



RESEARCH SERVICES SECTION

TECHNICAL SUMMARY

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PROJECT COST:

\$178,524



Researchers measured the water infiltration rate and soil strength to assess the effectiveness of the tilling procedures.

Compaction Remediation for Construction Sites

What Was the Need?

While building highways, heavy machinery passes over the ground next to the road many times, severely compacting the soil. This results in poor drainage, inhibits the growth of vegetation and causes erosion. Managing the storm water runoff from highways and compacted rights of way may require the purchase of additional land, which is often a significant expense in construction projects. Holding ponds built to manage storm water runoff are also expensive and need regular maintenance.

Once a highway is complete, the rehabilitation of the land in the ROW routinely includes reseeding with native plants and grasses, many of which have deep roots that are severely inhibited from growing properly by heavily compacted soils. Deep tilling of the soil by various methods has been shown to be a low-cost method to improve water infiltration, reduce runoff and enhance crop growth in agricultural applications. This practice offers a promising avenue for ROW rehabilitation.

What Was Our Goal?

The objective of this study was to develop a tilling protocol for ROW areas that would enhance drainage and be compatible with current erosion control methods. This should reduce the size and number of required holding ponds, and increase the effective use of current resources.

What Did We Do?

Researchers selected highway construction sites with a variety of soil types, grades and development of vegetation, all of which exhibited poor water infiltration according to Mn/DOT personnel. The sites and soil classifications were:

- Highway 169-TH 19, Belle Plaine (clay loam, established vegetation)
- Highway 319, Brainerd (sandy loam, established vegetation)
- Highway 14-County 3, Janesville (clay loam, newly constructed)
- MnROAD facility, Albertville (silty loam, established vegetation)

One-acre test plots were established at each site representing three major soil types: sand, silt and clay. Three indices were used to characterize the benefits of tillage:

- Soil strength, measured with a tractor-mounted soil cone penetrometer
- Water infiltration rate, measured as the time required for a given amount of water to seep into the ground (the Philip-Dunne method)
- The amount of vegetative growth, which researchers quantified by analyzing digital photographs

Three tillage methods corresponding to three different pieces of equipment were compared to nontilled soil:

- DMI Chisel Plow: five tines, 30-inch spacing, 12-inch operational depth
- Kongskilde Paraplow: four tines, 36-inch spacing, 18-inch operational depth
- Caterpillar Subsoiler: two tines, 36-inch spacing, 24-inch operational depth

Data was collected and the sites were evaluated over two growing seasons following the tillage treatment.

“Sometimes the ground was so hard you couldn’t pound a nail in it.”

—Dwayne Stenlund,
Natural Resource
Specialist and Senior
Ecologist, Mn/DOT
Environmental Services

“Planning the right of way to minimize the presence of utilities and construction waste would have a big impact on the effectiveness of the tillage.”

—Jonathan Chaplin,
Associate Professor,
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Investigators used three plows—with varying tine depths and tine types—to till the soil types examined in the project. The DMI chisel plow (shown above) operates at 12 inches deep.

What Did We Learn?

The study showed that soil type governed whether tilling improved infiltration. No measurable differences in soil strength were detected between the tilled and nontilled soil, regardless of soil type. Tilling improved water infiltration rates, but primarily in sandy soil; marginal improvement was observed in silty soil, with almost no change measured in clay soil.

In sandy soil, results indicate it would be possible to reduce the ROW area by up to one-third if infiltration is the only consideration. Vegetation coverage improved after tilling. The Paraplow, which does not invert the soil during tilling, left the original vegetation relatively undisturbed and had a significantly better aesthetic appeal than the other tilling methods.

A limited cost analysis showed that the cost of tilling would range from \$11/acre to \$33/acre. This was judged to be minimal compared to the savings from purchasing smaller areas of land for ROW access.

What's Next?

Researchers made several recommendations for future best management practices:

- Restricting and regulating the distribution of utilities in the ROW would make tilling more consistent, effective and cheaper.
- Tilling should only be performed in dry conditions to avoid inhibiting rather than increasing infiltration.
- Piles of heavy clay, disposed concrete and other debris relocated to the ROW during construction detrimentally affect the water infiltration patterns and the ability to properly till the soil. Managing material and debris relocation at construction sites would improve the reliability of tillage efforts and make tilling easier.

Implementation of tilling in some ROW areas is in progress, particularly in haul roads and staging areas on construction sites, using the noninverting Paraplow.

This Technical Summary pertains to Report 2008-01, “Compaction Remediation for Construction Sites,” published January 2008. The full report can be accessed at <http://www.lrrb.org/PDF/200801.pdf>.