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DEPARTMENT OF TRANSPORTATION
RESEARCH SERVICES & LIBRARY

TECHNICAL SUMMARY

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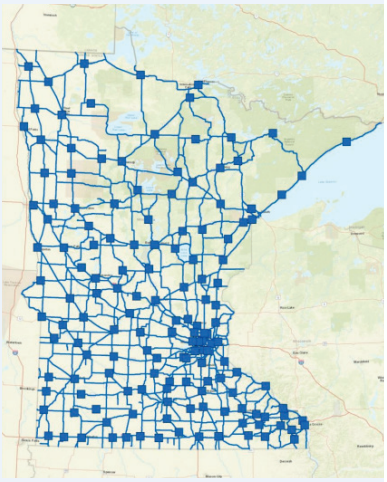
PROJECT COST:
$163,413



This project will determine the future of more than half of MnDOT's 137 truck stations in the next two decades.

New Tools to Optimize Truck Station Locations

Researchers collected multiple sets of data about MnDOT's many truck stations and used a geographic information system platform to determine the most effective locations for future stations, including a benefit–cost analysis for each alternative.

What Was the Need?

MnDOT operates 137 truck stations, 18 headquarter sites for maintenance operations and over 50 areas for materials delivery. Truck stations are used to house and maintain large highway equipment, and to provide office and work space for highway maintenance staff. Some stations also store materials.

The average life span of a truck station is 50 years. Within the next 20 years, 80 of MnDOT's truck stations will need to be replaced. With costly capital replacement imminent, MnDOT has considered measures to optimize truck station locations within its eight state districts, including possibilities of reducing the size of some, increasing others, or combining the facilities of some state and local agencies into new partnerships. Determining the best effective locations for new truck stations could reduce costs for both state and local partners.

MnDOT needed a means of selecting and collecting the most appropriate data for an investigation into optimizing truck station locations. The agency also needed tools such as a computer model to analyze the data. These resources would allow MnDOT to determine the most time- and cost-effective locations for future truck stations.

What Was Our Goal?

The initial objective of this project was to collect data about truck service areas, including the quantity of highway equipment and materials capacity, and the materials storage capacity of facilities. This information combined with service route data would allow MnDOT to optimize truck station locations by determining whether facilities should be closed, resized, combined or relocated, and whether other materials storage locations would be necessary. An economic benefit–cost analysis would compare alternatives.

What Did We Do?

To determine how other departments of transportation (DOTs) and related agencies have addressed choosing the best locations for facilities, researchers conducted a literature review that included reports from six state DOTs and Australia, Transportation Research Board publications and other research papers. In addition, they consulted the standards developed by MnDOT's Truck Station Standards Committee.

Researchers also conducted surveys and interviews of both MnDOT and outside agency stakeholders.

With many data sets collected for each truck station site, researchers used a geographic information system (GIS) platform to solve a location-allocation problem and a multi-vehicle routing problem for the truck stations. The problems incorporated such factors as amount of equipment, equipment capacity, storage capacity, material demand for road segments and other information. Estimated costs of operation for each location alternative were compared to present costs of each truck station.

continued

"We successfully analyzed all of our truck station and loading locations, determined which were good candidates for potential relocation or consolidation, and developed a data-driven plan of action to save millions of dollars."

—Christopher Moates,
Planning Director,
MnDOT Building Services

"Using real-world data, we built GIS models of maintenance operations to determine optimal truck station locations. With expected life spans of around 50 years, truck stations that are optimally located will reduce operating costs and save money for MnDOT and Minnesota taxpayers."

—William Holik,
Assistant Research Engineer,
Texas Transportation Institute

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MnDOT's Maple Grove Truck Station and Maintenance Center is a new 108,000-square-foot facility. MnDOT's truck stations range in size from Class 1 buildings of at least 25,000 square feet to smaller Class 3 facilities with four or fewer overhead doors.

What Did We Learn?

The literature review showed that optimizations of facility locations may require a second level of sites, such as strategically placed materials storage depots. Some research also showed that both transportation and facility costs must be considered and that after a certain point, consolidation of stations could cost more as vehicles and staff were required to drive farther to reach them.

Reports of state DOT location optimization efforts were instructive. Iowa DOT noted the need to consider the slow highway speeds of snowplows. This was a critical element for researchers to include in their optimization models as it determines route travel times. Vermont Agency of Transportation highlighted the use of satellite materials depots. Generally, state DOT efforts were confined to small regional issues, unlike MnDOT's statewide scope.

In interviews with MnDOT and local agency stakeholders, researchers learned about partnerships that already existed between MnDOT and city and county agencies. These partnerships primarily included the sharing of truck stations and sometimes of materials. These partnerships were included in the optimization development.

Researchers optimized the truck station location using a GIS optimization model and separate cost analyses. They developed alternatives for each truck station individually. Each alternative was then analyzed to determine costs and savings over a 50-year life cycle.

Finally, researchers determined which alternatives could be most effectively executed and their optimum order. They also developed an implementation plan for station relocation and replacement. This modeling was an iterative process: Each optimal location replaced the existing location and became the baseline against which the next station alternative was compared. The result was a comprehensive set of location possibilities for each MnDOT district with multiple alternatives for every truck station, including benefit–cost analyses. Researchers' optimization solutions determined that 123 truck stations could be rebuilt on-site, 24 could be relocated on land available to MnDOT, and two could be combined.

What's Next?

MnDOT now has the information it needs to effectively implement cost-saving changes in future truck station planning and construction. The agency could use the researchers' initial recommendations or further employ the GIS modeling tool to examine variations on the results of the project.

This Technical Summary pertains to Report 2019-10, "Optimizing Truck Station Locations for Maintenance Operations," published February 2019. The full report can be accessed at http://mndot.gov/research/reports/2019/201910.pdf.