Linking Congestion Management to Operations – Hampton Roads Planning District Commission

Congestion is mounting in many metropolitan areas, but capacity increases are often not feasible. In order to increase transportation system performance without adding capacity, many MPOs are increasingly assessing the use of operations strategies as a way to achieve greater efficiency. The Hampton Roads Planning District Commission (HRPDC) serves a 16-jurisdiction planning area in southeast Virginia with a large number of water features, bridges, and tunnels. Therefore, proactive congestion management strategies have been required for this region. HRPDC began developing operations strategies a number of years ago and has taken a leadership role on these strategies. This case study presents an example of HRPDC's approaches for improving congestion management by strengthening the relationship between CMP and operations.

In 2005 the HRPDC ITS Committee initiated the development of a Regional Concept of Transportation Operations to improve safety, mobility and travel time reliability.

Operations Partnerships

HRPDC's relationship to the operations function of the Virginia DOT (VDOT) has evolved, largely due to several reorganizations at VDOT. VDOT has recently placed a greater emphasis on operations at the statewide level. A separate operations division at VDOT was created in the past two years, replacing the former arrangement under which operations was part of the State traffic engineering division. Along with the new division, a new VDOT chief of operations position was created at the State level with an operations manager at the district level. VDOT representatives actively participate on both the HRPDC ITS and operations committees. Other operations planning has taken place at VDOT through an active incident management planning group and with hurricane evacuation planning, in which the HRPDC is involved.

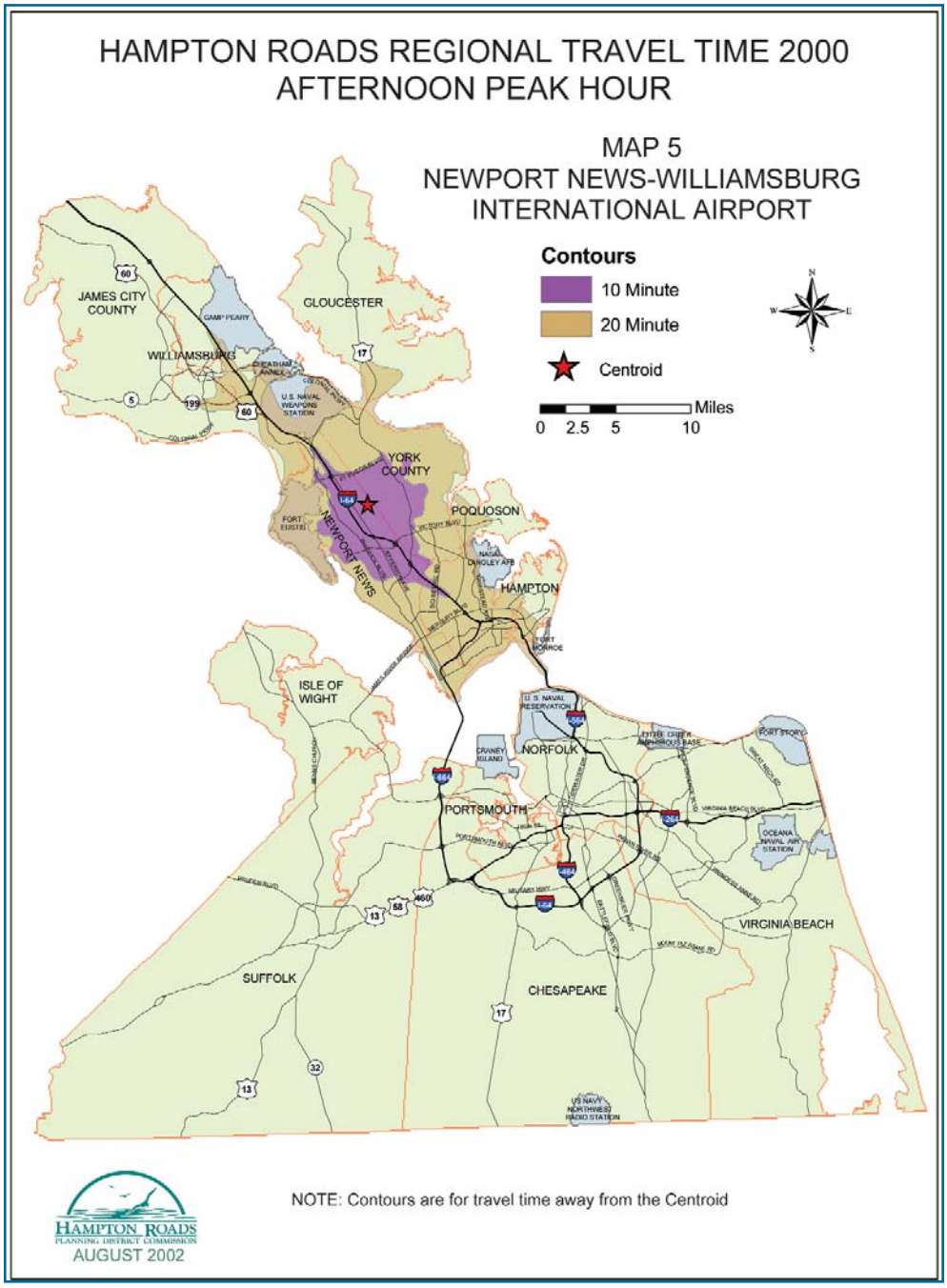
Another key component of HRPDC's operations planning has been its partnership with VDOT's Hampton Roads Smart Traffic Center (STC). This traffic operations management center was established in the mid 1990s using Federal early deployment funds designated for stand-alone ITS programs. The center manages congestion, high-occupancy vehicle (HOV) lanes, and incidents, and collects data on 80 Interstate centerline miles. The center also serves as the backbone for regional operations communications, with connections both in place and planned to several local traffic management centers. The STC operations data is archived at the Smart Travel Lab[1] at the University of Virginia.

[1] Available at: http://cts.virginia.edu/stl_index.htm.

The Smart Travel Lab was established in 1998 in cooperation with the University of Virginia's civil engineering department and the research council of VDOT. The Lab is staffed by both the University and VDOT. Researchers at the Smart Travel Lab conduct a number of projects using Hampton Roads data. Although HRPDC does not direct the areas of research, it has access to the results and data, which have helped inform planning activities.

An Archived Data Management System[2] (ADMS) was put in place three years ago that is administered by the Smart Travel Lab. The ADMS allows stakeholders throughout the State to access operations data via a password-protected web site. The system includes loop data from the Interstates that is available nearly in real time; it can be accessed the day after collection. Other archived data that can be accessed via the ADMS includes incident data, weather-related information, and signal system data from localities. The Federal Highway Administration (FHWA) and VDOT originally funded ADMS Virginia with $1 million as an operational test. VDOT continues to sponsor this project and is leading the effort with the team members of the Virginia Transportation Research Council and the University of Virginia Center for Transportation Studies.

Figure 1 – Hampton Roads Afternoon Peak Travel Time 2000



Regional Concept of Transportation Operations

In 2005 the HRPDC ITS Committee initiated the development of a Regional Concept of Transportation Operations (RCTO) to improve safety, mobility and travel time reliability and document how these improvements would be implemented. The genesis for developing this concept was the result of HRPDC staff attending a session at the Transportation Research Board annual meeting and learning from a peer agency in Phoenix about the concept, which staff decided to apply to Hampton Roads. At the time, a large number of high-profile incidents were occurring at tunnel and bridge locations. The perception had developed that incidents were not being cleared as quickly as they should be, and that clearing incidents was consuming more lanes than necessary and causing extended traffic delays. Elected officials requested that the HRPDC staff address incident management, which is the first task of the RCTO. The RCTO working group developed a draft charter for the RCTO in October 2005, which describes how the working group is formed under the

[2] Available at: http://cts.virginia.edu/stl_adms.htm.

authority of the Hampton Roads Transportation Technical Committee. The RTCO working group is chaired by James Mock, an operations engineer at the STC.

The RCTO's first task was to develop an incident management plan, which was initiated in 2005. CMAQ funds were allocated to hire VDOT's on-call consultant to assist with development of the RCTO document. Members of the RCTO include a range of enforcement, emergency response, and engineering and transportation stakeholders. The group meets monthly.

Hampton Roads RCTO Working Group Participants include:

- VDOT Smart Traffic Center (chair);
- Virginia State Police;
- Virginia Association of Chiefs of Police;
- VDOT Traffic Engineering (District and Central Office);
- VDOT Operations Management (Central Office);
- VDOT Environmental Office;
- FHWA Virginia Office;
- HRPDC;
- Local Fire Chiefs (York County, Hampton, Newport News, Chesapeake);
- Local Police Departments (Hampton, Newport News, Norfolk);
- Local Traffic Engineers (Hampton, Newport News, Norfolk, Virginia Beach); and
- Members of the towing community.

The RCTO has been instrumental in improving the dialogue between State police, fire and rescue, and traffic engineers. The process has evolved from little dialogue occurring a few years ago to regular meetings with high-level representatives of these agencies. As defined in its charter, the RCTO has developed performance measures, and data will be collected at 12 locations selected for evaluation of the duration of clearance time and number of incidents.

Another related process that has resulted in better stakeholder coordination was the addition of incident management stakeholders to HRPDC ITS stakeholders group. When updating the ITS strategic plan in 2004, Hampton Roads decided to add incident management representatives to the committee. As a result, members of the ITS committee also began attending incident management committee meetings, and a dialogue between the two groups was initiated.

Performance Measures and Data Sources

HRPDC's primary congestion performance measure considers segment level of service (LOS) based on traffic volumes and Highway Capacity Manual methods. HRPDC staff calculates the congestion level by lane-mile based by segment LOS for morning and afternoon peak hours.

The data required for this measure is segment travel volumes in 15-minute intervals, which the agency receives from VDOT. Data is also collected from four localities that maintain their own traffic monitoring programs. A few of the larger jurisdictions have established their own smart traffic centers, including Chesapeake, Virginia Beach, Norfolk, and Hampton. Connections are either in place or planned between these centers and the regional STC, with this data also being archived at the Smart Travel Lab. Newport News is moving in the direction of setting up their own centers as well and hopes to have their own traffic management systems running in the next few years.

Another data source is travel time/speed runs that are conducted every five years for the entire thoroughfare system for a.m. and p.m. peak hours. Using this data, HRPDC staff are able to create contour maps, shown in Figures 1 and 2, for 12 activity centers. The maps show improvement or deterioration in congestion by displaying contours representing 10-minute or 20-minute auto travel times from the centroids representing regional points of interest at 5-year intervals.

As of 2006, HRPDC is investigating the use of cellular phone wireless data. A demonstration project is being conducted by the Smart Travel Lab, VDOT, and Airsage, Inc. to test the technology. With this new data collection process Hampton Roads may be able to obtain average speeds by day. If successful, HRPDC could discontinue the use of loop detectors and obtain data for the entire roadway system.

Rather than using LOS for its performance measure, HRPDC would prefer to use data on delay and travel times and speeds, which would relate better to operations. The agency has started collecting travel times and speeds on the Interstate system to measure travel time variability. To consistently use these measures they would need better system coverage and data

quality. The agency is hopeful that the cell phone pilot project will be successful and will provide a new option for collecting this type of data.

HRPDC is also considering using person throughput as a performance measure. However, the region's HOV and transit systems (bus and ferry) are not widely used at this point, and traditional measures capture most travel movements. Transit demand is increasing, although the region is struggling with funding transit. Transit alternatives are part of the long-range plan, and light rail for the City of Norfolk is getting very close to having funding secured and moving forward.

Congestion Management Process

HRPDC completed its two-part CMP in December 2004 and April 2005. The CMP documents the state of system performance, identifies congested areas, and proposes mitigation strategies. As part of the CMP, locations that meet the following three characteristics are identified:

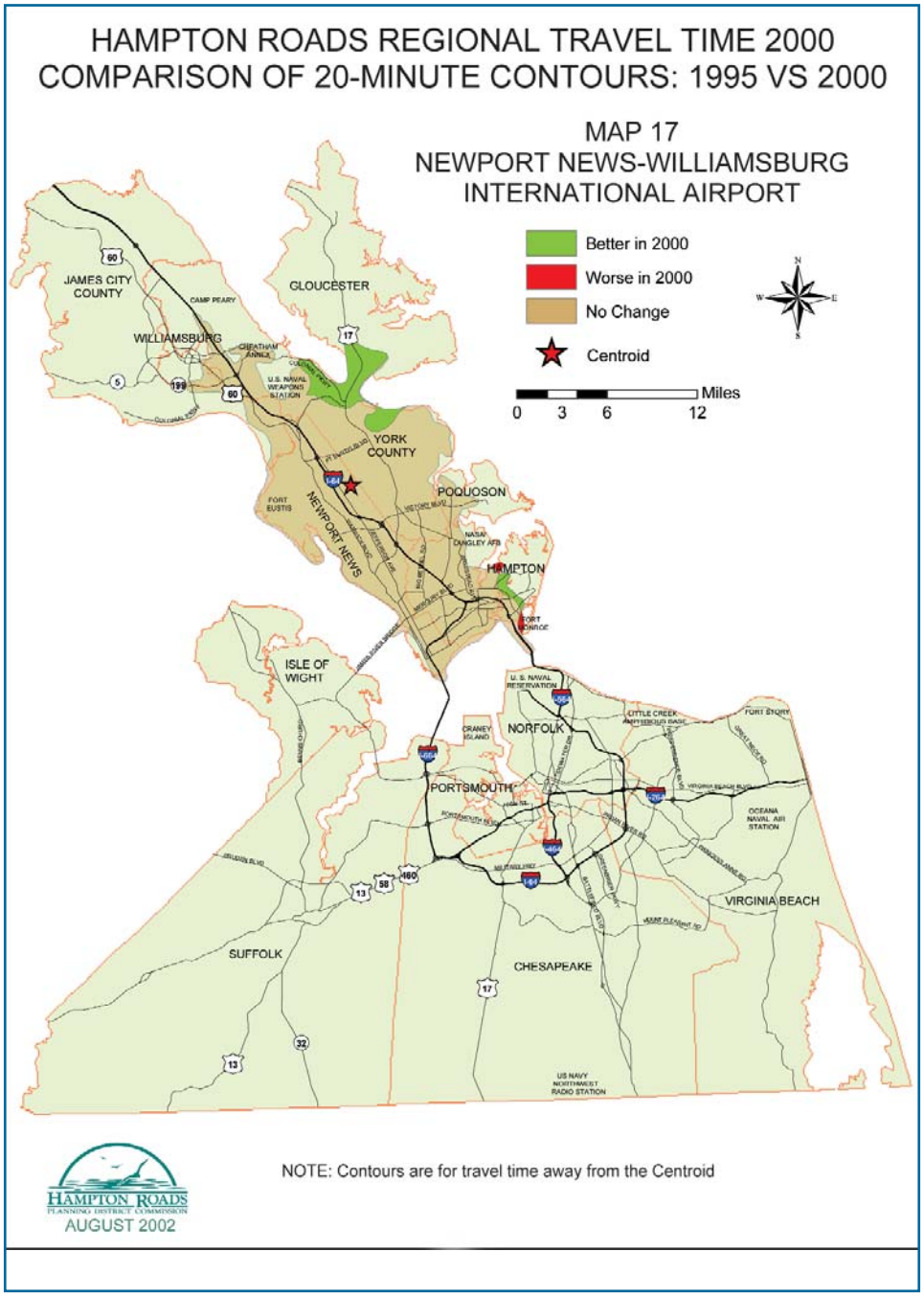
- Roadway segments that are currently congested;
- Roadway segments that are also expected to be congested in the future (20-year horizon); and
- Roadway segments for which no improvements are funded in regional long-range plans.

In the most recent update, eight percent of the lane-miles in the CMP network met these three characteristics during the a.m. peak and 12 percent of lane-miles met the criteria during the p.m. peak.

For each of the congested roadway segments, congestion management strategies are recommended for evaluation. In the HRPDC CMP Toolbox, strategies are grouped into five categories, with one-third of the strategies listed under operations. The categories of strategies include:

1. Eliminate Person Trips or Reduce VMT (growth management, congestion pricing, travel demand management);
2. Shift Trips from Auto to Other Modes (public transit improvements, bike/pedestrian);
3. Shift Trips from SOV to HOV (encourage HOV use, transportation demand management);
4. Improve Roadway Operations (traffic operational improvements, freeway operations and management, access management); and
5. Add Capacity (addition of general purpose lanes).

Figure 2 – Regional Travel Time 1995 versus 2000



HRPDC recommends and implements a wide range of these strategies. Although Hampton Roads has completed studies involving land use planning and land use is included in the CMP Toolbox, in Hampton Roads and the State of Virginia, local jurisdictions are solely responsible for land use planning, and HRPDC cannot implement land use policy changes.

Additionally, the agency prepared a Congestion Management System Special Report: State of Transportation in Hampton Roads, an abbreviated version of its CMP, designed to document the state of system performance. The nine-page document was targeted to elected officials and the general public. HRPDC sent out thousands of copies of the report to groups including civic leagues, planning commissions, churches, and the State General Assembly. Presentations are also made by the agency staff to many of these groups.

Project Programming and Implementation

HRPDC has been successful in programming and implementing a large number of CMP projects. Between 1993 and 2006, the region received over $200 million in Regional Surface Transportation Program (RSTP) and $90 million in Congestion Mitigation and Air Quality Improvement Program (CMAQ) funding. Thirty-eight percent of the total CMAQ funds were allocated to bikeway/pedestrian, new transit service, bus replacement, and TDM projects. Signal system integration, intersection geometric improvements, and ITS projects received 62 percent of the total funds. Of RSTP funds, 65 percent went to highway projects and 35 percent went to transit and bikeway projects.

A project selection process is in place for RSTP and CMAQ funds. HRPDC receives proposals from local governments and transit agencies for those programs. The MPO staff evaluates the projects and presents the results to the technical committee. In Hampton Roads, projects are selected for funding with CMAQ funds based on the amount of air quality improvement expected per dollar spent, with improvements measured as reductions in the emissions of volatile organic compounds (VOC) and nitrogen oxides (NOx). The region has not faced challenges in getting operations projects implemented because these projects tend to score well in terms of reducing emissions.

"We can say with great confidence that having a CMP has measurably improved regional cooperation in selecting and implementing congestion relief projects. Because we have a CMP we can document the level of congestion, apply for funds, implement projects, and see improvement."

– Camelia Ravanbakht, Ph.D., Principal Transportation Engineer, Hampton Roads Regional Planning District Commission.

Project Evaluation

In 2002, HRPDC conducted a post-implementation study in order to validate the CMAQ analysis methodology and measure the actual cost-effectiveness of projects. As part of the analysis, projects were evaluated based on other relevant measures, such as intersection delay for geometric improvements and signal retiming, ridership levels on transit, and bicycle counts on bikeways. The overall results showed that no one category of projects performed better than the others, and that successful projects came from a mix of project categories. Additionally, the evaluation showed that usage of nonhighway projects was significantly overestimated and that better estimates are needed. Another conclusion of the study was that better marketing and public information is needed, especially for rideshare and other TDM projects, in order to capture all potential users. In addition to the CMAQ evaluation, one or two special studies are conducted each year to evaluate congested intersections, corridors, or subareas.

Benefits of Hampton Roads Operations Approach

In the Hampton Roads region, stakeholders and local government work together very effectively. The overall benefits of the CMP process in the HRPDC region include the following:

- Improved the efficiency of the MPO's CMAQ project solicitation process by substantially reducing the annual number of CMAQ project submittals while at the same time improving the quality of CMAQ project applications. Project submittals became more regional in nature and thus more beneficial to air quality and congestion relief;
- Coordinated road/bridge/tunnel closures and maintenance work across jurisdictional boundaries among planners, city traffic engineers, state, emergency responders, and transit operators to reduce conges-

tion impacts of closures and construction/maintenance on major facilities;

- Facilitated regional traffic signal coordination to meet air quality attainment goals;
- Police and fire became aware of the importance of clearing an incident quickly to avoid congestion;
- Helped justify financial resources for operations projects such as issuing bonds or access to transportation funds;
- Improved understanding by the public and elected officials of the importance of coordinating operations regionally;
- Joint purchasing arrangements made possible, which save money;
- Standardized operations data for use in transportation planning; and
- Coordinated security and safety planning for mass evacuation during a hurricane event and provided access to major navel port facilities. MPO hosts meetings and makes model runs for development of security and evacuation safety plans.

One specific CMP project that HRPDC implemented and that showed benefit was a set of geometric improvements and signal retiming in Virginia Beach at Lynnhaven Parkway and Viking Drive. The project designed to reduce P.M. peak hour congestion yielded the following benefits:

- Reduction in intersection delay of 74.3 seconds per vehicle;
- Reduction in vehicle delay of 666.5 hours per day;
- Reduction in HC of 10.2 kg/day;
- Reduction in CO of 205.52 kg/day; and
- Reduction in NOx of 4.07 kg/day.

The benefit of the CMP is that local jurisdictions are aware of the situation and can use this information to request regional STP and CMAQ funds. In addition, HRPDC's evaluation efforts have shown that the strategies implemented through the CMP have been successful in helping to reduce congestion in the region.

Challenges

Many stakeholders agree that implementing technology is only half the solution to operations improvements. Another important component is maintenance of the technology. Jurisdictions have had some trouble maintaining the data monitoring system as society is moving to a 24/7 culture and the transportation system receives heavy use nearly round the clock, leaving little time for ongoing maintenance to be performed.

Hampton Roads has faced data quality challenges due to loop failure and limited quality control. VDOT is responsible for maintenance of the loop detectors. VDOT is replacing embedded loops with detectors on the side of the roadway, which is expected to provide more reliable data with significantly less maintenance required. A second issue is completeness of the data, as it includes only information for the instrumented portion of the Interstate system.

Another data challenge is the lack of real-time data on arterials. Continuous collection stations in over 40 locations operate year-round. To obtain that data, Hampton Roads must make a request each year for the previous year. The vision at the regional level is to one day have access to data for more locations on both Interstates and arterials.

Lessons Learned

HRPDC feels that the primary key to success in integrating congestion management processes and operations is to develop and maintain a high level of cooperation among stakeholders. As a result, the agency members can collectively determine their priorities, pursue funding, and implement projects.

FIGURE 3 – HRPDC ORGANIZATIONAL CHART