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RESEARCH
SERVICES SECTION

TECHNICAL SUMMARY

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PROJECT COST:
$121,896

Researchers took infiltration and GPS measurements on this grassed swale in Minnetonka.

LRRB
LOCAL ROAD RESEARCH BOARD

Impact of Alternative Storm Water Management Approaches on Highway Infrastructure

What Need Did We See?

Storm water running off roadways can pollute downstream water sources. This concern is especially acute for Minnesota given the quantity of deicing products on our roads during long winters. A variety of techniques have been developed and implemented in recent decades to reduce the quantity of storm water runoff and improve water quality.

However, these **storm water best management practices** can cause problems if they significantly increase the water content in the soil underneath the roadway. While studies have shown that BMPs produce measurable benefits in managing storm water, more research is needed into secondary impacts, such as how installing a BMP might affect the life expectancy and maintenance costs of nearby roads. With so many BMPs available, city engineers need to have a clear picture of the pros and cons of each approach to make the most effective and economical decisions.

What Was Our Goal?

- The primary objective was to assess the potential adverse impact of storm water BMPs on the operation and long-term cost of roadways.
- A secondary objective was to evaluate a method for assessing the effectiveness of storm water BMPs in controlling storm water runoff volume.

What Did We Do?

Researchers evaluated the most commonly used storm water management approaches in urban Minnesota: dry ponds, wet ponds, infiltration trenches, infiltration basins, constructed wetlands, grassed swales, bioretention cells, sand filters and porous pavements. Some tasks included:

- Administering a Web-based opinion survey to highway design and maintenance professionals within the counties of the Twin Cities metro area to determine satisfaction levels with these BMPs.
- Determining the water infiltration capacities of 24 BMP installations by taking infiltration and storage capacity measurements and analyzing soil properties. Would these BMPs have the capacity to capture and control the volume of storm water generated from a ¼" runoff event?
- Evaluating pavement integrity on roads adjacent to BMPs by:
  - Comparing pavement distress levels of locations near BMPs to those of control locations using Mn/DOT's Surface Rating index.
  - Using MnPAVE, Mn/DOT's pavement design and performance model, to calculate pavement longevity as related to subgrade properties.
- Performing cost estimations for BMPs, including a full life-cycle cost for BMPs as well as for pavements potentially affected by the BMPs.

What Did We Learn?

Researchers created the *Guide for Selection of Best Management Practices* (Part A of the project report), which presents evaluations and cost estimation formulas for a wide

continued

"Roadway designers, planners and engineers had a very important question: Do storm water management practices affect pavement life?"

–Alan Rindels,
Mn/DOT Senior Engineer

"We can calculate the decrease in a pavement's life if excess moisture is present, enabling roadway designers to decide whether it's economically worth putting in drainage or making a heavier road."

–John Nieber,
Professor, Department of Bioproducts and Biosystems Engineering, University of Minnesota

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Researchers evaluated the effectiveness of infiltration basins like this one in Roseville.

range of BMPs, with test results for numerous specific BMP sites. They identified some BMPs as not having sufficient capacity to control a ¼" runoff event and noted that several additional BMPs had persistent standing water, a sign of inadequate capacity.

Local officials surveyed were generally satisfied with current BMPs, regarding them as having a positive impact on infrastructure by a greater than 4:1 margin. The BMPs rated the highest for positive impact were wet ponds, extended detention dry ponds, rain gardens and dry swales. Respondents judged some BMPs as likely to be poorly designed: infiltration basins, infiltration trenches, infiltration beds and bioretention ponds. Interestingly, there was no strong indication in the survey that the benefits of BMPs are on the whole outweighed by the costs.

BMPs were not found to produce any measurable distress on nearby pavements. The Surface Ratings of these pavements were statistically indistinguishable from those in the control group. While MnPAVE can be used to show that excessive moisture in the soil beneath the roadway can significantly reduce a pavement's life span, more work is needed to determine if storm water BMPs actually increase subgrade moisture content. The researchers recommend periodic inspections of pavements near BMPs for signs of distress.

What's Next?

LRRB has been funding projects in the area of storm water management since 1992, and this research is part of an ongoing effort to maximize the effectiveness of Minnesota's construction decisions. The researchers presented their findings to Mn/DOT district managers to facilitate use around the state, and the *Guide* is now available over the Web to anyone making storm water management decisions. The *Guide* served as a foundational work, with its specific focus on roadway impacts; for a more comprehensive manual funded by the Minnesota Pollution Control Agency, see *Assessment of Stormwater Best Management Practices*.

This research has also been used to inform national storm water management efforts, and principal investigator John Nieber has presented his results as part of a webcast for the Izaak Walton League of America that was viewed by more than 3,000 people. He will soon have an article on this topic in *Storm Water Solutions* magazine. The awareness campaign is ongoing in an effort to educate city engineers who fear that BMPs could be damaging roadways.

This Technical Summary pertains to the LRRB-produced Report 2005-49, "INV 799: Impact of Alternative Storm Water Management Approaches on Highway Infrastructure," published April 2006. The full report can be accessed at http://www.lrrb.org/pdf/200549A.pdf *and* http://www.lrrb.org/pdf/200549B.pdf.