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HEADLINE: Special report: Ramp meters;
Drivers get benefits, but many pay a price;
Motorists love to hate them. So are they worth the hassle? Ramp meters speed freeway flow, but Twin Cities-area drivers endure the longest ramp waits in the country, and the Minnesota Department of Transportation doesn't have studies to back up all of its claims.

BYLINE: Joe Rigert; Staff Writer

BODY:

Under the most extensive system of freeway controls in the nation, Twin Cities-area drivers routinely spend 10 to 15 minutes _ and some say 20 minutes _ waiting on metered ramps to get onto freeways during rush hours.

And they're told it's for their own good.

Minnesota Department of Transportation officials say ramp metering provides more gain than pain. By restricting freeway access, they say, meters dramatically ease congestion, speed traffic and reduce accidents.

In fact, the metering program has been so impressively portrayed it is viewed as a national model.

Do meters help commuters?

The short answer: Yes, but not as much as transportation officials have said.

Because the department has never comprehensively studied ramp meters, there is no way to conclusively grade their performance. That has prompted Senate Minority Leader Dick Day of Owatonna to call for an areawide test of their merits.

A Star Tribune examination of metering has found that while the ramp controls improve the flow and safety of freeways, they also impose burdens:

- For some drivers, metering makes work trips longer rather than shorter. They pay a time toll at the ramp meters, only to wait again in stop-and-go traffic on the freeways.

- Although motorists say they have a generally favorable impression of meters, almost two-thirds sometimes skirt

the freeways to avoid ramp delays. Keeping drivers off the freeways is a key to the success of metering.

- Even with metering, 123 miles _ one-quarter of the seven-county metropolitan area's freeways _ are congested during rush hours. Department officials say that, with ever more vehicles on the road, ramp controls can no longer prevent traffic backups on sections of major freeways such as Interstate Hwys. 35W, I-494 and I-94 and Hwy. 169.

- The department has overstated ramp-meter benefits, especially in claims to the Legislature earlier this year. The department's claims are based largely on the most favorable findings of old studies and on anecdotal information that outside experts say generally can't be considered scientific proof. The department also has downplayed newer studies showing modest gains under more congested conditions.

Department officials say that although they don't have a recent, comprehensive study, they have reams of current data that back up their claims to the Legislature and to the public. They made the data and additional materials available to the Star Tribune and shared their views in 19 memos and several interviews.

Glen Carlson, manager of the department's Traffic Management Center, which controls the meters, said the controls sometimes achieve even greater traffic volumes and periods with fewer crashes than the department claims.

Carlson and other officials say that metering by itself will not solve congestion problems, but they emphasize that the controls help get the most out of freeways as traffic increases, limiting the duration of congestion and keeping it from growing even worse.

In less-congested areas, officials say they believe major benefits still can be gained from metering. For example, they recently announced installation of 11 more ramp meters on southern sections of Interstate Hwy. 35E and on Hwy. 77. Their goal is to cover the metro system by 2007.

A national transportation authority, James Moore at the University of Southern California, supported the department's program after evaluating its studies at the Star Tribune's request. Overall, Moore said, the studies _ despite some deficiencies _ indicate that Twin Cities-area ramp metering improves or maintains freeway conditions, especially travel speeds.

"Are these measures worth the money? . . . If I had to wager based on the available evidence, I would bet 'yes,' " said Moore, director of USC's transportation engineering program and associate director of the National Center for Metropolitan Transportation Research.

But he lamented a lack of meter-nonmeter comparisons on similar freeways and said none of the studies met a needed test: Turn off the meters and see what happens.

Key legislators took opposing positions on metering in reaction to the Star Tribune's findings. Rep. Tom Workman, R-Chanhassen and chairman of the House Transportation Committee, said he will push for a metering holiday and more money to eliminate bottlenecks. He voted against the meter turnoff this year. Sen. Carol Flynn, DFL-Minneapolis and chairwoman of the Senate Transportation Policy Committee, said she also wants to provide more money to fight congestion, but remains opposed to a metering holiday as "much too dangerous." Day said the newspaper's findings should help in his renewed effort to require the Transportation Department to test the merits of meters.

Trip times

For some drivers, meters speed up traffic enough to shorten trips. But in a limited study last year, the department found that meters were increasing at least some travel times. Ramp waits on Hwy. 169 (in the western suburbs) added to trip times on five out of 10 freeway sections, the study showed, even though motorists could drive faster once on the highway. It took drivers who'd waited through meters longer to go 10.5 miles, for example, than it took drivers who didn't wait through meters to go 14 miles. The department called the more time-consuming trips one of the drawbacks of metering.

In another study, Washington state's transportation agency in 1996-97 asked drivers to report travel times before and after meters were installed on Interstate Hwy. 405. The result: an increase in commuting time of 3 to 9 percent after metering in the morning peak period, and an increase of 11 percent on one freeway section in the evening.

Minnesota officials acknowledge that, systemwide, the long ramp waits here lengthen the work trips for some drivers, but they say that because the meters make freeways flow better, they help ensure shorter trips overall for most motorists. "It's a net benefit to the region and the public," said Richard Stehr, the department's metro division engineer.

Officials assure drivers that the ramp delays generally aren't too onerous. They cite an average wait of two-and-a-half to five minutes, but concede that some drivers routinely wait longer because of heavy traffic. In fact, a January 1998 department study found that among 26 ramps around the metro area, the maximum delay was 10 minutes or more at 19 ramps, 15 minutes or more at three and 19 minutes at one.

The Star Tribune came up with similar findings in a random check of ramps, and motorists reported similar experiences in a Star Tribune Minnesota Poll.

Carlson said the department is sensitive to ramp waits, places a high priority on complaints and checks them out. In February, the department cut four seconds from the maximum red-signal time. Now, the longest red signals are 40 seconds.

But officials say there are no plans to further shorten the waits. Rich Lau, a traffic systems engineer and the department's metering expert, said ramp delays will get longer as traffic increases and bottlenecks get worse. When an overload of vehicles causes traffic to slow down, meter managers increase the ramp wait time to keep freeways from getting even more congested.

Transportation experts say the only effective way for metering to fight congestion is to keep many drivers off the freeways. Put simply, if the roads aren't too crowded, traffic will flow more freely.

Minnesota officials say that the purpose of metering is not to divert drivers but to allow more of them to use the freeways through improved traffic flow. Yet they acknowledge that they expect and want some commuters, especially those on short trips, to shift to other routes.

Moreover, in an interview earlier this year, Lau said that those who wait too long _ eight minutes or more _ should move. If such drivers have no faster alternate route, he said, "those are the people who I would encourage to change jobs or change houses."

The bigger picture

Three decades ago, when Minnesota became one of the first states to install ramp meters, the Transportation Department predicted that the controls might reduce congestion enough to postpone or cancel proposed freeway construction. It would be a way to avoid higher gas taxes for building roads, a key issue in the face of increasing citizen opposition to taxes _ and to freeways.

Metering costs a fraction of the expense of building freeways _ \$50 million so far for 429 meters, television surveillance and other traffic-management measures, compared with at least \$400 million for 10 miles of six-lane freeway. The department also says it spends far less than other cities on its traffic-management program.

In the earlier years, however, the state was still spending billions of dollars to expand the freeway system, partly from revenues generated by a doubling of the gasoline tax in the 1980s. But state politicians have shied away from tax increases in this decade, causing a major cutback in freeway expansion and delaying work on bottlenecks.

In 1989, meanwhile, the department began to rapidly extend ramp controls for what Stehr, the metro division

engineer, now describes as a war on congestion. In the 1990s, the number of metered ramps was increased sixfold to cover two-thirds of the freeway system _ more coverage than in any other metro area.

The metering added to freeway capacity, but not nearly enough to deal with increased traffic. The department reports that congestion has grown by more than one-third in the past five years. A national study last year by the Texas Transportation Institute of Texas A&M University lists the Twin Cities area among the three major metro areas that need the most additional miles of freeway lanes _ 60 _ to prevent congestion growth. The institute says freeway traffic here has more than doubled since 1982, an increase that is second highest among the 20 largest metro areas.

The Transportation Department is planning improvements to help meet those needs. With existing funding, the department has scheduled two dozen projects for the next 10 years to alleviate congestion. Meantime, Transportation Commissioner Elwyn Tinklenberg has not yet decided whether he'll seek more funds from the Legislature. Stehr has said, however, that Tinklenberg is considering a new strategy of targeting funds at bottlenecks, as well as transit improvements and major regional highways.

Studies and claims

Earlier this year when Day, a Republican, and Rep. Doug Reuter, an Owatonna independent, first proposed turning off ramp signals temporarily to test their value, the department warned of more crashes and other dire consequences that would be blamed on legislators. In fact, the department gave legislators statistics that showed even greater metering benefits than the department had been claiming on its Web site and in other public pronouncements. The proposal for a metering holiday died last session, but two weeks ago Day announced his intention to try again in 2000.

When the Star Tribune asked officials to support their claims, they did not mention the many findings from their studies that showed more limited gains. And in their public statements, they generally have given metering credit for the gains, even though freeway expansion and improvements also do much to make freeway travel faster and safer.

Moore, the USC expert, said his perception, based on his review of department studies and Star Tribune research, is that the department is exaggerating the benefits of metering. Moore said the department's reluctance to do a genuine before-and-after study shows it understands that the benefits of metering are modest. "The agency would rather keep the question open than jeopardize funds for ramp meters or admit previous errors," he said.

Here's what the department has said:

- Speed. The department told the Legislature that typical increases in speed after metering ranged from 73 to 92 percent, or more than 20 miles per hour. That's more than double what the department had been saying to the public.

Asked to back that up, department officials told the Star Tribune that those big increases were found in 1974-1975 studies of sections of Interstate Hwys. 35W and 35E, and are supported by current data. But the current data come from freeway pavement detectors and field observations, not from full-blown studies. The two freeways haven't been studied since the 1970s.

Studies of other freeways in the '80s and '90s show most speed increases considerably under 10 mph and way under 20 percent. On heavily congested Hwy. 169, the biggest average increase was 5 mph, or 13 percent.

- Capacity. The department told the Legislature that metering made it possible for the freeways to carry 29 to 42 percent more vehicles _ again more than double the increase (15 percent) the agency often has used in its public statements. The 42 percent would work out to about 800 more vehicles per lane per hour.

Officials didn't cite specific studies to back up this claim. Instead, they presented graphs showing large traffic volumes counted by freeway detectors this year at four locations, and they offered to provide many more. They acknowledged that no before-and-after studies had been done at those four locations.

The department didn't tell the Legislature that its studies at other locations showed a wide range of changes in capacity after metering, from a slight reduction to an increase of 21 percent. Nor did the department tell the Legislature that one of its studies gave freeway expansion part of the credit for that 21 percent increase, which came on Interstate Hwy. 694 in the early '80s.

Minnesota officials say that 1998-99 data and their field observations _ anecdotal snapshots _ are a better source of information to prove their claims on speed and capacity than studies from the past two decades showing mixed results. "This data doesn't need to be published in reports to have validity . . ." Carlson said. "It flows in from our system detectors hour after hour, day after day . . ."

Academic experts on engineering studies don't agree. They say that before-and-after studies, not anecdotal data, are needed to provide credible evidence of metering benefits. James Banks, a civil engineering professor and metering researcher at San Diego State University, said that anecdotal data are "sort of" what somebody believes they are. "This particular field has been plagued by a tendency to jump to conclusions about the benefits of metering," he said.

- Accidents. Transportation officials have told the public and legislators that ramp meters have cut crashes by 1,280 a year. They came up with that figure by comparing accidents in 1988-89, before the big metering expansion, with crashes in 1990-96, when the freeways were more widely metered.

In the past two decades, however, the number of accidents has gone up and down, often with little relationship to the amount of metering or traffic.

Douglas Hawkins, chairman of the University of Minnesota's applied-statistics department, looked at the Transportation Department's data and said he found little to support its claim. He said the fact that the data show year-by-year fluctuations in accidents, for no apparent reason, renders the findings not terribly compelling. "They can certainly claim that as an estimate [of reduced crashes]," he said, "but they haven't proved it from those numbers."

Carlson said, "Accidents do go up and down for no apparent reason, but the data . . . clearly demonstrate a significant difference before [metering] and after."

The department also has claimed a 40 percent decrease in the rate of accidents per miles traveled, which is a better measure of trends than a comparison of the number of accidents. But a department report indicates that meters alone didn't bring the reduction. The department's 1997 Metro Transportation Plan said that physical improvements in freeways _ a dozen projects since the early '80s _ have contributed to a decline in the rates.

While fluctuating, the accident rate has been going down on Twin Cities-area freeways _ metered or not _ since 1979.

Carlson said that the department's accident claims are very conservative.

Asked why the department made greater claims about speed and capacity to the Legislature than to the public, Carlson said the claims were justified by the effects of an expanded and improved metering system, as shown by widespread anecdotal data in the past two years. In printed information offered to the public at the State Fair, however, the department did not cite the higher claims, reverting instead to claims it often has made to the public: that ramp meters increase freeway speeds during peak periods by 35 percent and increase freeway capacity by 15 percent.

Asked why the department hasn't done more studies in recent years that would test the claims, Carlson gave a list of reasons: heavy workload, lack of time, reliance on current data and increased confidence in the success of metering.

Carlson said that a simulation study released in September by University of Minnesota researchers offered unbiased support for the department's claims.

While the simulation, funded partly by the department, showed that metering significantly increased freeway speeds, the increases were lower than what the department told the Legislature.

And Carlson said it would not be fair to quote an expert from another city without comparing his credentials and capabilities with those of Lau, whom he described as "the foremost ramp metering expert in North America." Lau has been with the department for 25 years.

More meters ahead

The U.S. Department of Transportation has acknowledged the problems of evaluating meters, including a lack of common standards for studies. But problems in the studies themselves haven't kept the federal agency from promoting meters with almost unqualified praise. The department relies mostly on studies from the '80s to portray what it calls the proven success of metering.

Traffic growth nationwide in recent years, however, suggests the need for new studies to assess meter performance, according to transportation experts at the University of California, Berkeley.

But some states are moving ahead anyway. Dolf May, the metering pioneer who started ramp controls in Chicago in the 1960s, is planning another project, this one in Salt Lake City. Though May, a consultant and professor emeritus at Berkeley, still supports meters, he says that with increasing congestion, it is more difficult to show benefits.

Meter image mostly positive

"In general, do you have a favorable or unfavorable opinion of the ramp meters on the Twin Cities area's freeway system?"

Favorable

Strongly 29%

Not strongly 31%

Unfavorable

Strongly 24%

Not strongly 14%

Source: Star Tribune Minnesota Poll of 1,001 adults statewide July 6-14. Margin of sampling error for the 488 licensed drivers in the 11-county Twin Cities metro area on which these results are based: no greater than 4.4 percentage points, plus or minus, at a 95 percent confidence level.

SENSING CONGESTION

You may not see them, but under-pavement sensors and overhead cameras control your movement as you enter Twin Cities-area freeways by metered ramps. Sensors under the pavement send traffic information along an electronic chain of collection points to a central computer. That computer, along with staff aided by cameras, determines how long you have to wait at a meter.

How ramp meters are controlled

Though there are a few meters that currently operate from preset instructions, 97 percent respond to traffic conditions. Here's a step-by-step look at how data affecting ramp meter timing is collected and used.

1. Every 1/2 mile under-pavement sensors, called loop detectors, register how frequently and quickly vehicles pass over them. There are about 3,500 detectors.
2. That information travels along buried cable to cabinets, which are spaced approximately 3 miles apart.
3. More than 200 closed-circuit cameras spaced about 1 mile apart and changeable message signs attached to overpasses are also hard-wired to these cabinets. Cameras can pan 350 degrees, tilt and zoom.
4. Because the current going through the loop detectors is very small, amplifiers in the cabinets strengthen the signal. The signal then proceeds to one of about 500 data collection boxes called controllers. The controller stores the information and every 30 seconds sends it to the main computer.
5. The cabinets relay information to and from the main computer, or central processor, at the Traffic Management Center using fiber-optic cable.
6. Twice a minute, Traffic Management Center's computers adjust ramp meters in an attempt to maximize the number of cars able to go an optimum speed through bottlenecks.

The main computer locates freeway congestion. The computer takes two factors into account when adjusting ramp meters:

- Density. When information from loop detectors indicates that traffic is becoming more dense, meters will adjust to space cars just entering the freeway farther apart.

- Flow. The computer will also look upstream to determine how heavy approaching traffic is. So meters may slow down to help head off potential congestion.

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How loop detectors work

A coil of wire is imbedded in the road surface. The wire is electrified, producing a magnetic field of flux shaped like a doughnut. When a vehicle travels over the wire, the mass of metal in the vehicle disturbs the field. A signal gets sent to the main computer telling it when and for how long the field was disturbed.

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The Traffic Management Center

The Minnesota Department of Transportation's Traffic Management Center, located near the Minneapolis Convention Center, was built in 1972. Its control room, with a peak-period staff of five, has more than 100 video screens that keep tabs on traffic conditions. Here's who works there:

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Ramp meter operators

Two people verify that ramp meters are responding to real-time traffic conditions by browsing among live camera images displayed on a bank of video screens. Operators also view loop detector information on a large display map and activate changeable message signs as needed.

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Traffic Reporter

Mike Mauren, the state's official traffic reporter, broadcasts live traffic situations on KBEM Radio (88.5 FM) every 10 minutes during rush hours and every half-hour between 11:30 a.m. and 1 p.m.

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Information officers

Two people listen to the State Patrol scanner, log incidents, relay pertinent information for radio broadcast or to other media partners, and dispatch Highway Helpers to assist stranded motorists and to remove stalls before they create traffic slowdowns.

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Here's looking at you

Video feed from cameras is shared with, among others, the cities of Minneapolis and St. Paul, Hennepin County, the State Patrol, Transportation Department maintenance, the University of Minnesota's Center for Transportation Studies and Metro Transit. The control center also coordinates with local traffic engineering departments, police and emergency services.

GRAPHIC: CHART; ILLUSTRATION; PHOTO

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