary Technical Contact: L. Bradley Foltz  
Organization: PennDOT, Bureau of Design, Design Services, Photogrammetry & Surveys Section  
Address: 145 Limekiln Road, Suite 300  
City: New Cumberland  
State: PA  
Zip Code: 17070  
E-mail: lbfoltz@state.pa.us  
Phone: 717-346-4278  
Fax: 717-346-4286

1. Technology Description  
   Name of Technology: High Definition Surveys

2. Briefly describe the technology.  
   High Definition Survey (HDS) 3D laser scanning system is an advanced surveying instrument, a standard laptop PC, and specialized software. HDS laser scanning system captures the desired site with tens of millions of survey-quality data points in less time and more safely than traditional surveys. HDS software allows the user to rapidly create highly accurate maps, drawings, and models from ultra-rich data sets generated by the laser scanner.

3. Briefly describe the history of its development.  
   The first laser scanner went into production in 1999 after five years of development. Advanced hardware and software provides the solution for measuring and modeling large, complex sites and structures with high accuracy, detail and speed.

   HDS was developed by a hardware and software system that would meet the complex needs of process piping and steel construction industries. Because of its ability to acquire 3D images of objects and scenes the technology was quickly adapted into the civil engineering and surveying industries.

   HDS technology has been tested under very rigorous criteria through demonstrations, and pilot projects for a wide range of companies throughout the world.

   PENNDOT assembled all the District Chief’s of Survey for a day long presentation and field test of the HDS technology. At the end of the day, it was concluded that the scanner could prove to be invaluable in providing a safe way to measure structure detail and inaccessible natural and man-made features. It could reduce field survey time for surveying pavement of heavily traveled highways (without lane closure), bridge structures, and vertical walls.

   Two pilot projects were performed using HDS. Two projects, each in District 2-0, Centre County, PA. were selected for the tests. A discrepancy over the amount of cut from a rock-face wall was the first study area. The rock-face was scanned in a tenth of the time a conventional crew would have required to perform the survey. Plus, there were no safety risks involved using the scanner as is the case with conventional surveying. Conventional surveying would have required our surveyors to repel down the wall, while holding a prism to collect data. The scanned files were overlaid with the original mapping files prior to construction. The volume calculations from these files confirmed the Department's original estimates.

   The second pilot survey was that of an existing bridge. Estimates to conventionally surveying the bridge would have required a three man crew two weeks to survey the bridge detail. The scanner gathered thousands of additional points in three days with a one-man survey crew. With all the additional data collected saves time and expense for field crews eliminating the need to return to the site to pickup additional points. The scanner captures all four sides of the bridge the first time the site is surveyed.

4. State of Development  
   For how long and in approximately how many applications has your organization used this technology?  
   PennDOT has HDS for three years. It has been used for detailed bridge surveys, rock-face walls, and heavily traveled pavement.

5. What additional development is necessary to enable routine deployment of the technology?  
   N/A

6. Have other organizations used this technology? If so, please list organization names and contacts.  
   Organization  Name  Phone  E-mail  
   PA State Police  Trooper Matrin Long  717-705-2678  martilong@state.pa.us  
   Colorado School of Mines  Kieth Turner  303-273-3802  kturner@mines.edu

7. Potential for Payoff  
   What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

   Field survey time is cut 70-80% for difficult surveys or where safety was a concern. Where mm accuracy is required and conventional surveys could not complete survey task such as heavily traveled pavement, rock-faces and bridges. The cost in the safety to our field surveys is immeasurable. Cost savings are realized in the ability to retrieve data impossible to measure by any other means.
8. Please describe what actions another transportation agency would need to take to adopt this technology.
   Budget 200K in the future for the scanner, software, and training time. Dedicate a field survey crew to
   learn the technology and dedicate one office staff technician to manipulate the large data files generated by
   the scanner and developing the model files needed by the engineering community.

9. What is the estimated cost, effort, and length of time required for procurement or adoption by another
   transportation agency?
   200k, dedicating one survey field crew and one office technician to post-process data and several months
to one year to be proficient in the technology.

10. What organization(s) currently supply and provide technical support for this technology?
    Leica, Inc; Riegl, Inc

11. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease
    of implementation.
    Budgetary limits, sufficient staff to support this technology, education of design staff to accept and learn
    techniques to manipulate larger data file.

12. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the
    AASHTO Task Force on Technology Implementation?  ☑ Yes  ☐ No

13. Date:

14. Please include image(s) of sketches or photographs, if available  ☑ Image(s) are attached

This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)

Please E-mail or Fax by August 27, 2004 to:

<table>
<thead>
<tr>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Manager for Engineering</td>
<td>Fax: 202.624.5469</td>
</tr>
<tr>
<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
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</tbody>
</table>

Page 2
<table>
<thead>
<tr>
<th><strong>Sponsoring DOT</strong></th>
<th>1. Sponsoring DOT (State): New York State Department of Transportation</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Zoeb G. Zavery  
Organization: Materials Bureau  
Address: 50 Wolf Road, Mail Pod 34  
City: Albany  
State: NY  
Zipcode: 12232  
E-mail: zzavery@dot.state.ny.us  
Phone: (518) 485-5277  
Fax: 518-457-8171 |
| **Technology Description** | 3. Name of Technology:  
Electronic Surface Contact Devices for the Determination of Hot Mix Asphalt (HMA) Pavement Densities |
| **Technology Description** | 4. Briefly describe the technology.  
Dielectric constant is the ability of a material to store an electrostatic energy per unit volume. All materials, including air has a dielectric constant. Aggregates and PG Binders have a dielectric constant in the range of 5 to 6. Air has a dielectric constant of 1. The dielectric constant of a composite material, such as HMA, is a function of the volume of each component times its individual dielectric constant. As a HMA pavement is compacted the amount of air decreases, in turn increasing the dielectric constant of the HMA pavement. These devices can determine the dielectric constant of a given HMA pavement by measuring the “impedance” of that pavement at a chosen electrical frequency. The internal circuitry of the devices then uses these measurements to determine the density of the HMA pavement. |
| **State of Development** | 5. Briefly describe the history of its development.  
This technology was formally discussed with NYSDOT in 1996 and a prototype guage was evaluated through the IDEA Program. After experimenting with the gauge in 1997, NYSDOT arranged to have the technology evaluated by Turner Fairbanks Research Lab. In 2000, pooled fund study SPR-3(082) - Evaluation of Non-Nuclear Gauges to Measure Density of Hot-Mix Asphalt Pavements, was initiated. The pooled fund study eventually evaluated two gauges from different manufacturers. As a result of the pooled fund study, NYSDOT sponsored an AASHTO provisional specification that was approved as TP 68-04 Density of In-place Hot Mix Asphalt (HMA) Pavement by Electronic Surface Contact Devices. These devices address the safety and security concerns associated with the use of nuclear density gauges. |
| **State of Development** | 6. For how long and in approximately how many applications has your organization used this technology?  
NYSDOT has been studying these devices since 1996. NYSDOT was a participant in a pooled fund study (SPR-3(082)) with several other states. In 2004, NYSDOT changed our Standard Specifications to allow for the use of these devices for monitoring HMA pavement density. NYSDOT also developed Materials Procedure (MP) 03-001 - Non-Nuclear Density Gauge Data Collection for Hot Mix Asphalt, for using the gauges. |
| **Potential for Payoff** | 7. What additional development is necessary to enable routine deployment of the technology?  
No further development is needed to enable routine deployment. |
| **Potential for Payoff** | 8. Have other organizations used this technology?  
The other participating States in pooled fund study SPR-3(082). |
| **Potential for Payoff** | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
The use of these devices will lead to cost savings in licensing fees, certification courses fees, and monitoring badge fees associated with the use of nuclear density gauges. These devices do not have any of the safety or security concerns related to working with radioactive materials like nuclear gauges. |
10. Please describe what actions another transportation agency would need to take to adopt this technology. Changes to their specifications to allow the use of these devices anywhere a nuclear density gauge is used to monitor HMA density.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? These devices are readily available from their manufacturers. Cost for these devices is in the $7,000 to $8,000 range. Depending on the agency’s specifications, these devices could be allowed for contractor quality control at no cost to the agency, while using a different method for quality assurance.

12. What organization(s) currently supply and provide technical support for this technology? The device manufacturers provide technical support for these devices.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. NYSDOT is not aware of any issues that could affect ease of implementation.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?  ☒ Yes ☐ No

Date Submitted 15. Date: August 18, 2004

16. Please include image(s) of sketches or photographs, if available ☒ Image(s) are attached

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Please E-mail or Fax by August 27, 2004 to:

<table>
<thead>
<tr>
<th>Jeremy Fissel</th>
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<tr>
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<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
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</table>
# AASHTO Technology Implementation Group
## Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Wisconsin Department of Transportation (WisDOT)</th>
</tr>
</thead>
</table>
| Primary Technical Contact | 2. Name: Dave Larson  
Organization: Bureau of Highway Construction – Pavements Section – Technology Advancement Unit  
Address: 3502 Kinsman Boulevard  
City: Madison  
State: WI  
Zip Code: 53704  
E-mail: david.larson@dot.state.wi.us  
Phone: 608-246-7950  
Fax: 608-246-4669 |
| Technology Description | 3. Name of Technology:  
Notched wedge longitudinal joint for hot mix asphalt (HMA) pavements (as a standard specification) |
| State of Development | 4. Briefly describe the technology.  
When constructing HMA pavements using conventional paving practices, it is often difficult to create a longitudinal joint with high densities on both sides. This density variation across the joint reduces the tensile strength of the pavement and leads to both longitudinal cracking and raveling. By constructing a notched wedge joint along the longitudinal edge of the pavement (12:1 taper, ½”–1” vertical notch), high densities are achieved on both sides of the joint and the density gradient is reduced, resulting in less longitudinal cracking and raveling. This joint is also much safer for traffic to traverse during construction. |
| | 5. Briefly describe the history of its development.  
Wisconsin first became involved with the notched wedge joint (based on the Michigan DOT’s design) when the National Center for Asphalt Technology (NCAT) and Auburn University initiated a longitudinal joint research study in 1992. As part of that research study, test sections were constructed in several states, including Wisconsin. Wisconsin continued to evaluate the notched wedge joint after the NCAT/Auburn study, with an additional WisDOT research study in 1993 and the implementation of a special provision specification in 1994. A standard specification for the notched wedge joint was implemented in 2004. |
| | 6. For how long and in approximately how many applications has your organization used this technology?  
Since the special provision specification was implemented in 1994, several of the contractors in the state began constructing the notched wedge joint. As of November of 2004, nearly all HMA pavements constructed in Wisconsin will use the notched wedge joint. |
| | 7. What additional development is necessary to enable routine deployment of the technology?  
No additional development is necessary to enable routine deployment of this technology. |
| Potential for Payoff | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
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<tbody>
<tr>
<td>Michigan DOT (MDOT)</td>
<td>Gary Mayes</td>
<td>517-322-3315</td>
<td><a href="mailto:MAYESG@michigan.gov">MAYESG@michigan.gov</a></td>
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</table>
| 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Benefit to Public (safety) and Contractor (scheduling): The tapered edge of the notched wedge joint is much safer for traffic to traverse during construction than the vertical drop-off created by the butt-type joint. Therefore, WisDOT does not set a time requirement for the adjacent lane to be paved when the butt-type joint was used, adjacent lanes were required to be paved so that they matched up at the end of the day).  
Benefit to WisDOT and Wisconsin Residents (cost savings): After 10 years, a notched wedge joint can reduce the amount of cracking at the longitudinal joint by 65 percent, compared to the conventional butt-type joint. The additional service life provided by the notched wedge joint can provide large savings in maintenance and rehabilitation costs. |

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Page 1
### Implementation Potential

**10. Please describe what actions another transportation agency would need to take to adopt this technology.**

Any state can use this technology by implementing a standard specification or a special provision for the notched wedge joint. Contractors will be able to easily adapt to the new specification, as the joint can be constructed with simple modifications to standard paving equipment. Commercial equipment is also available to construct the notched wedge joint.

**11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?**

The cost, effort, and time required to adopt the notched wedge longitudinal joint as a standard would be minimal, as it only involves the writing, approval, and distribution of a standard specification or special provision.

**12. What organization(s) currently supply and provide technical support for this technology?**

The Michigan DOT provided advice to WisDOT as the WisDOT specification for the notched wedge joint was drafted.

**13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.**

NA

**14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?**

☐ Yes ☐ No

**Date Submitted**

**15. Date:** July 30, 2004

**16. Please include image(s) of sketches or photographs, if available.**

Image(s) are attached

See Page 3 – CADDs Detail


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Please E-mail or Fax by August 27, 2004 to:

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<th>Jeremy Fissel</th>
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<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
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</tbody>
</table>
TYPICAL PAVEMENT CROSS SECTIONS OF
TAPERED AND NOTCHED LONGITUDINAL JOINTS

Cell name: 8
Description: TAPERED NOTCHED LONGITUDINALA
Scale: 1:10,062069 for 82400 UOR box
Range: (1123.6460, 1027.0210)
Cell type: Graphic
Levels: 51
Nested cells: 
Element types: 3,4,6,14,17
Linkage: No
Cell size: 46592 bytes (91.00 blocks)
SECTION 450 General Requirements for Asphaltic Pavements
450.3 Construction
450.3.2 Constructing Asphaltic Mixtures
450.3.2.8 Jointing

(1) Place all layers as continuously as possible without joints. Do not roll over an unprotected end of freshly laid mixture unless interrupting placement long enough for the mixture to cool. If interrupting placement, ensure proper bond with the new surface. Form joints by cutting back on the previous run to expose the full depth of the layer. After resuming placement, place the fresh mixture against the joint to form intimate contact and be co-planar with the previously completed work after consolidation.

(2) If an asphaltic mat adjoins an older high-type asphaltic mat, cut back the old mat on a straight line to form a butt joint for over full depth of the new mat.

Add three new paragraphs before existing 450.3.2.8(3) to require a notched wedge joint as the standard longitudinal joint for all mainline paving where the layer thickness meets the minimum layer thickness for the specified nominal size mixture.

(3) Construct notched wedge longitudinal joints for all mainline paving if the pavement thickness conforms to the minimums specified in 460.3.2, unless the engineer directs or allows an alternate joint. Taper each layer at a slope no greater than 12:1. Extend the taper beyond the normal lane width, or as the engineer directs. Ensure that tapers for all layers directly overlap and slope in the same direction.

(4) Place a 1/2 to one inch (13 to 25 mm) vertical notch at the top of tapers on all layers. Place the finished longitudinal joint line of the upper layer at the pavement centerline for 2-lane roadways, or at the lane lines if the roadway has more than 2 lanes.

(5) Construct the tapered portion of each layer using an approved strike-off device that will provide a uniform slope and will not restrict the main screed. Apply a weighted steel side roller wheel, as wide as the taper, to the tapered section. Compact the initial taper section to as near the final density as possible. Apply a tack coat to the taper surface before placing the adjacent lane.

(6) Clean longitudinal and transverse joints coated with dust and, if necessary, paint with hot asphaltic material, a cutback, or emulsified asphalt to ensure a tightly bonded, sealed joint.
# AASHTO Technology Implementation Group
## Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Federal Highway Administration</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Raymond A. Krammes  
Organization: Federal Highway Administration, Office of Safety Research and Development  
Address: 6300 Georgetown Pike  
City: McLean  
State: VA  
Zipcode: 22101  
E-mail: ray.krammes@fhwa.dot.gov  
Phone: (202) 493-3312  
Fax: (202) 493-3417 |
| **Technology Description** | 3. Name of Technology: Interactive Highway Safety Design Model (IHSDM) |
|  | 4. Briefly describe the technology.  
IHSDM is a suite of software analysis tools for explicit, quantitative evaluation of safety and operational effects of geometric design decisions during the design process for two-lane rural highways. IHSDM evaluates existing and proposed alternative highway geometric designs and provides quantitative information on their expected safety and operational performance. IHSDM can check designs against relevant design policy values, estimate the crash frequency expected for a specified geometric design, and estimate other safety and operational performance measures (e.g., 85th percentile speed and percent time spent following) that help diagnose factors that contribute to expected safety performance. There are five evaluation modules in the 2003 release of IHSDM for two-lane rural highways: policy review, crash prediction, design consistency, intersection review, and traffic analysis. |
|  | 5. Briefly describe the history of its development.  
IHSDM is a product of the Federal Highway Administration's Safety Research and Development Program. Conceptual planning began in 1992, research in 1993, and software development in 1997. In January 2003, the first public release of IHSDM was posted at www.ihsdm.org for testing and evaluation purposes. Several States are evaluating the use of IHSDM. Several consultants have used it in design studies for their State DOT clients. |
|  | 6. For how long and in approximately how many applications has your organization used this technology?  
The Federal Highway Administration's Western and Central Federal Lands Highway Division Offices received training approximately 1 year ago and, subsequently, started using IHSDM on projects. To date, IHSDM has been used on at least 4 projects. The Central Federal Lands Highway Division Office recently added IHSDM to their 30 percent checklist for 4R projects. |
|  | 7. What additional development is necessary to enable routine deployment of the technology?  
IHSDM will be expanded to match the crash prediction capabilities of the 1st Edition of the Highway Safety Manual, which is under development by TRB with research support from NCHRP, that will include two-lane rural highways, multilane rural highways, urban and suburban arterials. Work is underway with civil design software vendors (e.g., Autodesk and Bentley) to expand their data export capabilities to support IHSDM. |
|  | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
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<tr>
<th>Organization</th>
<th>Name</th>
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<tbody>
<tr>
<td>BMI-SG</td>
<td>Dan Nabors</td>
<td>703-847-3075, ext. 235</td>
<td><a href="mailto:dnabors@bmisg.com">dnabors@bmisg.com</a></td>
</tr>
<tr>
<td>CH2M Hill</td>
<td>Nick Antonucci</td>
<td>703-471-6405, ext. 4160</td>
<td><a href="mailto:Nick.Antonucci@ch2m.com">Nick.Antonucci@ch2m.com</a></td>
</tr>
<tr>
<td>Texas DOT</td>
<td>Elizabeth Hilton</td>
<td>512-416-2689</td>
<td><a href="mailto:elilton@dot.state.tx.us">elilton@dot.state.tx.us</a></td>
</tr>
<tr>
<td>Ontario, Canada, Ministry of Transport</td>
<td>Safia Ullah</td>
<td>613-545-4211</td>
<td><a href="mailto:safia.ullah@mto.gov.on.ca">safia.ullah@mto.gov.on.ca</a></td>
</tr>
</tbody>
</table>
|  | 9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
IHSDM results support more safety cost-effective geometric design decisionmaking on two-lane rural highway projects. |
### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology.

Typically, an agency would start by assigning an individual or design squad to evaluate IHSDM by applying it to a design project on a pilot basis. For wider implementation, actions include integration with the agency’s civil design software, developing State calibration factors, editing AASHTO Green Book policy tables to match the State’s design manual, and training staff.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

IHSDM is currently available for downloading free of charge from www.ihsdm.org. Technical support is also available free of charge. Approximately 1 person-month of staff time is required to customize the software to the agency. A 2-day training course offered by FHWA’s National Highway Institute is recommended for users.

12. What organization(s) currently supply and provide technical support for this technology?

Technical support is available free of charge from the Geometric Design Laboratory in the Office of Safety Research and Development of the Federal Highway Administration.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

There are no such issues.

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☑ Yes ☐ No

### Date Submitted

15. Date: 08/23/2004

16. Please include image(s) of sketches or photographs, if available ☑ Image(s) are attached
AASHTO Technology Implementation Group  
Nomination of Technology Ready for Implementation

Sponsoring DOT  
1. Sponsoring DOT (State): New Mexico Department of Transportation (NMDOT)

Primary Technical Contact  
2. Name: John H. Tenison, P.E.  
   Organization: NMDOT – State Materials Bureau  
   Address: P.O. Box 1149  
   City: Santa Fe  
   State: New Mexico  
   Zipcode: 87505  
   E-mail: john.tenison@nmshrd.state.nm.us  
   Phone: (505) 827-9811  
   Fax: (505) 827-5649

Name of Technology:  
Probabilistic Pavement Design Procedures using Data Derived Probabilistic Density Distributions

Briefly describe the technology.  
Many of the current probabilistic pavement design procedures assume that all input density distributions are normally distributed with recommended standard deviations that are directly associated with those distributions. This technology does not make this assumption and allows the actual field data to select one of twenty-six density distributions that best characterizes the range of actual field collected data and other design assumptions using the 1972 (for asphalt pavement designs) or 1994 (for Portland cement concrete pavement designs) AASHTO pavement design equations. These various probabilistic distribution inputs are then used to model many of pavement design and construction variations so that a more realistic pavement resign with a known reliability may be prepared with less variance in predicted performance life.

Briefly describe its development.  
After attending a meeting where the use of a probabilistic approach in analysis was demonstrated for life cycle cost analysis using an off-the-shelf commercially available add-on program to MS Excel, this same off-the-shelf add-on program was then adapted and customized to perform probabilistic pavement design analysis. The data that was selected to be represented by a probabilistic density distribution input were: newly constructed and existing layer thickness variations, uncertainty in design ESALs projections, and subgrade support strength variations. Many of these density distributions are not normally distributed as assumed to be the case in other current pavement design procedures. Once this work was completed, it has tested over a 4 month period and then adopted for use by the NMDOT for the design of all future pavement structures.

For how long and in approximately how many applications has your organization used this technology?  
NMDOT has used this technology for over 6 years and has design well over 400 pavement structures using this probabilistic based design procedure.

What additional development is necessary to enable routine deployment of the technology?  
None

Have other organizations used this technology? If so, please list organization names and contacts.

<table>
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<th>Organization</th>
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What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

According to AASHTO, for 2003, only 13 other states currently have pavements that are outperforming NMDOT’s. This is a vast improvement from 1995 where more than 40 other states had pavements that outperformed NMDOT’s pavements. It is anticipated that NMDOT will be in the top 10 states by 2006. Due to the reduced variability in predicted pavement performance of NMDOT’s pavements, less funding is being used to maintain them and this allows NMDOT to better address other system needs. It is felt by NMDOT that without the use of this procedure, projected 20-year pavement designs were only performing for approximately 12 to 14 years before major reconstruction may be required. Using this probabilistic based procedure, NMDOT now believes that projected 20-year pavement designs are performing for approximately 17 to 22 year before major reconstruction may be required.
10. Please describe what actions another transportation agency would need to take to adopt this technology.

The agency would need to purchase the off-the-self commercially available MS Excel add-on program. Once obtained and assuming the agency is using the AASHTO 1972 (for asphalt pavement designs) or 1994 (for Portland cement concrete pavement designs), NMDOT could provide the actual developed MS Excel worksheet and provide a train-the-trainer 2-day training class in its use at NMDOT’s main office in Santa Fe, New Mexico.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

The estimated cost is approximately $800. This cost would only cover the purchase of the commercially available add-on MS Excel program. Additional cost would be incurred for travel to NMDOT’s main office for training to use this procedure.

12. What organization(s) currently supply and provide technical support for this technology?

NMDOT could provide the training at no-cost. However, NMDOT will not provide any direct technical support in the use of this procedure, in the use or operation of MS Excel, in the use or operation of the add-on commercially available MS Excel program, or customization of this procedure for other pavement design procedures.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

None that could be identified.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? □ Yes □ No

15. Date: 6/1/2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached
### Sponsoring DOT
1. Sponsoring DOT (State): Texas

### Primary Technical Contact
2. Name: Caroline Herrera, P.E.
   Organization: Texas Department of Transportation
   Address: 9500 N. Lake Creek Pkwy.; Bldg 51
   City: Austin
   State: Tx
   Zipcode: 78717
   Phone: 512-506-5907
   Fax: 512-506-5915

### Technology Description
3. Name of Technology:
   Conductivity and colorimetric techniques for evaluation and determination of sulfate concentrations in soils.

4. Briefly describe the technology.
   The conductivity method is used as a field screening tool for the identification of potential sulfate-rich soils (TxDOT draft test procedure Tex-146-E). The colorimetric method is used for determining the actual level of sulfate concentrations in soils (TxDOT draft test method Tex-145-E).

5. Briefly describe the history of its development.
   Research project 0-4240, “Laboratory and Field Procedures for Measuring the Sulfate Content of Texas Soils,” evaluated various methods of measuring sulfate content of soils. Based upon 0-4240 recommendations, Implementation Project Recommendation (IPR) 5-4240 “Implementation of the Sulfate Equipment and Test Procedure” was initiated. The purpose of this IPR was to provide all the Districts in the State of Texas with the recommended equipment and test procedures for the evaluation and determination of sulfate concentrations in soils.

6. For how long and in approximately how many applications has your organization used this technology?
   TxDOT has been using the conductivity and colorimetric techniques for about 2 years. These techniques are being used for: soil investigation for future projects, detection of high sulfate potential on current construction projects, quality assurance, detection of sulfate levels of soils in the field prior to stabilization to determine stabilization options, and forensic evaluation of existing pavements suspected to have sulfate induced heave.

7. What additional development is necessary to enable routine deployment of the technology?
   None

### State of Development
8. Have other organizations used this technology? If so, please list organization names and contacts.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTI</td>
<td>John Pat Harris</td>
<td>979-845-5845</td>
<td><a href="mailto:pat-harris@tamu.edu">pat-harris@tamu.edu</a>.</td>
</tr>
</tbody>
</table>

### Potential for Payoff
9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.
   These two techniques have been used to monitor the sulfate level of projects. Based on an estimate that 10% of projects will be severely impacted by sulfate heave problems, the new test procedures can be used to detect and eliminate/minimize sulfate heave problems. This could add 25% to the life of a pavement. Given a typical 20 year design life, it is estimated that the benefits/savings realized by using these techniques could be in the order of $25 million per year.
<table>
<thead>
<tr>
<th>Implementation Potential</th>
<th>10. Please describe what actions another transportation agency would need to take to adopt this technology.</th>
<th>Adopt standard test methods, purchase equipment, and develop construction specifications and testing frequencies.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?</td>
<td>The cost for each unit with accessories is approximately $1500. The length of time required for procurement of equipment is minimal because it can be purchased from catalogs currently available from Thermo Electron Corporation and Fisher Scientific</td>
</tr>
<tr>
<td></td>
<td>12. What organization(s) currently supply and provide technical support for this technology?</td>
<td>TTI and TxDOT</td>
</tr>
<tr>
<td></td>
<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.</td>
<td>none</td>
</tr>
<tr>
<td>Willingness to Champion</td>
<td>14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?</td>
<td>Yes</td>
</tr>
<tr>
<td>Date Submitted</td>
<td>15. Date: August 2, 2004</td>
<td></td>
</tr>
</tbody>
</table>

16. Please include image(s) of sketches or photographs, if available □Image(s) are attached

Figure 1. Colorimetric Test Equipment
Figure 2. Conductivity Test Equipment

Please E-mail or Fax by August 27, 2004 to:
Jeremy Fissel
Program Manager for Engineering
AASHTO
Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org

This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)
Tex-146-E

Conductivity Field Test
<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Texas</th>
</tr>
</thead>
</table>
| Primary Technical Contact | 2. Name: Aurora (Rory) Meza, P.E.  
Organization: Texas Department of Transportation  
Address: 125 East 11 Street  
City: Austin  
State: Texas  
Zipcode: 78701  
E-mail: amezar@dot.state.tx.us  
Phone: 512-416-2678  
Fax: 512-416-3098 |
| Technology Description | 3. Name of Technology:  
The Quantm system |
| | 4. Briefly describe the technology. |
| | The Quantm system has been designed to support road and rail planners through the complex process of selecting corridors and alignments by allowing a holistic approach that simultaneously considers: terrain, geology, geometric/design standards, costs of bulk earthwork and major structures, crossing rules for existing features and infrastructure, environmental protection, cultural heritage and community values. The result is a more comprehensive 3-dimensional analysis of alternatives, significant construction cost savings, reductions in environmental impact and much improved public consultation. This approach has also demonstrated a considerable reduction in project planning time and enables project momentum to be maintained through fast turnaround of scenarios and “what-if” conditions. |
| | 5. Briefly describe the history of its development.  
The system, originally developed by the Australian Government's scientific agency CSIRO over ten years, has undergone 3 subsequent version releases with Quantm, and is the first technology to specifically address the complex task of route alignment selection. It is also an integrating technology that allows planners to utilize information from packages such as GIS, CAD and other transportation modeling systems in the route selection process. It won an Australian Technology Award in 2001. |
| | 6. For how long and in approximately how many applications has your organization used this technology?  
TxDOT began using the Quantm technology in 2003. There are currently 5 projects under contract using the Quantm application, including the I-69/Trans Texas Corridor project. |
| | 7. What additional development is necessary to enable routine deployment of the technology?  
None specifically to enable routine deployment but there is on-going development to improve functionality, incorporate user requests and broaden the technology's application to other type of linear infrastructure. |
| | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation Corridor Agencies</td>
<td>James Brown, P.E.</td>
<td>949-754-3428</td>
<td><a href="mailto:brown@sjhtca.com">brown@sjhtca.com</a></td>
</tr>
<tr>
<td>Bechtel SAIC Company</td>
<td>Woody Stroupe, P.E.</td>
<td>702-295-0742</td>
<td><a href="mailto:woody_stroupe@ymca.gov">woody_stroupe@ymca.gov</a></td>
</tr>
<tr>
<td>Caltrans</td>
<td>Robin Collins, P.E.</td>
<td>707-441-5868</td>
<td><a href="mailto:robin_collins@dot.ca.gov">robin_collins@dot.ca.gov</a></td>
</tr>
<tr>
<td>Pierce County, WA</td>
<td>Doug Thompson, P.E.</td>
<td>253-798-7250</td>
<td><a href="mailto:Dthomp1@co.pierce.wa.us">Dthomp1@co.pierce.wa.us</a></td>
</tr>
</tbody>
</table>

Comment: Rick Collins emailed nomination indicated to deleted this nomination.
<table>
<thead>
<tr>
<th>Potential for Payoff</th>
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| 9. **What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.**  
There is truly no technology to compare Quantm to. The Quantm application has allowed our project planners and designers the opportunity to determine preliminary corridors and then alignments in a much shorter period of time than by using conventional planning methods. The system also enables a planner to complete sensitivity analysis on an array of design criteria in a very short period of time to compare various alternative solutions to the same problem. TxDOT corridor studies are being conducted to ascertain the feasibility of a 1200 foot wide multi-modal corridor. The studies were based on highway and railroad geometric design constraints and environmental criteria. The results indicate that there is no appreciable difference between separating the highway and rail modes into separate corridors compared to including them in a single corridor. A study of this magnitude and detail would have taken months to complete using traditional or conventional planning. Instead this initial study was completed in a matter of weeks to provide TxDOT with the information they required to make important financial and planning based decisions. Quantm also has the unique ability to simultaneously integrate the engineering and environmental constraints of the project into the analysis and respond to changes in the various data inputs overnight like no other technologies. |

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<th>Implementation Potential</th>
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| 10. **Please describe what actions another transportation agency would need to take to adopt this technology.**  
**Terrain Data** is provided by the client and converted into a Quantm format, by Quantm’s technical team, as a base for the Quantm alternatives analysis. This data can come from many sources but the most common are standard USGS DEM models for early in the corridor studies followed by aerial photography, lidar survey, or other more detailed terrain models as the project progresses to more detailed alignment studies. Linear and polygon feature and constraint data is also provided in standard GIS and/or CAD formats for conversion into Quantm format.  
Quantm’s Client Services Engineers then provide training and support in the use of a front-end Quantm Integrator system through which the project engineers and planners access the automated Quantm alternatives analysis capability. Quantm Integrator is operated from the planners’ desktop or laptop computers and interfaces with the Quantm Pathfinder system (algorithms producing 20 or 50 alignment options per scenario processing run) via the Internet by way of small email attachments. |
| 11. **What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?**  
The cost, effort and time required is very little as the electronic terrain, feature and constraint data is required anyway for the conventional corridor study approach. Approximately one week is required for conversion of this data into the Quantm format and the initial corridor/alignment options are produced with the 5 day training program. |
| 12. **What organization(s) currently supply and provide technical support for this technology?**  
Quantm provides all training and support for all projects in the United States though its subsidiary company Quantm, Inc. |
| 13. **Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.**  
None currently |

<table>
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<tr>
<th>Willingness to Champion</th>
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| 14. **Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?**  
XX Yes ☐ No |

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<th>Date Submitted</th>
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<td>15. Date: 08/18/04</td>
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</table>
16. Please include image(s) of sketches or photographs, if available. Image(s) are attached.

50 options from “unseeded” optimization.

Options displayed over background image.
Plan, Profile and Dynamic Cross Section view of any alternative

Example of earthworks footprint impact on nominated environmental areas

This form is available electronically at http://www.aashtotig.org/solicitation/

Please E-mail or Fax by August 27, 2004 to:

Jeremy Fissel
Program Manager for Engineering
AASHTO

Phone: 202.624.3640
Fax: 202.624.5469
jfissel@aashto.org
### Sponsoring DOT

1. **Sponsoring DOT (State):** New Hampshire

### Primary Technical Contact

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zipcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill Hauser</td>
<td>New Hampshire Department of Transportation</td>
<td>7 Hazen Drive</td>
<td>Concord</td>
<td>NH</td>
<td>03302-0483</td>
</tr>
</tbody>
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<tr>
<th>E-mail</th>
<th>Phone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:Bhauser@dot.state.nh.us">Bhauser@dot.state.nh.us</a></td>
<td>(603) 271-3226</td>
<td>(603) 271-7199</td>
</tr>
</tbody>
</table>

### Technology Description

#### 3. Name of Technology:

Risk Assessment for Site Contamination and Appraisal of Land (RASCAL) and Inventory of Managed Properties (IMP)

#### 4. Briefly describe the technology.

The New Hampshire Department of Transportation (NHDOT) has implemented a system of integrated handheld computers and web-based data management to support a contaminated property valuation policy for prospective and currently owned properties. NHDOT project development policy necessitates that 1) all properties potentially affected by design projects be screened for hazardous materials (hazmat) issues, and 2) this screening be performed as early as possible in project planning to maximize the time available for assessment of contamination and to allow for the incorporation of this data into purchasing decisions, route selection, construction planning, and health & safety plan preparation. NHDOT operations policy requires that all NH DOT properties be screened and all environmental concerns are recorded. The technology for both programs is identical and consists of personal digital assistants (PDAs) running custom site-screening checklist software. The program also stores digital photographs and GPS coordinates collected from hardware that integrates directly with the PDA. Prior to mobilizing to the field, site screeners download pertinent information to the PDA about the properties to be evaluated, from a web-based database. This information is linked with the NHDOT right-of-way database. Upon completing the screening, data is uploaded from the PDA to the web database and is managed and analyzed through user-friendly graphic interfaces and reporting functions.

#### 5. Briefly describe the history of its development.

The development began with a comprehensive User Needs Assessment, with extensive discussions and process mapping performed with the Bureau of Environment and NHDOT’s IT Services. A consultant to the NHDOT that performs environmental assessments and also maintains a software development group has spearheaded the development. The Bureau of Environment and IT Services each designated project managers to work with the design team to ensure that quality and user needs were addressed throughout the development. The development of the RASCAL application software took approximately one year. The development of the IMP program was done in several weeks, as the database was an exact duplicate of the technology used for RASCAL. The aggressive timeline was largely due to the number of personnel involved, and the continuous testing throughout the programs development. Since their debut, both projects have been met with enthusiasm, understanding and affirmation of the need for the tool. The implementation of both programs has helped identify some important issues related to required training and user operations revisions.
For how long and in approximately how many applications has your organization used this technology? The RASCAL program has been in use for roughly 1 year and has been used on roughly twenty different current and past projects throughout the state. Currently, IMP has solely been used in the documentation of hazardous waste inventories, remediation and issues for each of the DOT maintenance facilities throughout the state. However, it will soon be used to document stormwater management and cultural resource issues at all DOT owned sites around the state.

What additional development is necessary to enable routine deployment of the technology? RASCAL does not currently require any additional development aside from routine maintenance and the addition and removal of projects as they cycle through various stages of development. However, future plans for the RASCAL system include the addition of historical, archeological, wetlands, and existing structure information to the database, which may require several minor adjustments. While these upgrades are still under development, documents relating to non-hazardous materials issues may be added under each parcel. Documents uploaded to the system may include aerial photographs, Sanborn and topographic maps, site maps, wetlands permits, and other written documents. A Global Positioning System (GPS) that is built into the PDA locates each parcel and may easily be linked to the NHDOT Global Information System (GIS). In addition, RASCAL provides a direct link to the New Hampshire Department of Environmental Services (NHDES) website. Upon completion, authorized users will be able to access multiple aspects of a specific project on a single database quickly, easily, and efficiently.

Currently the technological side of IMP does not require any further development. The IMP project requires the addition of other state owned properties as well as stormwater and cultural resource data. Both projects have already been deployed and been in use for nearly one year.

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<tr>
<th>State of Development</th>
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<tr>
<td>6. For how long and in approximately how many applications has your organization used this technology? The RASCAL program has been in use for roughly 1 year and has been used on roughly twenty different current and past projects throughout the state. Currently, IMP has solely been used in the documentation of hazardous waste inventories, remediation and issues for each of the DOT maintenance facilities throughout the state. However, it will soon be used to document stormwater management and cultural resource issues at all DOT owned sites around the state.</td>
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<td>7. What additional development is necessary to enable routine deployment of the technology? RASCAL does not currently require any additional development aside from routine maintenance and the addition and removal of projects as they cycle through various stages of development. However, future plans for the RASCAL system include the addition of historical, archeological, wetlands, and existing structure information to the database, which may require several minor adjustments. While these upgrades are still under development, documents relating to non-hazardous materials issues may be added under each parcel. Documents uploaded to the system may include aerial photographs, Sanborn and topographic maps, site maps, wetlands permits, and other written documents. A Global Positioning System (GPS) that is built into the PDA locates each parcel and may easily be linked to the NHDOT Global Information System (GIS). In addition, RASCAL provides a direct link to the New Hampshire Department of Environmental Services (NHDES) website. Upon completion, authorized users will be able to access multiple aspects of a specific project on a single database quickly, easily, and efficiently. Currently the technological side of IMP does not require any further development. The IMP project requires the addition of other state owned properties as well as stormwater and cultural resource data. Both projects have already been deployed and been in use for nearly one year.</td>
</tr>
<tr>
<td>8. Have other organizations used this technology? If so, please list organization names and contacts.</td>
</tr>
<tr>
<td>Organization</td>
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<tr>
<td>---------------</td>
</tr>
<tr>
<td>Jacques Whitford</td>
</tr>
<tr>
<td>GEI Consultants</td>
</tr>
<tr>
<td>Vanasse Hangen Brustlin</td>
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<tr>
<td>Normandeau</td>
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</table>
9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

The policy to screen all properties potentially impacted by a project or currently owned by the state has increased the volume of hazmat data being collected and managed. It has also placed more emphasis on early detection than previous approaches to identification and assessment. A robust site screening protocol was developed to collect preliminary field observations of hazmat sources and receptors. The result of this technology has reduced the time spent on site, and standardized data collection and reporting performed by consultants.

To support the protocol, the field data collection application was developed for use on PDAs. The PDA software standardizes site-screening data, improves data completeness and quality, and reduces time delays from fieldwork to data reporting. Since digital photographs and GPS data are captured using integrated hardware, and are stored directly to the database upon collection, there is no sorting, labeling, and management of this information following field work.

Both web-based databases are protected by password security, allowing consultants and NHDOT employees to access the database from outside the NHDOT firewall. The database is dynamically linked to the Bureau of Right-of-Way, ensuring that property information is kept accurate and redundancy of data is eliminated. NHDOT also has the ability to control dataflow between its servers and the external web-site to maintain security of the systems. Functionality built into the graphic user interface on the web calculates “risk scores” for each property and prioritizes all of the sites within a corridor, flagging key hazmat issues. The developed technology provides the NHDOT with better and faster data from the initial phases of a project; the ability to “triage” sites based on their calculated risk rankings and flags; and the capability to manage contaminated sites from identification through remediation within the web application.

IMP also has the added advantage of allowing DOT to easily communicate with the state’s Department of Environmental Services (DES). By allowing DES to view this data at their leisure, minor incidents do not need to be reported directly to the department, as long as the occurrence is posted on the database. This helps eliminate several sets of paperwork, which would normally need to be prepared for both NHDOT and NHDES.
10. Please describe what actions another transportation agency would need to take to adopt this technology.

Both applications should be implemented simultaneously with a User Needs Assessment for the user groups. It is relatively easy to customize the applications and both will be most successful if it satisfies the needs of the user, which may vary from state to state.

The ease of the technology implementation depends on the scale of the application, the number of users and the user-specific features developed. The availability of developers with enough knowledge of site assessment and programming to translate between users and programmers may be limited. The application is designed to be user friendly, and as a result, there is relatively little training required. The web applications are intuitive, and the PDAs require a minor amount of practice to operate with speed. PDAs are available for about half the cost of a laptop computer.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

The costs associated with the implementation of the technology are borne by the implementing agency, which is also the primary user. The initial development costs for these programs were $85,000 for RASCAL and $30,000 for IMP. However, since these programs have been previously developed for NHDOT, the cost of implementation to another state agency would likely be about $30,000-40,000, depending upon the number and complexity of necessary changes requested by the new agency.

Maintenance costs include the periodic replacement of PDAs ($400-$600) that are lost or damaged (this may be passed on to outside consultants if they are directly responsible). Some DOTs may have an available external web server, in which case they will not need to pay to maintain the web-based service. However, this can be an additional cost should the state need to purchase or rent this technology. The annual maintenance and rental of an external server cost NHDOT $10,000 for RASCAL and $5,000 for IMP, depending mainly on each program’s size.

The timeframe for implementation would also depend somewhat on the customization required by the end user. A system could be implemented in as little as 2-3 months if substantial changes from the version developed for NHDOT were not required. Integration with different existing systems (e.g. the NHDOT Right-of-Way database in this instance) can require some substantive discussion and testing.

12. What organization(s) currently supply and provide technical support for this technology?

Jacques Whitford developed the software and has indicated a willingness to promote and support implementation. Possibilities include developing similar solutions or customizing the NHDOT version for other states.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

We are not aware of any implications.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? _X_ Yes __ No
Date Submitted 15. Date: August 25, 2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached

This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)

Please E-mail or Fax by August 27, 2004 to:

<table>
<thead>
<tr>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Manager for Engineering</td>
<td>Fax: 202.624.5469</td>
</tr>
<tr>
<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
</tr>
</tbody>
</table>
**AASHTO Technology Implementation Group**  
**Nomination of Technology Ready for Implementation**

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): Georgia Department of Transportation and FHWA Office of Safety</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Christopher Wagner  
Organization: Federal Highway Administration  
Address: 61 Forsyth Street SW, Suite 17T26  
City: Atlanta State: Georgia Zipcode: 30303  
E-mail: christopher.wagner@fhwa.dot.gov Phone: 404-562-3693 Fax: 404-562-3700 |
| **Technology Description** | 3. Name of Technology:  
The Safety Edge |
|  | 4. Briefly describe the technology.  
One major concern for driver safety on two lane undivided highways is vertical dropoff between the paved surface and the unpaved shoulder. One solution to this problem is to form a thirty-degree tapered transition at the edge of the paved surface called the “safety edge”. A safety edge provides an easily traversable transition for an errant vehicle to reenter the travel lane from the unpaved shoulder. |
|  | 5. Briefly describe the history of its development.  
After realizing the need for a low-cost solution to pavement edge dropoff the Federal Highway Administration Office of Safety worked with the Georgia Department of Transportation in the development of the safety edge. The FHWA Division and Resource Center administered this research project and documentation in coordination with the Georgia Department of Transportation (GDOT). After a successful development of the hardware needed to create the safety edge and completion of the pilot project, GDOT is pursuing implementation of the Safety Edge on a Statewide basis.  
Other states including Indiana, New York, North Carolina, and California are constructing pilot projects to quantify the safety benefits of the safety edge. |
| **State of Development** | 6. For how long and in approximately how many applications has your organization used this technology?  
The Safety Edge has been used in Georgia for approximately one year and is being implemented on a statewide basis beginning in 2005. |
|  | 7. What additional development is necessary to enable routine deployment of the technology?  
No additional development is needed in order to deploy this technology. State and Local Highway Agencies will need to specify the safety edge in project contracts. Literature documenting the hardware, construction, and durability of the safety edge is available from the FHWA Office of Safety. |
|  | 8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
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<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Indiana</td>
<td>Elizabeth Pastuszka</td>
<td>317-610-7251</td>
<td><a href="mailto:epastuszka@indot.state.in.us">epastuszka@indot.state.in.us</a></td>
</tr>
<tr>
<td>New York</td>
<td>David J. Clements</td>
<td>518-457-3537</td>
<td><a href="mailto:dclements@dot.state.ny.us">dclements@dot.state.ny.us</a></td>
</tr>
</tbody>
</table>
**Potential for Payoff**

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

Although the safety benefits of the safety edge have not been quantified, the benefit of a tapered edge on vehicle reentry to the paved travel way has been well documented in past research. The cost of implementation of the safety edge is negligible and therefore the benefit to cost ratio is believed to be very high.

Research to quantify the safety benefits of the safety edge in terms of crash reduction and saved lives is currently underway through a multi-state NCHRP pooled fund study.

---

**Implementation Potential**

10. Please describe what actions another transportation agency would need to take to adopt this technology.

Transportation agencies will need to fabricate or buy the commercially available safety edge hardware, instruct contractors on its use, and specify its use in applicable projects.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

This technology can be implements at less that 1% additional asphalt material cost. The hardware is available commercially for less than $2000 or can be fabricated for under $500.

12. What organization(s) currently supply and provide technical support for this technology?

The FHWA Office of Safety has available material documenting the cost, construction, and benefits of the safety edge design and hardware.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

None.

---

**Willingness to Champion**

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?  

- [x] Yes  
- [ ] No

Date Submitted: 15. Date: 8/25/04

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16. Please include image(s) of sketches or photographs, if available. 

Image(s) are attached

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This form is available electronically at [http://www.aashtotig.org/solicitation/](http://www.aashtotig.org/solicitation/)

Please E-mail or Fax by August 27, 2004 to:

<table>
<thead>
<tr>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
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<tbody>
<tr>
<td>Program Manager for Engineering</td>
<td>Fax: 202.624.5469</td>
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<tr>
<td>AASHTO</td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
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</table>
# AASHTO Technology Implementation Group
## Nomination of Technology Ready for Implementation

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<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): MT</th>
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<tbody>
<tr>
<td><strong>Primary Technical Contact</strong></td>
<td>2. Name: Pat Basting  Organization: Montana Department of Transportation  Address: 2100 West Broadway  City: Missoula  State: Montana  Zipcode: 59802  E-mail: <a href="mailto:pbasting@state.mt.us">pbasting@state.mt.us</a>  Phone: (406)-523-5872  Fax: (406)-523-5801</td>
</tr>
<tr>
<td><strong>Technology Description</strong></td>
<td>3. Name of Technology:  Culvert animal shelves, wildlife crossing structures, small mammals.</td>
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</table>
4. Briefly describe the technology.

(MDT) modified several culverts placed along wetland zones to include a ramp and walkway-shelf. The hope was that small animals might use such platforms to move through the culverts even when water was present. Our preliminary research suggested that certain species [e.g., raccoons, striped skunks, short-tailed weasels (Mustela erminea), deer mice (Peromyscus maniculatus)] routinely used these culverts to traverse the highway while others, such as the meadow vole (Microtus pennsylvanicus), which is the most abundant species living adjacent to the culverts, did not use them. In addition, species which used the culverts are influenced by water in the culvert, opting to use the shelf when water was present. Additionally, live-trapping data suggested that vegetation within the barrow pits significantly affected species distributions and that areas at the entrances of culverts which are devoid of vegetation limited animal movement to the culverts.

Montana Department of Transportation installed animal shelves in 3 1.2 m diameter steel drainage culverts during construction of the Lolo South segment of Highway 93. We paired each of these culverts with an adjacent culvert, not containing shelving, which then served as an experimental control [designated as Carleton Creek Experimental and Control (CCE and CCC), Gravel Pit Experimental and Control (GPE and GPC), and Maclay Flat Experimental and Control (MCE and MCC); MCC was subsequently found to be continually flooded and was removed from further study]. These remaining 5 culverts served as the primary focus of this research and will be referred to as the “main culverts” throughout this report. As this research progressed, the number of culverts monitored on a daily basis increased to 12 (including culverts on I90 and Highway 203), spanning a wide range of sizes and configurations. Two of these additional culverts [Gravel Pit Large (GPL) and Bass Creek Large (BCL)] were also eventually retrofitted with modified animal shelving.

Our preliminary research suggested that modifications would be needed in the shelf design, in particular the floor surface and the entrance ramp. To address the floor surface, 2 diamond mesh sizes (25 mm and 12 mm), and one solid surface (heavy gauge polypropylene truck bed liner), were subsequently tested. Entrance ramps were repositioned upwards and a prototype of an entrance ramp design fabricated out of wood and extruded sheet metal was tested on all shelves.

Figure 1. Original culverts, (a) and (b), and 25 mm diamond shelving (c).
5. Briefly describe the history of its development.

This is the final report for research which was begun in January, 2001 summarizing an 8 month pilot project along the Lolo South Project from Lolo to Florence, Montana. When highways bisect wetland habitats small diameter culverts are often used to provide drainage so that water does not erode the roadbed. During periods when these drainage culverts carry water animal use is prohibited. In order to provide a travel corridor for small animals under the highway during periods of high water, ramp/shelf structures were mounted inside such drainage culverts. The stated goals of this research were to compare small mammal use of drainage culverts with (experimental) and without (control) these animal walkways (Fig. 1). Animal activity in 3 paired sets of culverts (Fig. 2) was monitored on a daily basis using roof-mounted remote sensing cameras (TrailMaster®). Animal populations adjacent to the culverts were assessed by live trapping along transect lines (Sherman traps) so that a comparison could be made between the species actually using each culvert and those present. Activity patterns were assessed on a temporal basis as well as in correlation with temperature, light, and humidity levels. Such an approach allowed for an analysis of seasonal variation in animal presence and activity patterns. Vegetative changes between spring and summer were also noted at each culvert.

6. For how long and in approximately how many applications has your organization used this technology? Experimental designs began in 2001 with modifications continuously occurring until Fall 2003/Spring of 2004. We will now be incorporating these culverts into road projects in appropriate placement locations statewide.

7. What additional development is necessary to enable routine deployment of the technology?

None. A co-patent is being applied for by the University of Montana and Roscoe Steel Co.. Once the design is given a patent number this technology will be available to DOT's and FHWA nationwide.

8. Have other organizations used this technology? If so, please list organization names and contacts.

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![Image of culvert containing a ramp/shelf animal walkway and one not containing a walkway](image)
### AASHTO Technology Implementation Group
#### Nomination of Technology Ready for Implementation

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<th>Potential for Payoff</th>
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| 9. **What benefits has your organization realized from using this technology?** Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

By funding this research and actively participating in its development and implementation, MDT has improved public relations by showing a willingness to be proactive, try new applications, improve wildlife habitat connectivity, and have this research presented to a multitude of state, federal and tribal agencies, national and international audiences. The Colorado DOT is presently funding research for a threatened or endangered meadow jumping mouse to see if these “critter ramps” can mitigate highway construction impacts to that particular species in that state. As more and more species get listed on the threatened and endangered species list across the country, many of them are small invertebrates, mammals or insects. This technology can be placed either in new culverts or it can be retro-fitted into existing culverts at a relatively small cost.

| 10. **Please describe what actions another transportation agency would need to take to adopt this technology.** Accept philosophy and use of critter ramps and implement it into future construction projects or retro-fit existing culverts.

| 11. **What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?**

Lineal foot price for “Critter Crawls” is running about $90.00 foot. This includes the angle that attaches to pipe, cables, hooks and the panels. All material is galvanized.

| 12. **What organization(s) currently supply and provide technical support for this technology?**

MDT, University of Montana, Roscoe Steel & Culvert Company
5405 Momont Road, Missoula, Montana 59808
Cory W. Clausen; Missoula Culvert Sales Mgr.
Email: cclaussen@roscoesteel.com

| 13. **Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.** Co-Patent Pending between University of Montana and Roscoe Steel and Culvert Company.

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<th>Willingness to Champion</th>
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| 14. **Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation?**

X Yes  [] No

<table>
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<tr>
<th>Date Submitted</th>
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</table>
| 15. Date: August 10, 2004

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16. Please include image(s) of sketches or photographs, if available (Yes) Image(s) are imbedded in document
## Sponsoring DOT

1. **Sponsoring DOT (State):** Iowa Department of Transportation

## Primary Technical Contact

2. **Name:** Dennis Burkheimer, Winter Operations Administrator  
   **Organization:** Iowa Department of Transportation, Office of Maintenance  
   **Address:** 800 Lincoln Way  
   **City:** Ames  
   **State:** Iowa  
   **Zip code:** 50010  
   **E-mail:** Dennis.Burkheimer@dot.state.ia.us  
   **Phone:** 515-239-1355  
   **Fax:** 515-239-1005

## Technology Description

3. **Name of Technology:**  
   The Maintenance Decision Support System (MDSS)  
   **Principal Technical Contact:** Paul Pisano (paul.pisano@fhwa.dot.gov, 202-366-1301)

4. **Briefly describe the technology.**  
The MDSS is a prototype system that was designed with the goal of bringing advanced winter maintenance decision support to state Department of Transportation (DOT) garage supervisors. The MDSS combines state-of-the-art weather forecasting technologies (e.g., numerical weather prediction) with customized winter maintenance rules of practice. MDSS output consists of a combination of detailed route-specific weather forecasts and road treatment recommendations. The treatment recommendations have been optimized to maintain the highest road mobility while making the most efficient use of equipment and chemical applications.

The MDSS prototype is a complex integration of numerous components. The system was designed so that a private sector weather service provider could select one or more components for integration into their product line so that improved services could be offered to the state DOTs. The main components of the MDSS prototype are:

- **Numerical Weather Prediction (NWP) Module:** The NWP module consists of high resolution weather models that are run over a region of interest (such as the central plains or the upper Midwest). These models provide a more accurate and fine-tuned set of predictions than those available by national scale models run by the National Weather Service (NWS). These models also take advantage of state DOT Road Weather Information Systems (RWIS) as valuable input during their initialization phases.

- **The Road Weather Forecast System (RWFS) Module:** The RWFS is a data fusion module that accepts many different types of weather input and provides forecast information as output that is better than any individual input using advanced ensembling methods.

- **The Road Condition and Treatment Module (RCTM):** The RCTM contains algorithms that assist in the recommendation of treatments. These include:
  - **Road Temperature Prediction Module:** This module provides both road temperature and snow accumulation forecasts.
  - **Chemical Concentration Module:** This module uses chemical eutectic curves to predict chemical concentrations and freeze point temperatures on roadways.
  - **Rules of Practice Module:** This module is fully customizable and takes all of the predictions from the above modules and applies them to garage and route-specific treatment rules. The output consists of a set of recommendations on treatment type, timing and application rate for each maintenance route.

- **The Graphical User Interface (GUI):** The GUI is the only application that runs in the state DOT maintenance facility. A team of state DOT representatives worked with engineers to develop a display that was easy to navigate and interpret and did not require a degree in meteorology to use. The result is a set of displays that provides route-specific road weather forecasts and treatment recommendations in an intuitive and colorful way. Figures 1 through 9 (below in section 16) provide some examples of the GUI.

The MDSS prototype contains a powerful tool for running “what-if” scenarios. The MDSS treatment generator allows the user to change the treatment times, chemical type, and application amount to see what the resulting conditions would be on the road surface. Figure 7 (below in section 16) shows that changing one or more of these parameters may change snow or ice accumulation amounts, the chemical concentration and the resultant forecast of roadway mobility.
The MDSS is now at a maturity point so that it can benefit from more outreach, exposure and education to the greater community. We are looking to a process such as AASHTO TIG to assist in championing this new technology to industry.

5. Briefly describe the history of its development. 

The MDSS concept originated with research conducted by the FHWA under the rural Intelligent Transportation System (ITS) Program of the ITS Joint Program Office. In 1998, a FHWA white paper recognized the need for integrated decision support for surface transportation managers. The project, then named the WIST-DSS (Weather Information for Surface Transportation – Decision Support System) sponsored an initiative to address the problems and program recommendations cited in the white paper. This effort, which began in 1999, was called the Surface Transportation Weather Decision Support Requirements (STWDSR) project.

The premise for the STWDSR process was that groups representing all facets of program development needed to be brought together to form a diverse stakeholder group. The core of the stakeholder group included state DOT practitioners, developers from national laboratories, interested academics from the university community, with private sector service providers rounding out the group. In early 2000, representatives from 28 states gathered in Boulder, CO to begin the requirements process. A series of weather scenarios were presented and extensive surveys were collected and analyzed. In mid 2000, a second stakeholder meeting took place to review the requirements and make sure that the stakeholder’s needs and concerns were addressed. These requirements became the basis and genesis for an evolutionary development cycle.

Since 2000, the MDSS stakeholders have held meetings annually to review the project progress and to ensure that the output remained intuitive and usable by DOT practitioners. In 2001, the national labs began their development by creating conceptual storyboards. From the storyboards, a self-contained prototype was created and demonstrated to the stakeholders in 2002. A small group of state DOT stakeholders formed a subcommittee to meet with the development engineers to make sure that the GUI would be understood by state DOT garage personnel. During the summer of 2002, a competition took place to find a proactive and cutting-edge state DOT to host the rapidly evolving MDSS prototype. The winner was the Iowa DOT (IADOT). Garages in Des Moines and Ames were selected for prototype demonstration and evaluation.

The first field demonstration of the operational prototype occurred during the winter of 2002-2003. Workstations were set up at three IADOT maintenance garages (Des Moines North, Des Moines West and Ames). National lab representatives traveled to Iowa and provided extensive training to the garage operators. The demonstration lasted 2 months and provided a wealth of lessons. These lessons were presented to stakeholders at the annual MDSS meeting that was held in Des Moines during the summer of 2003. Lessons from the first demonstration and advice from the stakeholder community provided the seeds for many changes that were implemented for a second field demonstration during the winter of 2003-2004. Changes were made to the weather forecasting models, a new blowing snow algorithm was created and 8 IADOT plows were fitted with new Global Positioning System/ Automated Vehicle Location (GPS/AVL) devices. The GPS/AVL units provided truck location, speed, application type, application rate, blade position and air temperature every 10 seconds or 1000 feet. These new datasets will be used to enhance verification. In addition, representatives from the national laboratories were in Iowa during the entire demonstration to experience operations in a maintenance garage and to help collect verification information.

The MDSS prototype project has taken on a life of its own as one of the premiere road weather management initiatives. Papers and presentations have been delivered at dozens of conferences during the course of the project. The stakeholder process has been hailed as a major success as gauged by consistent participation by over half of the states during the development of the system. The number of private sector companies that routinely attend the stakeholder meetings and order the project software continues to grow. Several private companies have begun to tailor MDSS for state DOT customers based upon their specific operational needs. One company is currently working with a consortium of state DOTs that have pooled funds to create an operational MDSS for winter maintenance managers in five states.
The 2004 MDSS stakeholder meeting is expected to be the largest to date. In addition to presenting results from the second demonstration and providing a forum for private sector companies a 2-day technology transfer workshop will be held. The workshop will provide technical background, tutorials and examples on how companies could integrate MDSS prototype modules into their product lines for state and local DOT customers.

6. For how long and in approximately how many applications has your organization used this technology? The MDSS prototype has been in development since early 2000 under the direction and funding of the FHWA. Two operational demonstrations were held in central Iowa during the winters of 2002-2003 and 2003-2004. Operational workstations were installed in IADOT maintenance garages during the demonstrations. Development personnel traveled to Iowa during the demonstration and had routine interaction with the garage supervisors for both training and evaluation. Lessons learned from the first demonstration were presented at the 2003 MDSS stakeholder meeting. Results from the second demonstration will be available at the 2004 MDSS stakeholder meeting in Boulder in July. Preliminary results (from interviews with visiting lab personnel) indicate that the MDSS prototype continues to develop and has added value to IADOT winter maintenance operations.

7. What additional development is necessary to enable routine deployment of the technology? The MDSS prototype has been created in a modular form. This means that interested companies can take only those pieces of the total system that they feel will benefit their product line. Software engineering expertise will be required to understand software interface and customization issues. A technology transfer workshop will be held during the 2004 MDSS stakeholder meeting to allow private sector developers to interact directly with national laboratory engineers. All of the MDSS prototype software, including documentation, will be made available to anyone during the fall of 2004 (MDSS CD Release 3.0). The MDSS Web Site may be accessed at http://www.rap.ucar.edu/projects/rdwx_mdss/index.html

8. Have other organizations used this technology? If so, please list organization names and contacts. The list below contains names of individuals at IADOT and MNDOT facilities that have had training on the system and participated in the demonstration. However, a "restricted-access" version of the software was made available for download to anyone on the internet. Numerous state DOTs and companies have downloaded this application. If needed, information from the registration list may be made available to AASHTO to contact these individuals once permission has been granted.

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<tr>
<td>IADOT Ames Garage</td>
<td>Paul Durham</td>
<td>515-232-8226</td>
<td><a href="mailto:Paul.durham@dot.state.ia.us">Paul.durham@dot.state.ia.us</a></td>
</tr>
<tr>
<td>IADOT Des Moines North</td>
<td>Ed Mahoney</td>
<td>515-265-1614</td>
<td><a href="mailto:Edward.mahoney@dot.state.ia.us">Edward.mahoney@dot.state.ia.us</a></td>
</tr>
<tr>
<td>IADOT Des Moines West</td>
<td>Rich Hedlund</td>
<td>515-986-5726</td>
<td><a href="mailto:Richard.hedlund@dot.state.ia.us">Richard.hedlund@dot.state.ia.us</a></td>
</tr>
<tr>
<td>Minnesota DOT</td>
<td>Curt Pape</td>
<td>651-297-1798</td>
<td><a href="mailto:Curt.Pape@dot.state.mn.us">Curt.Pape@dot.state.mn.us</a></td>
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9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

The MDSS provides optimized guidance that includes treatment start times, chemical types, and application rates. The treatment recommendations also provide forecasts of roadway mobility. During the second demonstration, some of the IADOT garages followed the MDSS treatment recommendations and found that they kept the roads clear of accumulated snow. If used routinely, the MDSS could provide a cost savings by potentially reducing the number of plow passes (saving wear and tear on equipment and infrastructure) and minimizing the amount of treatment chemicals needed to maintain bare pavement and adequate levels of service. This could provide a greater factor of safety as well as provide environmental benefits from reduced use of chemicals. The MDSS also has the added benefit of providing hourly forecasts of precipitation type, precipitation start and stop times, wind speeds and snow accumulation.

The IADOT Office of Maintenance has estimated that advances provided by the MDSS prototype in improved weather forecasts and treatment recommendations could easily translate into a ten percent reduction in operating expenses. This would translate into significant savings over the state’s $35 million winter maintenance budget. Additional savings could be realized in the following ways:
### AASHTO Technology Implementation Group

**Nomination of Technology Ready for Implementation**

<table>
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<td>10. Please describe what actions another transportation agency would need to take to adopt this technology.</td>
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<tr>
<td>The MDSS technology, as it was configured in the most recent demonstration, requires only a PC and a dedicated internet connection. (Wideband is better for downloading software updates). All of the other hardware and processing took place remotely at national lab facilities. It is envisioned that in the future, operational MDSS processing such as that which took place at the national labs will be handled by a private sector vendor. It will be up to individual vendors to determine how much of the MDSS functionality should be made available to the state DOTs based upon their specific operational requirements. If transportation agencies desire MDSS capabilities, they would likely contract with private sector weather providers to deliver MDSS services for a specified contract period.</td>
</tr>
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| 11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? |
| Once a private sector company has included MDSS capabilities into their product line, the only cost and effort that would be incurred would be in gathering customization data, training users and making sure that the PC and communications infrastructure is in place. It is estimated that it would take approximately 6 months to 1 person-year for a private sector company to integrate MDSS technologies into their product line depending on the total number of modules utilized. Once this initial integration is completed, the agency would be in a position to make them available to multiple transportation agencies. Tailoring and configuring the system for a specific transportation agency should take 15-30 person days depending on the number of plow routes. |

| 12. What organization(s) currently supply and provide technical support for this technology? |
| Technical support is currently being provided by a consortium of national laboratories with funding from FHWA. Some level of technical support and funding will continue to be provided into FY05. However, once private sector companies implement MDSS capabilities, it will be up to the company to provide technical support to state agencies. |

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<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.</td>
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<td>All MDSS prototype software and documentation is provided free of charge (as public domain) on a non-exclusive basis except for one module. The core data fusion portion of the Road Weather Forecast System is a proprietary system owned by the University Center for Atmospheric Research (UCAR). The RWFS is available for free to government agencies. It is available for a one-time charge of $15K for commercial use in surface transportation applications. Note, the MDSS can be configured to operate without the RWFS module, so in this configuration, the system is freely available.</td>
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| 14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? | ☑ Yes ☐ No |
| The MDSS has already been promoted and supported by not only the sponsoring DOT, but other DOTs that make up the MDSS Stakeholder Group. |

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<td>15. Date: 03/30/2004</td>
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16. Please include image(s) of sketches or photographs, if available. Images are attached:

Welcome to the MDSS Main Screen Display. It is composed of 4 main parts:

- **Road & Weather Alerts**
- **Weather Parameters**
- **State Alerts and Local Routes**
- **Time Selection and Animation**

Figure 1 – The MDSS Main Screen Display
Figure 1 shows the opening screen of the MDSS demonstration prototype. It consists of four sections. At the top left, weather, road and blowing snow alerts can be seen for the next 48-hour period. A description of the alert color definitions can be found by clicking on the alert legend. At left center is a series of radio buttons that show forecast weather elements and current RWIS observations. The road weather elements range from forecasts of air temperature and dew point to precipitation type and accumulated snowfall. The top right screen shows the weather alert categories over the entire state of Iowa. White boxes over portions of central Iowa are portals that lead to local route displays for Des Moines and Ames. The bottom section shows the animation control. This function allows the user to either look at forecasts in one hour increments or provides a looping capability throughout the entire forecast period.
Weather parameters can be displayed on the state and route maps by clicking on the radio buttons

Figure 2 – Weather Parameters for the MDSS Main Display
Figure 2 is a close up of the many road weather parameters that can be displayed on either a statewide or local basis. Weather alert categories are based on the affects of weather on road mobility. In addition to forecast elements, the most current RWIS pavement and road temperature information is available for display. RWIS data can include readings for different lanes as well as subsurface probes.
Figure 3 – Information Pop-Up Boxes at Forecast Points
Figure 3 provides a close up of the Des Moines route map (background). When a user places the cursor over one of the forecast dots, then specific forecast and weather alert information are provided in a pop up window.
Figure 4 – Information Pop-Up Boxes at Verification Routes
Figure 4 shows the pop up box that appears when a cursor is placed over a road segment on the screen. Route-specific forecast information will be displayed. The box includes route treatment status (if any), roadway mobility forecast, road temperature, snow depth and pavement chemical concentration.
Figure 5 – RWIS Road Temperature Information
Figure 5 shows the results of placing a cursor over a dot that represents an RWIS site. A box will display all available road temperature information.
Quick Tour: Blowing Snow Alerts

New for 2004 – Blowing Snow Alerts!
Alerts are determined by:
1) Time since snow ended
2) Wind speed and gusts
3) Occurrence of liquid precipitation since it snowed
4) Maximum temperatures at end of snow event

Categories for Blowing Snow are the same as for Weather and Road conditions

Figure 6 – Blowing Snow Alert Criteria
Figure 6 shows the criteria that were used in the creation of the blowing snow alerts.
Figure 7 – The “What-If” Scenario Selector Screen
Figure 7 shows the MDSS “what-if” scenario selector screen. The user can select chemical type, application rate, treatment start times and the overall number of treatment passes. The results of changing these values can be seen in Figure 8.
Figure 8 – “What-If” Scenario Treatment Selector Results Screen
Figure 8 shows the results of changes made in the “what-if” scenario treatment selector. In this display, the recommended treatment maintains a minimal snow depth on the road surface. However, an alternative (user selected) scenario uses less chemicals and a more compressed application time period. This results in accumulating snow (and resultant reduced mobility) during the storm (i.e., after 6pm on the graphic).
Figure 9 – Route-Specific Event Summary Table
Figure 9 provides an event summary for each treatment forecast route. The top section visually displays the probabilities of liquid, freezing or frozen precipitation along the specified route through the forecast period. The remaining sections show snow accumulation, road temperature predictions and forecast winds. Blowing snow advisories and recommended treatment times can be found at the bottom of the page.

<table>
<thead>
<tr>
<th>Precipitation Type: (declared)</th>
<th>Probability of Precipitation Types: (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain</td>
<td>Snow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Snow Accumulation with No Treatment: (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max: 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Road Temperature with Recommended Treatment: (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max: 25.5</td>
</tr>
<tr>
<td>Min: 13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind Speed: (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max: 14</td>
</tr>
<tr>
<td>Min: 7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blowing Snow Advisories: Recommended Treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>recommended treatment</td>
</tr>
</tbody>
</table>
## Nomination of Technology Ready for Implementation

<table>
<thead>
<tr>
<th>Sponsoring DOT</th>
<th>1. Sponsoring DOT (State): North Dakota</th>
</tr>
</thead>
</table>
| **Primary Technical Contact** | 2. Name: Darcy R. Rosendahl  
Organization: North Dakota Department of Transportation  
Address: 608 East Boulevard Avenue  
City: Bismarck  
State: North Dakota  
Zip code: 58505-0700  
E-mail: drosendahl@state.nd.us  
Phone: 701-328-4463  
Fax: 701-328-1404 |

| Technology Description | 3. Name of Technology:  
Multi-Agency Cooperative Weigh-in-Motion (WIM) Project |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Briefly describe the technology.</td>
<td>The technology consists of PAT/IRD Traffic (formerly PAT America) WIM Electronics/Processors along with Kistler Quartz Piezo Electric Sensors linked telemetrically with mobile highway patrol vehicles. There is also a direct link to the NDDOT for data collection purposes.</td>
</tr>
</tbody>
</table>
| 5. Briefly describe the history of its development. | The 2003 State Legislative Session budget process called for a conceptual change in truck weight enforcement by moving away from the fixed scale concept. In 2003, the North Dakota Highway Patrol and the North Dakota Department of Transportation developed a plan to install four virtual weigh-in-motion (WIM) sites linked to 12 highway patrol vehicles with wireless communication capability.  
The first phase took place starting in mid-2003 and continued into 2004, resulting in converting four permanent manned scales to unmanned scales and installing four WIM sites. During the second phase three permanent scale sites will be converted to unmanned sites by July 2005, and eight additional WIM sites will be installed at strategic locations throughout the state. |
| 6. For how long and in approximately how many applications has your organization used this technology? | The project was started in September 2003 and in January 2004 there were four permanent WIM sites on line. From January through August 2004, we have obtained size and weight data on about 250,000 trucks at four sites. |
| 7. What additional development is necessary to enable routine deployment of the technology? | Identify additional site locations and monitoring opportunities. |
| 8. Have other organizations used this technology? If so, please list organization names and contacts. | **Organization**  
North Dakota Highway Patrol  
**Name**  
Captain Scott Brand  
**Phone**  
701-328-1864  
**E-mail**  
sbrand@state.nd.us |
### Potential for Payoff

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.

   The additional sites provide the NDDOT with better truck forecasting data. Eventually the NDDOT hopes to use WIM data to forecast Equivalent Single Axle Loadings (ESALS). The system also provides 24 hour seven day a week readouts on types and weight of trucks traveling on the highway system.

   The Highway Patrol has a wireless connection to log on to sites and monitor trucks. The Highway Patrol has greater knowledge of when and where overloads occur and can adjust enforcement efforts.

   When fully implemented, about 33 positions at the permanent scales will be eliminated at an annual estimated savings of about $1.3 million.

### Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology.

   Legislative support may be needed to direct partnerships between multiple agencies dealing with enforcement and roadway responsibility to undertake the endeavor. It may be necessary to develop agreements and memorandums of understanding between agencies involved.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?

   Phase one took about eight months for procurement and installation of equipment. Installation of the four WIM sites took place during one construction season. Fine tuning of enforcement procedures has occurred over a period of 12 months.

   The cost for installing a WIM site on a two-lane roadway is $125,000. Installing a site on just one lane is about $105,000. Other requirements include a smooth surface, less than two percent grade, and the equipment must be located on a tangent section of the roadway. The total cost for installing the four WIM sites was about $715,000. It is estimated that it will cost about $903,500 to install the remaining eight sites.

12. What organization(s) currently supply and provide technical support for this technology?

   PAT/IRD Traffic Company -- WIM equipment supplier
   Edling Electric -- Local electrical contractor
   North Dakota Department of Transportation -- Information Technology and Planning and Programming Division provide technical support.
   Highway Patrol -- Provide support to software mobile units.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.

   None have currently been identified.

### Willingness to Champion

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? Yes

### Date Submitted

15. Date: August 27, 2004

16. Please include image(s) of sketches or photographs, if available □ Image(s) are attached

<table>
<thead>
<tr>
<th>Please E-mail or Fax by August 27, 2004 to:</th>
<th>Jeremy Fissel</th>
<th>Phone: 202.624.3640</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Manager for Engineering</td>
<td>Phone: 202.624.3640</td>
<td></td>
</tr>
<tr>
<td>AASHTO</td>
<td>Fax: 202.624.5469</td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:jfissel@aashto.org">jfissel@aashto.org</a></td>
<td></td>
</tr>
</tbody>
</table>
### Sponsoring DOT

1. Sponsoring DOT (State): Iowa, South Carolina, South Dakota

### Primary Technical Contact

2. Name: Louisa Ward  
   Organization: FHWA  
   Address: 400 7th Street, Suite 4515, HSA-10  
   City: Washington  
   State: DC  
   Zipcode: 20590  
   E-mail: louisa.ward@fhwa.dot.gov  
   Phone: 202.366.2218  
   Fax: 202.366.2249

### Technology Description

3. Name of Technology:  
   Road Safety Audits

4. Briefly describe the technology.  
   A road safety audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent team. The RSA concept is a proactive approach to save lives on new or existing roads and intersections. RSAs are an excellent tool to identify issues before roads or intersections are built or before crash patterns develop.

5. Briefly describe the history of its development.  
   In the 1980s, the U.K. was the first country to conduct Road Safety Audits. Road safety audits next spread to Australia, New Zealand, Canada, and Europe. In 1996, FHWA conducted an international scan on road safety audits to bring this safety tool to the U.S. Road Safety Audits have been conducted in the U.S. since 1997. A workshop to promote RSAs was held in 1998 and several States participated in a pilot program to access the benefits of RSAs from 1998 – 1999.

Since then road safety audits have been conducted in approximately 20 State and local agencies. FHWA is trying to increase the implementation and integration of RSAs into State and local safety programs.

6. For how long and in approximately how many applications has your organization used this technology?  
   FHWA introduced road safety audits to the U.S. via a pilot program in 1998.

7. What additional development is necessary to enable routine deployment of the technology?  
   None. However, it is most beneficial for State DOTs to take a training course on road safety audits to train those who will be on audit teams. The National Highway Institute has a 2-day course on road safety audits.

8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa DOT</td>
<td>Tom Welch</td>
<td>515-239-1267</td>
<td><a href="mailto:tom.welch@dot.state.ia.us">tom.welch@dot.state.ia.us</a></td>
</tr>
<tr>
<td>Maine DOT</td>
<td>Gerry Audibert</td>
<td>207-624-3315</td>
<td><a href="mailto:gerry.audibert@maine.gov">gerry.audibert@maine.gov</a></td>
</tr>
<tr>
<td>South Carolina DOT</td>
<td>Terecia Wilson</td>
<td>803-737-1161</td>
<td><a href="mailto:wilsontw@dot.state.sc.us">wilsontw@dot.state.sc.us</a></td>
</tr>
<tr>
<td>South Dakota DOT</td>
<td>Cliff Reuer</td>
<td>605-773-5361</td>
<td><a href="mailto:cliff.reuer@state.sd.us">cliff.reuer@state.sd.us</a></td>
</tr>
</tbody>
</table>

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
   South Carolina DOT saved thousands of dollars on their very first RSA when a design deficiency was identified and corrected before the road was built. Iowa DOT’s engineers consistently look for ways to implement low-cost safety solutions on new projects based on what they learned in previous RSAs.
<table>
<thead>
<tr>
<th>Implementation Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Please describe what actions another transportation agency would need to take to adopt this technology. States need to learn the process and obtain management support for RSAs and a willingness to incorporate/implement changes based on the RSA findings.</td>
</tr>
<tr>
<td>11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? The cost to conduct a RSA varies on the size of project and whether the DOT hires an outside consultant or uses agency staff independent of the project. An average estimate is $2,000 - $7,000 depending on the complexity of the project and number of consultants used. Other costs are unknown in terms of the improvements recommended as a result of a RSA.</td>
</tr>
<tr>
<td>12. What organization(s) currently supply and provide technical support for this technology? FHWA Office of Safety has developed a brochure and a website on road safety audits (<a href="http://www.roadwaysafetyaudits.org">www.roadwaysafetyaudits.org</a>). Work is underway on a Guidelines document and Checklists to use when performing RSAs. The Resource Center has a RSA team member who can provide technical assistance on RSAs. An NHI course is offered for RSA training.</td>
</tr>
<tr>
<td>13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. Some States perceive possible tort liability issues. But based on our experience giving the NHI course (where the State's attorney comes to speak to the class), the courts in many States see RSAs as a good faith effort and realize the State does not have unlimited resources to fix all of the suggestions immediately. States' Sovereign Immunity doctrines usually have an effect along with how the courts in their State interpret the protections from 23 U.S.C. 409 for RSA reports.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Willingness to Champion</th>
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</thead>
<tbody>
<tr>
<td>14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☑ Yes ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date Submitted</th>
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<tbody>
<tr>
<td>15. Date: 08/23/2004</td>
</tr>
</tbody>
</table>

16. Please include image(s) of sketches or photographs, if available ☐ Image(s) are attached
## Sponsoring DOT

1. Sponsoring DOT (State): North Carolina

## Primary Technical Contact

2. Name: Richard Powers  
Organization: FHWA  
Address: 400 7th Street, Suite 4515, HSA-10  
City: Washington  
State: DC  
Zipcode: 20590  
E-mail: richard.powers@fhwa.dot.gov  
Phone: 202.366.1320  
Fax: 202.366.2249

## Technology Description

3. Name of Technology:  
Cable Median Barrier

4. Briefly describe the technology.  
Cable barrier is a cost-effective flexible traffic barrier that is ideally suited for use as a retrofit design in existing relatively wide and flat medians to prevent cross-over crashes. This traffic barrier differs from concrete and from metal-beam median barrier in that it can be installed on sloped terrain and still perform effectively. It is a more “forgiving” system when struck by an errant motorist because it deflects laterally and reduces impact forces transmitted to vehicle occupants. Three designs (two of which are proprietary) are seeing increased usage in the U.S. as retrofit barriers installed in existing medians.

5. Briefly describe the history of its development.  
Cable barrier has been in use as a roadside barrier since the 1960’s. In the 1980’s, some State DOTs, including Missouri, started using a modified cable rail as a median barrier. Today, many more states (e.g., Arizona, Colorado, North Carolina, Oklahoma, Ohio, Oregon, South Carolina, and Utah) are installing cable barrier in the medians of freeways originally built without barrier. In addition to the original “generic” low-tensioned design, there now exist competing proprietary high-tension designs that require less maintenance after a crash.

6. For how long and in approximately how many applications has your organization used this technology?  
A few states have used the generic roadside cable design since its development over 20 years ago, and several have installed the modified median version in recent years, but high maintenance costs, both actual and in some cases, perceived, have limited its use. Several states are beginning to use the proprietary designs which are damaged less in crashes and are generally easier to repair when struck.

7. What additional development is necessary to enable routine deployment of the technology?  
As more states adopt increasingly conservative warrants for median barriers, designers need to be aware of the barrier choices available. As noted above, cable barrier can usually be installed in existing medians with a minimum of site work and remain one of the most cost-effective choices for barrier.

8. Have other organizations used this technology? If so, please list organization names and contacts.  
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Phone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oklahoma DOT</td>
<td>Faria Emamian</td>
<td>405 521-2867</td>
<td></td>
</tr>
<tr>
<td>NC DOT</td>
<td>Kevin Lacy</td>
<td>919 733-3915</td>
<td><a href="mailto:JKlacy@dot.state.NC.US">JKlacy@dot.state.NC.US</a></td>
</tr>
<tr>
<td>Oregon DOT</td>
<td>Dan McDonald</td>
<td>503 986-3779</td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>Skip Outcalt</td>
<td>303 757-9984</td>
<td></td>
</tr>
</tbody>
</table>

## State of Development

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies.  
Cable barrier is a relatively cost-effective barrier that can reduce the number of freeway crossover crashes and their resultant fatalities. Both the number and severity of crashes varies significantly from state to state. North Carolina and Oregon DOTs have completed detailed in-service evaluation reports documenting the number of impacts into their cable median barrier installations and reported near-100% effectiveness in preventing deadly crossover crashes on freeways. Because of its relatively low installation cost and the need for minimal site preparation in existing medians, the cable median barrier is the least costly barrier to install in freeway medians and will reduce the number of fatalities resulting from head-on and opposite direction sideswipe crashes. When the current AASHTO median barrier warrants are revised, there will be a need in most states to consider adding a barrier in medians that fall within the more conservative warrants.
10. Please describe what actions another transportation agency would need to take to adopt this technology.
DOTs can review cross-median crashes and select locations where barrier installation should be considered, especially in conjunction with the more conservative warrants that AASHTO plans to adopt in the near future.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency?
Cable barrier, both the generic design and the competing proprietary designs, can be specified by a highway agency exactly like any other type of traffic barrier.

12. What organization(s) currently supply and provide technical support for this technology?
The generic barrier, like W-beam guardrail or New Jersey Concrete Barrier, is a standard bid item. Detailed information on the proprietary designs can be obtained from the manufacturers - Brifen USA for the Brifen cable design and Trinity Industries for its CASS system.

13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation.
Federal law (23 USC, Section 635.411) prohibits state agencies from specifying proprietary products on federally-funded projects, with some exceptions. These exceptions include competitive bidding between equal products and an FHWA public interest finding.

14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? [ ] Yes [ ] No

15. Date Submitted: 08/23/2004

16. Please include image(s) of sketches or photographs, if available [ ] Image(s) are attached