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A Qualitative Study of the Core Functions of Smart Traffic Centers at the Virginia Department of Transportation

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Supplementary Notes

Abstract

The Virginia Department of Transportation's (VDOT) Smart Traffic Centers (STC) were established to address the growing problem of increased congestion caused by traffic demand exceeding roadway capacity. Initially, the core function of the STC was simply to get information to the public. However, VDOT's STCs were established at different times with different approaches to meet regional traffic needs. As a result, practices, processes, organizational structures, and relationships with other VDOT functions vary widely among STCs. With this complexity, the definition of the STCs core functions has evolved. To develop a clear understanding of these core functions, a group composed of STC operations managers was formed and this study was undertaken.

The study found that the core function of VDOT's STCs has expanded beyond disseminating information to the public, although that activity remains a critical tool of traffic and incident management. Specifically, STCs have four core functions: (1) traffic management, (2) incident management, (3) emergency operations/emergency management, and (4) regional networking. Incident management activities and events define the vast majority of work and, therefore, drive the development of systems, procedures, policies, and relationships with communities, agencies, and private companies with whom an STC must work on a daily basis.

Further, the study determined that a fully developed Safety Service Patrol (SSP) greatly enhances the functionality of the STC. Where the SSP is fully operational, the STC's ability both to gather information and to interact directly with the public and other state, local, and federal agencies is complete. Without a functional SSP, the STCs ability to manage incidents directly (and therefore traffic) is limited, impaired, or disabled.

In addition, the study found that STCs are VDOT's most direct link to the public and that regional networking is critical to successful STC operations. VDOT's STCs are, therefore, critical to coordinating and working directly with local, state, and federal agencies. This is particularly clear in regions such as Northern Virginia and Hampton Roads, where the large number of cites and communities that directly abut increases the number of responder agencies and organizations. The inherent complexity of such regions requires careful coordination and networking to ensure the safe and efficient management of incidents and emergencies and to mitigate their impact on regional traffic flow.

The recommendations offered in this report will help coordinate STC development. Although there will always be some variation because of regional needs, STC practices will benefit from increased and continual sharing of information and practices across locations. Fully developed SSPs are arguably the single most practical and powerful resource an STC has to manage incidents, as well as to develop strong relations with the public, local communities, and other agencies. Because of the necessary interface with communities, cities, and agencies at multiple levels, STCs are perfectly situated to develop regional relationships and structures; therefore, regional strategies for traffic operations should be shared among STC locations.

FINAL REPORT

A QUALITATIVE STUDY OF THE CORE FUNCTIONS OF SMART TRAFFIC CENTERS AT THE VIRGINIA DEPARTMENT OF TRANSPORTATION

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ACRONYMS

CAD	Computer-Aided Dispatch
CB Radio	Citizens Band Radio
CMS	Changeable Message Sign
CPR	Cardio Pulmonary Resuscitation
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HOV	High-Occupancy Vehicle
ITS	Intelligent Transportation Systems
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NOVA	Northern Virginia
PIO	Public Information Office
RCTO	Regional Concept of Traffic Operations
RHIM	Regional Highway Incident Management
RWIS	Roadside Weather Information System
SSP	Safety Service Patrol
STC	Smart Traffic Center
TEOC	Transportation Emergency Operations Center
UVA	University of Virginia
VATRO	Virginia Towing and Recovery Operations
VDOT	Virginia Department of Transportation
VOIS	Virginia Operational Information System
VSP	Virginia State Police

ABSTRACT

The Virginia Department of Transportation's (VDOT) Smart Traffic Centers (STC) were established to address the growing problem of increased congestion caused by traffic demand exceeding roadway capacity. Initially, the core function of the STC was simply to get information to the public. However, VDOT's STCs were established at different times with different approaches to meet regional traffic needs. As a result, practices, processes, organizational structures, and relationships with other VDOT functions vary widely among STCs. With this complexity, the definition of the STCs core functions has evolved. To develop a clear understanding of these core functions, a group composed of STC operations managers was formed and this study was undertaken.

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INTRODUCTION

In 1997, *The Virginian-Pilot*, a major newspaper in Hampton Roads, Virginia, reported that a new $13 million technology-driven system would be ready for testing that summer in the Hampton Roads region as a way to ease congestion, a problem that had proven impossible to address through conventional means. "'We cannot build our way out of this problem,' said Para M. Jaya Singhe, chief traffic engineer for Norfolk. . . . 'We need to use technology to increase the efficiency and safety of the existing system.'"[1]

The new technology was called an Intelligent Transportation System (ITS), and a Smart Traffic Center (STC) in Hampton Roads was developed to "manage traffic" by providing real-time information to the public through a variety of means "so they can make good decisions about travel plans," said William J. Cannell, Virginia Department of Transportation (VDOT) spokesman. "Our hope is people will look at this information and decide to use alternate routes, delay their trip or not go at all."[1]

At that time, the core function of the STC was simply to get information to the public. Between 1997 and 2005, VDOT established six STCs in six districts across the state: Hampton Roads, Northern Virginia (NOVA), Richmond, Salem, Staunton, and Fredericksburg. In 2006, VDOT adopted a regional approach to system operations, reorganizing the state into five regions, each with an attendant STC. The status of the Fredericksburg STC is currently undetermined, but it remains in operation.

PURPOSE AND SCOPE

VDOT's STCs were established at different times, with different approaches, to meet traffic needs unique to the particular region. As a result, practices, processes, organizational structures, and relationships with other VDOT functions vary widely among STCs. With this complexity, the definition and understanding of the STC core functions have evolved. The purpose of this study was to determine how STC core functions are currently understood and fulfilled: What are they? How are they defined and performed at each location?

For the purposes of this study, a "core function" is a major activity the STC performs in the service of traffic operations.

METHODS

In keeping with the methods of a qualitative study, data were collected to determine the core functions of VDOT's STCs. Data were collected through interviews, group discussions, document analysis, and direct observations of VDOT's STCs. As noted previously, Fredericksburg is not currently defined as an STC, but useful data were collected from this operation for this study, and thus it is referred to as an STC in this report.

Interviews

A preliminary series of interviews was conducted with STC program managers in person to establish a basic understanding of STC organizational structure, management, and functions. A second sequence of interviews was conducted with operations managers and staff at each location to clarify questions and check the accuracy of the data. A third sequence of interviews was conducted by telephone to address follow-up questions and complete data collection

Group Discussions

A Community of Practice was established for the STC operations managers to facilitate more frequent and detailed communication than was formerly possible. Beginning in March 2005, a series of meetings was conducted with the operations managers from each STC, as well as the Transportation Emergency Operations Center (TEOC). These discussions served as opportunities to gather and coordinate data on STC core functions across locations.

Document Analysis

An intranet team site was established for the posting and collection of STC management documentation, according to location and topic. Documentation was reviewed to verify and support oral descriptions of core functions as stated in interviews and group discussions.

Direct Observations

Individual trips were made to each STC location for direct observations to confirm the accuracy of core function descriptions as reported in group discussions and posted documentation.

RESULTS

Three core functions are performed across all STCs, and a fourth is performed by all but one STC:

1. traffic management
2. incident management
3. emergency operations/emergency management
4. regional networking.

Each core function may be described in terms of a series of activities, systems, resources, or phases. Although the first three functions are performed at all locations, there are significant variations in application and execution among STCs because of differences in set-up history, organizational structure, regional highway characteristics, and transportation needs.

Core Function: Traffic Management

Traffic management is described by STC operations managers as "the common state" or "normal mode" in which an STC operates. Traffic management is the baseline activity that each STC conducts to monitor the state of traffic across a broad, defined region and to communicate the status of traffic conditions and needs to the appropriate audience. One STC operations manager described traffic management as reflective of the perspective of the shift supervisor, whose role is to keep abreast of incidents across a region, as opposed to that of the control room operator, who focuses on individual incidents. Traffic management activities may be described as follows:

- *Monitoring*. This is the most basic, ongoing activity conducted by the STC: the continuous monitoring of traffic conditions throughout the region.

- *Response*. This refers to the determination of what resources or assets should be dispatched on a regional level in response to the impact a given incident may have on the region and then either dispatching them directly or coordinating with local residencies or other emergency responders to do so.

- *Traffic authority*. This refers to an STC's ability to close a work zone in the event that an incident elsewhere in the region has shifted traffic patterns and that demand has increased to the point that additional traffic lanes must be made available to relieve regional congestion. A more proactive example exercise of the STC's traffic authority is the daily management of reversible lanes, high-occupancy vehicle (HOV) lanes, and ramp signals in NOVA and Hampton Roads.

- *Information dissemination*. This refers to how the STC distributes recurring delay, travel times, and incident information to the general public, along with impact information on traffic and suggestions for alternate routes. This is a critical component, as VDOT's STC's are the primary state entity responsible for communicating information to the general public through changeable message signs (CMS), Highway Advisory Radio (HAR), internet sites, and 511.

Although traffic management is considered the normal mode of operations, initial data collection found that the primary focus of day-to-day business actually centers on incident management, as the function that defines both daily activities and the overall role of the STC.

Core Function: Incident Management: "When Traffic Management Meets the Real World"

If traffic management describes the "normal mode" of keeping traffic flowing as smoothly as possible over the course of the day, *incident management* refers to the activities of dealing with each particular accident, scenario, or incident that may interfere with normal traffic flow. These activities are usually carried out at the STC operator level in cooperation with an SSP patroller (where available).

Phases of Incident Management

Incident management can be described as having five phases:

1. *Detection.* This is defined as when the STC first detects an incident independently or is notified of an incident by an outside source.

2. *Verification.* Because incident reports can be unreliable, even from official sources, it is critical to verify not only that an incident exists but also its location, severity, and nature.

3. *Response.* This refers to the determination of what resources or assets should be dispatched to manage and resolve the incident and then either dispatching them directly or coordinating with local residencies or other emergency responders to do so.

4. *Clearance.* This describes the period of time when resources and assets are on the scene to manage and resolve the incident and restore traffic to normal flow.

5. *Information Dissemination.* This refers to how the STC distributes incident information to the general public, along with impact information on traffic and suggestions for alternate routes. This is a critical component, as VDOT's STCs are the primary state agency for communicating information to the general public through CMSs, HAR, internet sites, and 511.

As stated previously, VDOT's STCs were established at different times and have developed a variety of mechanisms to perform each of these activities. Table 1 lists the mechanisms VDOT's STCs have in common for each phase. Table 2 details the mechanisms each STC uses according to phase in addition to those listed in Table 1 but that are not used across all VDOT STCs. For example, most STCs use cameras for detection, but Table 2 shows that not all STCs have cameras.

Table 1. Incident Management Mechanisms, by Phase, Common to VDOT's STCs

Detection	Verification	Response	Clearance	Information Dissemination
Agency call in's	VSP	VDOT field personnel	VDOT field personnel	511
Commercial media	Field personnel	Emergency response agencies	Emergency response agencies	CMS
Radio scanners	Agency call in's/ emergency responders	VOIS	VOIS	VOIS
VSP CAD System		Phone calls to follow up on original detection	Phone calls to follow up on original detection	VDOT radio
		Incident response plans	Response plans	VOIP
				Email
				Local media
				District PIO
				Internal communications
				Emergency responders

VSP = Virginia State Police, CMS = changeable message sign, VOIS = Virginia Operational Information System, CAD = computer-aided dispatch; PIO = public information officers; VOIP = Voice Over Internet Protocol.

Table 2. Incident Management Tools Specific to Each STC by Phase and Location

STC	Detection	Verification	Response	Clearance	Information Dissemination
Fredericksburg	SSP, public calls during operating hours	SSP	SSP	SSP	HAR
Hampton Roads	Cameras, SSP, traffic count stations, public calls 5 P.M.–8 A.M., reports from municipal STCs, military	Cameras, SSP, 70+ video monitors	SSP, HOV operations, towing and recovery, municipal STCs	SSP, HOV operations, towing and recovery, municipal STCs	HAR, UVA
NOVA	Cameras, SSP, traffic count stations, public calls 5 P.M.–8 A.M.	Cameras, SSP, electronic detectors	SSP, signal timing; HOV operations, towing and recovery	HOV operations, towing and recovery, SSP, signal timing	HAR, UVA
Richmond	Cameras, traffic count stations, RWIS	Cameras, detectors			HAR
Salem	SSP, RWIS, Fancy Gap Fog Detection System, traffic count stations, public calls 5 P.M.–8 A.M.,	SSP	SSP	SSP	HAR, UVA
Staunton	Cameras, SSP travel time system, RWIS, Afton Fog Detection System, traffic count stations, County/City 911 centers	Cameras, SSP	SSP, signal timing; towing and recovery	SSP, signal timing, towing and recovery	UVA

SSP = Safety Service Patrol, HAR = Highway Advisory Radio, HOV = high-occupancy vehicle.

In subsequent visits to each STC, Tables 1 and 2 provided the basic framework for examining the operations of each STC's operations, and it was confirmed that these lists accurately described their activities. In addition, while all STC's perform all these activities, conceptually they were considered elements of the single broader function of incident management.

Further, it was clear at each location that incident management was seen as the primary function. How that primary function was described varied from location to location and was informed by various factors, including the array of operational elements available to the STC, organizational structure, and specific regional demands. One element that varied greatly among locations was the Safety Service Patrol (SSP), and it is clear that the presence or absence of an SSP makes a critical difference to the overall functionality of the STC.

Safety Service Patrols

Role in STC Operations

SSPs are critical to the incident management functionality of the STC, but the relationship between the two varies according to location, as well as the extent to which the SSP operates. For example, Richmond currently does not have an SSP, whereas Staunton and Salem each have a limited SSP of four patrollers. The Fredericksburg SSP has more patrollers but does not report to the STC.

Where the SSP is limited or absent, STCs must rely on district or residency resources to respond to incidents. Since these resources are not dedicated to incident response, response times and effectiveness can vary. For example, during one visit to an STC where the SSP is limited to a tightly defined area, it was learned that a milk truck had overturned at approximately 4 A.M. on an interstate corridor outside the SSP's defined patrol range, causing significant delays. There were no cameras or other technology covering that section of the corridor. At 9 A.M., the STC had no way of ascertaining the status of the incident, let alone of managing it directly. The Virginia State Police (VSP) was asked for assistance, and 20 minutes passed before they supplied a vague, uninformative response.

The situation is very different for Hampton Roads, which currently has approximately 42 safety service patrollers, and NOVA, which has around 50 patrollers. For example, during a visit to the Hampton Roads STC, a truck driver became ill at the beginning of rush hour and had to pull off to the side of the road. Unfortunately, he was forced to do so on an overpass, blocking the end of the onramp interchange between two major corridors. Within minutes, a pair of SSP trucks were on the scene; the first closed the right lane of the overpass, directing traffic around the truck, while the second closed the feeder ramp from the corridor below. Although motorists had to be redirected, traffic was not significantly slowed on either corridor and the VSP and emergency medical technicians (EMTs) responding to the scene were free to concentrate on their roles. This example illustrates how the SSP is an indispensable component of incident management operations.

SSP Functions and Responsibilities

It is widely understood that one of the primary daily functions of the SSP is to provide motorist assistance. In 2005, the Hampton Roads SSP alone provided aid to more than 32,500 disabled motorists and vehicles. Such aid includes the following services:

- Provide first aid and/or cardio pulmonary resuscitation (CPR).
- Jump start vehicles.
- Provide water, fuel, directions, Virginia state maps, and cellular services.
- Perform minor mechanical repairs, e.g., change tires, tighten cables or hoses.
- Remain with a disabled motorist as the situation requires until assistance arrives.

In addition to their work for the motoring public, the SSP performs a critical incident management role through activities such as these, taken from the Employee Work Profile for NOVA's SSP Supervisor:

- Patrol interstate system on a continuous, rotating shift, reporting traffic pavement conditions, sign and guardrail conditions, drainage problems, and any related safety or maintenance problems.

- Maintain an average of 8 hours patrolling per 10-hour shift.

- Report all activity on the SSP laptop system, SSP Automatic Vehicle Locator system and through VSP and NOVA STC dispatchers.

- Respond to calls on the interstate as dispatched, using the principles of defensive driving.

- Evaluate the situation to determine necessary resources from fire, police, etc.

- Perform necessary life- and property-saving measures, such as first aid/CPR and basic firefighting.

- Operate heavy equipment, to include large and small wreckers, crash cushions, loaders, and sweepers as necessary.

- Report major incidents and closures to the operations manager and the assistant operations manager as necessary.

- Safely perform aggressive measures to re-open travel lanes of interstate during incident clearing stages.

- Maintain a level of incident management records consistent with others in the unit.

SSP as "Live Sensors"

For Hampton Roads, the SSP was described as "the scouts for the cavalry." With 42 patrollers and two satellite SSP locations, the SSP provides critical services in support of STC operations. As the Hampton Roads STC operations Manager reports, one of these services is to provide accurate, real-time information of incidents and traffic conditions beyond what is visible on camera.

> We have all of these ways to tell the public "X" but we only have so many ways to find out about "X" to tell the public; we can look at our cameras, we can list monitor scanners, and we also rely on the drivers who are out there on patrol routes to give us feedback, "Hey I am at this location; traffic is only doing this right now" or "this is the condition out here, and you're disseminating 'X' through signs or radio, but this is what I am experiencing out here on the road." So they're a live sensor for us.

The "live sensor" function is extremely important. Even though the Hampton Roads STC has 150 cameras and the most extensive video display of all of VDOT's STCs, with more than 70 wall-mounted monitors, a 21-foot by 9-inch projection screen that can display six image feeds, and four more monitors at each operator's workstation, there is simply no way to cover every mile of roadway with video. Even if there were, it would then be impractical to provide enough screens to display all the video from all the cameras. Further, operators do not have the time simply to sit and watch screens for incidents. With the SSP on the road, the STC has a versatile, reliable, and active information source for detecting and verifying incidents and traffic conditions. The Hampton Roads STC reported that patrollers were responsible for detecting approximately 70 percent of incidents managed in 2005.

To support the utility of the information source, NOVA's 50 patrollers are fully integrated into STC operations and capable of communicating across various populations, not only with the STC and other SSP units, but also with the VSP, other emergency responders, and the general public. NOVA SSP trucks are equipped with the following:

- laptops with wireless connections to access cameras via the internet site, Trafficland
- VSP computer-aided dispatch (CAD) access and radios
- VDOT radios
- Nextel cellular phones
- CB radios.

Core Function: Emergency Operations and Emergency Management

Emergency Operations: "Incident Management on Steroids"

Emergency operations is a core STC function that uses all the incident management tools described previously; it may be thought of as incident management on a broad scale; during weather-related (snow storms, flooding) and other extraordinary events, the rate of traffic incidents rises dramatically (hence the expression from one STC operations manager, "incident

management on steroids"). During such events, the STCs become VDOT's regional emergency operations centers responsible for the following:

- dispatching VDOT personnel throughout the districts to weather-related incidents
- coordinating with the other public safety agencies
- coordinating press releases with district public information office (PIO) staff.

For example, the Control Room Supervisor for the Richmond STC reported incident statistics gathered for Hurricane Isabel in September 2003 prior to CAD integration. The incidents were obtained through telephone notification from state and local police and VDOT/VMS, Inc., calls.

> Although this event actually stretched on for days, I decided to capture the amount of activity for a 22-hr. time period from 10:01 a.m. on 9/18 (first effects of Tropical Storm force winds) until 08:04 a.m. on 9/19 (several hours after the storm had passed). The Isabel event was by far the biggest event that we've handled, however, Tropical Storm Gaston (Richmond Flooding) ran a close second.

In 2003, the Richmond STC was averaging 437 incidents per month; during the 22-hour period between the onset of tropical force winds and several hours after the storm passed, it handled 144 incidents, "and some of these were multiple downed tree calls and high water calls that were grouped into single incidents." For the complete statistics on this weather event, refer to the Appendix.

Emergency Management

Emergency management is not an everyday function of the STC and operates at a higher level than emergency operations. *Emergency management* may cover hurricane evacuations, responses to natural or manmade disasters, and evacuation-type events that affect the entire region, requiring an STC to coordinate with local and statewide agencies.

With one notable exception, the emergency management experience has largely been limited to planning and practice sessions. For example, the Fredericksburg STC operations manager reported that his STC is involved in disaster planning for the Dominion Power North Anna nuclear power plant.

> We're involved in their evacuations plan . . . because that is a lake and it has a dam on it . . . and what would [happen] if the dam should be lost. Just to give you a little trivia, the dam is 27 miles away from I 95. if the dam was to have a hundred percent catastrophic failure and flood the North Anna River at I 95, I 95 would be under 17 feet of water.

In such an event, the STC has the infrastructure to collect information on how the roads are affected and to communicate the public the exact extent of the event, what roads are affected, and what alternate routes to take or areas to avoid if necessary.

With emergency management, the STC has to coordinate with other agencies such as the military, the National Guard, or the VSP in a different way than in emergency operations. Often, these agencies will take the lead, sometimes even establishing a presence in the control room,

while STC personnel provide support. The Control Room Supervisor in Hampton Roads reported an example of a training exercise his STC ran with various agencies in 2004 called Determined Promise.

> It was a [simulated] large scale terrorist attack, barges going up the river with some sort of terrorist type substance. Richmond's racetrack was bombed, and chlorine bombs [were placed] on the high-rise bridge and the tunnels [had] explosions and things like that, sending the whole area into panic really, and we actually physically had the Air National Guard participate in this exercise. They set up camp in our facility because we are a critical infrastructure; we're patrolling the perimeters on foot and going through their whole practice routine and we were practicing our security and we were responding to state police who were [in turn] responding to Virginia Department of Emergency Management.

A typical example of an actual emergency management experience is the Amber (child abduction) Alert. In this case, the VSP would request an alert through the TEOC in VDOT's Central Office, which would then distribute the information to other STCs as needed. In cases such as this, the STC

> stands by and wait for state police to give us commands…we really don't do anything proactively for Amber Alerts, we're in the receiving end, we provide the state a list of all the devices we have to support if you need us, and when you need us, you call us. You tell us what you want us to say and we do that.

The most exceptional example of emergency management would have to be VDOT's support in the emergency response to the attack on the Pentagon on September 11, 2001. In this case, not only were the NOVA STC's information and SSP resources fully engaged, but VDOT also supplied the portable lights needed to illuminate the interior of the crash site. The NOVA STC/SSP Operations Manager was on site to deploy this equipment inside the Pentagon and render critical support to the emergency and rescue teams.

The Richmond STC Operations Manager assisted with planning and coordinating activities in Washington, D.C., around the Pentagon. Because I-495 was shut down, the Richmond STC operated the CMS signs for Northern Virginia to let people in the District know which routes were available and which were not. According to the STC Operations Manager:

> We actually even acted as a VDOT liaison at the statewide EOC during the 9/11 event. We staffed the statewide EOC as VDOT representatives so we could coordinate with the Army, Virginia Power, [and others so] we could get information directly from our center or from the TEOC and disseminate that through all the other folks…we were the information hub and if the National Guard or the Army needed us to dispatch people out to where they were running convoys through for traffic management, we were the ones that they would come to.

Even though emergency management is a rare event, these examples clearly illustrate how critical it is for STCs to operate in close coordination with multiple agencies. This holds true for the daily responsibility the STCs have as a state agency responsible for traffic and incident management; they must work closely with private towing companies as well as with a tremendous variety of local, state, and federal agencies.

Core Function: Regional Networking

To the average motorist driving by an accident scene, it may appear as though the police, the fire department, EMTs, and VDOT are working as a single unit, but in fact each agency has very different jobs, priorities, and procedures. Working relationships among them are not only required by federal mandate, but must be painstakingly developed.

According to James Mock, the Operations Engineer at VDOT's Hampton Roads STC,, all jurisdictions receiving federal funds must adopt the National Incident Management System as disseminated by the Department of Homeland Security. This system requires that an Incident Commander, usually the most senior member of law enforcement or fire department present, take charge of the scene and direct all the responders present. When multiple state agencies or jurisdictions are present, a Unified Command System is instituted, with an identified command post that coordinates and directs all the state agency responders.

Federal requirements notwithstanding, effective coordination is enhanced by carefully developed relationships between agencies. For example, both NOVA and Hampton Roads reported that when the SSP first began operating, the VSP had no idea who they were and would even order them off the scene. Today, the SSP is regarded by the VSP as a critical part of incident management. To develop that type of relationship with all relevant responders and agencies from all communities within their areas, regional networking has become a core function of almost all STCs and is particularly developed in Fredericksburg, Hampton Roads, and NOVA. Richmond, the only STC without an SSP, did not report regional networking as a significant activity.

A detailed discussion of each STCs regional networking reveals a wide variety of strategies and activities. Some are highly dependent on the efforts and experiences of specific individuals. Others are more institutional in nature.

Salem

Of all the regional networks, Salem's is both the most informal and individual-dependent. Tim Martin, the Salem Smart Traffic Program Manager, grew up in the Salem area and knows several ranking VSP officers on a first-name basis. This greatly facilitates the establishment of communication, because meeting is as simple as Martin taking his operations manager over to the first sergeant's office without an appointment, knocking on the door, and walking in.

The most formal mechanism for developing regional relations in Salem is the quarterly responder meeting. Martin also coordinates these meetings, which are open to all first responder agencies. Participants include the VSP, locality fire departments, EMTs, and the Department of Emergency Management. According to the STC Operations Manager, Martin's personal relationship with local officials is critical to this formal networking as well:

> Tim coordinates it, sets it all up. Like I said, because he takes advantage of all those people he knows and basically it's kind of an open invitation to anybody who is considered a first responder, even down to HAZMAT people.

Staunton

The regional networking effort in Staunton is largely conducted through quarterly meetings with the Shenandoah Valley Regional Highway Incident Management (RHIM) Committee, which are facilitated by either the Director of the Staunton STC or the Staunton STC Operations Manager.

Held in the Harrisonburg area VDOT residency facility, these meetings began in 2003 to reduce incident duration without compromising responder safety by building relationships among agencies and localities. Participants include VDOT, all fire departments, emergency medical services, state and local police departments, towing and recovery companies, and the towns of Stanley and Luray.

Meeting activities center on incident management on the interstates and include post-incident review and discussion, as well as sharing of best practices, contact information, and incident management assessment. Joint projects have also developed, including one in which the VSP asked VDOT to do a speed study that included putting the following message on CMSs: "VA speed is 65. Reduce speed or face fines." Although no reduction in speed was measured, there was a slight reduction in the number of accidents on that stretch of I-81.

A second project has VDOT investigating towing programs in the area, coordinating which wreckers are on list with the VSP. The purpose of this program is to ensure that when a particular towing company is contacted, it is licensed and properly trained for response with the right equipment.

Fredericksburg

The Fredericksburg STC employs two main strategies for fostering close relations with other agencies in the region. The first is simply to maintain a workspace in the office where police officers can come in and work.

> We have the sheriff deputies and the state police coming in and out of our office all of the time. And all that does is foster a better working relationship when we get out on the road, so when I come to them and I say "how about giving me another lane?" He says "if I can, I will do that." It's not like "Who are you butting into our business here?" It is more like "We will work together; give me a little time and I will get you what you need." In those types of situations it pays dividends; it is always good to know who you are working with.

The second is to host and facilitate the annual RHIM Group that meets to discuss and resolve issues for various agencies. To that end, a formal Memorandum of Understanding (MOU) was composed "to set forth guidance for response to a highway incident in this multi-jurisdictional area." Signatory agencies include:

- Caroline County
- City of Fredericksburg
- King George County
- Spotsylvania County

- Stafford County
- VATRO Towing & Recovery
- VSP.

Formed in 2002, the RHIM Group used the MOU to outline how the disparate agencies could efficiently coordinate responses to highway incidents "through training of their personnel and mutual cooperation in response to incidents." The MOU includes definitions for the area to be covered by the agreement, the nature of an incident, the role of the incident commander, the responders, and the objectives of incident management.

Although the MOU plan explicitly does not supersede any given agency's policies, it does outline the overall strategy for coordinated incident management, including:

- how emergency responders should make use of roadway structures to access an incident
- how the role of incident commander is established as the first responder to arrive, but can shift as needed
- how vehicles should be parked to ensure maximum safety while minimizing impact on traffic flow
- the proper spotting and placement of emergency apparatus
- how an incident safety zone shall be established
- placement of traffic control devices
- a chart providing an example of how traffic control devices should be placed in relation to the posted speed limit
- guidelines for emergency vehicle visibility at night
- guidelines for clearing traffic lanes
- normalizing the area after the incident is cleared.

In addition to establishing the MOU, the Director of the Fredericksburg STC reported that the RHIM Group works collaboratively to improve the process of coordinating the incident management needs of multiple agencies, such as the medical examiner's office:

> What are their needs at the traffic incident? What are they looking for? What do they want? Why to we have to wait for the medical examiner to get here all of the time? Do we have to wait? Why couldn't we just put them in a rescue squad? Many of those questions were answered at our meeting and we actually included or now incorporate the medical examiner as one of our partners in our group.

Hampton Roads

Federal Regulatory Context

As one of the most populous and complex traffic regions in Virginia, the structure of regional networking in Hampton Roads is equally complex and requires a description to clearly situate VDOT's specific role. The Hampton Roads area is subject to specific federal planning regulations, as described on the Hampton Roads Planning District Commission website:

> Federal regulations require that urbanized areas throughout the United States have a Metropolitan Planning Organization (MPO) to conduct a continuing, cooperative and comprehensive transportation planning process. Urbanized areas are defined as areas with a population of 200,000 or greater, known as Transportation Management Areas (TMA). http://www.hrpdc.org/transport/mpo.shtml.

The metropolitan planning organization (MPO) for the Hampton Roads area is composed of the following members:

- City of Chesapeake
- City of Hampton
- City of Newport News
- City of Norfolk
- City of Poquoson
- City of Portsmouth
- City of Suffolk
- City of Virginia Beach
- City of Williamsburg
- County of Gloucester
- County of Isle of Wight
- County of James City
- County of York
- Transportation District Commission of Hampton Roads
- James City County Transit Authority
- Virginia Department of Transportation
- Hampton Roads Planning District Commission
- Federal Highway Administration
- Federal Transit Administration
- Federal Aviation Administration.

The MPO has in turn created a Regional Concept of Traffic Operations (RCTO) working group that is responsible for helping various MPO member agencies realize the impact caused by unnecessary lane blockage. When the number of MPO member communities is multiplied by the number of responder agencies each community has, each with its own procedures, history, and culture, this task becomes complex indeed. James Mock, the Operations Engineer at VDOT's Hampton Roads STC, is the Chair of the RCTO group.

RCTO Mission and Activities

The RCTO group meets monthly, alternating between the Hampton Roads STC and a location in Newport News. As Chair, Mock runs meetings, solicits support and participation from regional agencies and localities, and is responsible for coordinating the application to obtain a $400 thousand Congestion Mitigation and Air Quality grant to hire an engineering team to write the RCTO document.

The overall mission of the group is as follows:

- Describe the desired state of transportation operations in Hampton Roads, Virginia.

- Guide the region's many stakeholders in providing exceptionally well-coordinated Traffic Incident Management services to the motoring public

- Establish guiding principles, set performance measures, and evaluate response levels through after-action reviews. The RCTO will also evaluate policies and procedures that delay quick clearance of accidents and propose and advocate policies in support of incident management

The RCTO will determine how to use the incident management command structure and establish procedures for the management of high-profile events (e.g., incidents that incur fatalities or will block 50 percent of roadway capacity for more than 1 hour) and define the parameters of a HAZMAT spill. To this end, the RCTO organizes and hosts regular "post incident review" meetings with other agencies to examine specific incidents, agency response times, and interactions to collect lessons learned and identify ways to increase efficiency.

The RCTO is developing a "hub and spoke" plan for VDOT's STC coordination with locality STCs being built in Norfolk, Hampton, Newport News, Virginia Beach, and Chesapeake. Although the municipal STCs will monitor roads within city limits, VDOT will remain responsible for the major corridors that cross city lines. Therefore, VDOT's STC will be the database repository for all the locality STCs; if one of the municipal STCs wants to know what another municipal STC knows, it will go through VDOT to access that information. Mock reported that one of the greatest challenges in developing this "hub and spoke" approach has been to negotiate cultural change: it used to be that the local law enforcement and fire departments were their own entities, with their own histories, cultures, and traditions. This regional approach to transportation operations requires that they learn how to collaborate in ways they never had to before.

NOVA

Regional networking in NOVA consists of a unique combination of participation in formal organizations and activities driven by the individual experience and history of Chris Landis, the STC/SSP Operations Manager. Formal organizations dedicated to coordinating traffic incident management practices include:

- *The National Capital Regional Transportation Coordination Group.* VDOT's NOVA is instrumental in working with the District of Columbia Department of Transportation, the Maryland State Highway Administration, and the Washington Metropolitan Area Transit Authority in setting up the National Capital Regional Transportation Coordination Group, which will be matrixed with the 24 x 7 x 365 operations of its member agencies. It has been fully funded through a federal SAFETEA-LU grant and approved by the Metropolitan Washington Council of Governments' Transportation Planning Board. A concept paper describes the group's purpose as follows:[2]

> Transportation officials in the Washington area need enhanced means of managing transportation incidents and emergencies from a truly regional perspective, reacting cooperatively and effectively to incidents whose effects cross state boundaries, such as major crashes, extended lane closures, transit station closures, hazmat spills, or severe weather. This cooperation must extend across all phases of incident management, from preparedness to detection, response, recovery, and post-incident evaluation and analysis of lessons learned. Another part of this needed capability is the ability to incorporate public transportation more fully as a source and recipient of incident information and as a partner in regional incident management. The traveling public and news media also would benefit from a comprehensive source of information on current travel conditions, allowing travelers to make more informed choices and avoid unsafe conditions.

The I 95 Corridor Coalition. This organization comprises all the states, DOTs, and localities connected directly by I-95. A list of members and activities can be found on their website at http://www.i95coalition.org/members_list.html.

The Coalition website states:

> The I-95 Corridor Coalition is an alliance of transportation agencies, toll authorities, and related organizations, including law enforcement, from the State of Maine to the State of Florida, with affiliate members in Canada. The Coalition provides a forum for key decision and policy makers to address transportation management and operations issues of common interest.

- *The National Capital Freeway Incident Management Team.* This is the NOVA equivalent of the RHIM Groups in Fredericksburg and Staunton. The team has quarterly meetings and produces a *Team Operating Guide,* a pocket manual (just revised in February 2006) that includes guidelines on topics such as how to gauge incident severity; the response of the public information officer to incidents; the definition of the incident commander role's and responsibilities; and criteria for lifting HOV restrictions.

Because its current facilities cannot meet increasing space, technology, and security demands, the NOVA STC is developing a Public Safety Transportation Operations Center in cooperation with Fairfax County and the VSP. The facility is scheduled to be completed in May 2007. Occupants will include:

- Fairfax County Department of Public Safety Communications (911 Center)
- Police, Fire, and Emergency Management
- VDOT Traffic Operations, including the STC, signal operations, and SSP
- VSP Communications Center
- Police Department Forensics.

According to a briefing given to the Fairfax County Board of Supervisors in April 2005, key operational benefits of the center will include:

- a reduction of inter-governmental and inter-disciplinary barriers, allowing local and state transportation and public safety agencies to engage in cooperative planning, funding, and operations

- improvements in emergency preparedness, coordination, and response
- improvements in the interoperability of systems and shared information technology
- partnering of Fairfax County, the Commonwealth of Virginia and other agencies
- greater county/state/regional collaboration in the post-9/11 world
- a hardened, secure facility with redundant mission-critical systems
- growth through 2025, with additional expansion capabilities
- essential co-location of public safety and transportation functions and key emergency operations
- an improved Fairfax County EOC with adequate space, appropriate to support county business systems and information technology agencies; the Commonwealth of Virginia; and other public, non-profit, and profit private sector organizations during emergencies.

In addition to these formal, organizational affiliations, a great deal of regional networking is driven by initiatives that depend on the individual efforts and experience of Landis, the STC/SSP Manager. For example, Landis' experience as manager of a major towing company in NOVA is the basis for a personal relationship between Landis and key employees of towing companies that now hold exclusive contracts with NOVA counties.

NOVA currently works with more than 30 agencies, and Landis routinely receives calls on his cell phone from troopers on the road asking for information or providing notification of traffic conditions/incidents. This kind of informal communication is continuous and involves dozens of agencies, including:

- VSP
- police, fire, and EMTs from Prince William, Fairfax, Arlington, Alexandria, Falls Church, and Manassas
- Loudoun County Sheriff's office
- Maryland State Police
- Maryland State Highway Administration
- Metropolitan Washington Council of Governments
- Pentagon Police
- Office of Emergency Management for all jurisdictions
- Marines
- Army
- Delaware DOT
- Virginia Department of Emergency Management
- Capitol Police

- Federal Highway Administration's VOLPE National Transportation Systems Center
- Department of Homeland Security
- Quantico
- U.S. Park Police.

In addition, Landis spoke at the 30th annual Law Enforcement Management Training Conference and Exposition in Grapevine, Texas, on June 6, 2006, on behalf of the Capital Wireless Integrated Network on "Bringing Transportation and Law Enforcement Together." This network is the organization responsible for setting up and managing a network that allows local state and federal agencies wireless computer access across the Capital region. Landis also called a meeting on March 27, 2006, of all NOVA 911 Call Center managers, VDOT's Travel Information Program Manager, NOVA's District Operations Administrator, and VDOT's ITS Program Manager to promote the idea of VDOT's STC access to locality CAD info and how the STC can facilitate their access to each others' CAD information. Finally, Landis is working on an initiative to distribute camera phones to the VSP and other responders so that they can take pictures on scene and transmit them where needed so that other responders know what kind of equipment is needed at a given incident.

CONCLUSIONS

- *The core function of VDOT'S STCs has expanded beyond simply disseminating information to the public, although that activity still remains a critical tool of both traffic and incident management.*

- *STCs have four core functions:*

    1. traffic management
    2. incident management
    3. emergency operations/emergency management
    4. regional networking.

- *Incident management is the primary core function of the STC.* Incident management activities and events define the vast majority of work undertaken at STCs and drive the development of systems, procedures, policies, and relationships with communities, agencies, and private companies with whom the STC must work on a daily basis.

- *Regional networking is critical to successful STC operations.* This is particularly clear in regions such as NOVA and Hampton Roads, where the large number of cites and communities that directly abut multiplies the number of responder agencies and organizations. The inherent complexity of such regions necessitates careful coordination and networking to ensure the safe and efficient management of incidents and emergencies and to mitigate their impact on regional traffic flow. However, where the SSP is limited or absent, the STC must also network to develop good relations with agencies that do have the resources to respond to incidents directly.

- *Regional networking strategies often depend on the personal experiences of particular VDOT staff.* This dependence is present in each region but is particularly evident in Salem and NOVA. The efforts of these STC managers are highly laudable, but such dependence leaves VDOT vulnerable should these individuals leave the agency.

- *The presence of a fully developed SSP greatly enhances the functionality of the STC.* Where the SSP is fully operational, the STC's ability to manage incidents, gather information, and interact directly with the public and other state, local, and federal agencies is complete. Where a functional SSP is not present, the STC's ability to manage incidents directly (and therefore traffic) is limited, impaired, or disabled.

- *VDOT's STCs are critical to coordinating and working directly with other local, state, and federal agencies.* VDOT is responsible for maintaining the transportation infrastructure, and the STCs comprise VDOT's most extensive, direct, and continuous two-way interaction with the public. Therefore, the STCs provide a natural source of information and leadership in coordinating the efforts of diverse agencies with VDOT and each other.

- *Computer systems, procedures, and practices vary widely across STC locations.* Although it was beyond the scope of this report to discuss the variation of systems, procedures, and practices across STCs, this variation was a major challenge to data collection and presents significant issues for standardization of performance measures and processes. Roles and titles vary from location to location, as do organizational structures and responsibilities. Until this variation is minimized, the development of standardized performance measures and processes will remain problematic.

- *The STC operations managers benefited from the establishment of the Community of Practice.* The meetings held to discuss core functions comprised the first opportunity for STC personnel to communicate consistently with their counterparts or to visit each STC location in person. Prior to these meetings, each STC was developing solutions to similar problems entirely independently, such as how to forge a close relationship with the VSP. Discussions of core functions routinely yielded practical examples of best practices, lessons learned, and ideas for developing both individual STCs and improved traffic operations across the state.

RECOMMENDATIONS

1. *STC operations managers should continue to meet and share lessons learned and best practices in order to coordinate the development of practices and procedures.* Although there will always be some variation because of regional needs, coordinating and regulating practices and processes will lay the groundwork for standardized performance measures. Regular, face-to-face meetings will reinforce the ties among STCs and maintain effective sharing of information and practices across locations.

2. *SSPs should be fully developed at each VDOT STC.* The SSP is arguably the single most practical and powerful resource an STC can have in managing incidents and developing

strong relations with the public, local communities, and other agencies. In addition to serving as the STC's most reliable and versatile information resource, the SSP's physical presence on the road raises the STC's functionality from disseminating information to managing incidents and traffic directly.

3. *Each STC should institutionalize its regional traffic operations network.* Currently, regional traffic operations networks are greatly enhanced by or depend on the personal experiences and efforts of individual STC personnel. If these individuals were to vacate their positions, the STCs would need to reconstruct these networks. Since close working relationships with all regional responder agencies are critical to effective incident management, regional networking plans and procedures should be documented and formalized at each STC to the greatest practical extent.

4. *STC operations managers should share regional networking experiences and processes,* because close working relationships with all regional responder agencies are critical to effective incident management. Regional networking plans and procedures should be carefully developed at each STC to the greatest extent possible. Sharing experiences and processes across locations will support and enhance that development.

BENEFITS AND RISKS ASSESSMENT

The benefits of implementing the recommendations provided include the following:

- greater coordination and development of practices, policies, and procedures across STC locations
- enhanced opportunity for developing and standardizing performance measures
- more efficient and effective incident management in those areas where the SSP is underdeveloped or absent
- enhanced relationships with local communities and other state and federal agencies.

The expected risks of implementing the recommendations are as follows:

- With increased SSP on the road, there is an increased chance of injury or accidents for VDOT personnel. All precautions and training measures should be put in place to minimize such risk.
- Significant costs will be incurred for hiring, training, equipping, and supporting SSP staff. Although a comparative analysis of costs was outside the scope of this study, the cost of such implementation may compare quite favorably with the cost of camera installation. The SSP management currently in place in NOVA and Hampton Roads can provide critical information in establishing budget expectations and needs.

ACKNOWLEDGMENTS

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APPENDIX

HURRICANE ISABEL CALL STATISTICS FOR THE RICHMOND SMART TRAFFIC CENTER, SEPTEMBER 2003

DATE	TIME	COUNTY/CITY	ROUTE	PROBLEM
9/18/03	13:16	Brunswick	I-85 NB so. of Merridithville	Tree down
9/18/03	12:18	Brunswick	Rt. 674	Tree down
9/18/03	13:25	Brunswick	I-85 SB MM 35.5	Tree down
9/18/03	20:25	Brunswick	NB 85 @ MM 11.5	Tree down
9/18/03	11:39	Brunswick	Brunswick Rd.	Tree down
9/18/03	21:33	Brunswick	Rt. 684	Tree down
9/18/03	14:40	Brunswick	I-85 SB MM 34	Tree down
9/18/03	20:48	Brunswick	5786 Bell Field Rd.	Tree down
9/18/03	22:00	Caroline	SB MM 105	Trees down
9/18/03	20:30	Chase City	Rt. 689	Tree down
9/18/03	17:25	Chesterfield	NB MM 60	Tree down
9/18/03	20:41	Chesterfield	SB/NB MM 64	Power lines down
9/18/03	21:36	Chesterfield	NB Exit 61	Tree down
9/18/03	22:01	Chesterfield	NB MM 66	Tree down
9/18/03	22:30	Chesterfield	NB Exit 62	Tree down
9/18/03	22:54	Chesterfield	NB MM 56	Tree down
9/18/03	17:04	Chesterfield	Rt. 76 @ Powhite Toll Plaza	Tree down
9/18/03	21:07	Chesterfield	Summer Creek @ Hensley	Tree down
9/18/03	19:11	Chesterfield	Spring Run b/t Qualla & Beach	Tree down
9/18/03	22:15	Chesterfield	I-295 NB/SB @ Rt. 10	Tree down
9/18/03	20:17	Chesterfield	Rt. 150 @ Rt. 360	Sign down
9/18/03	18:20	Chesterfield	Rt. 76 NB/SB @ Courthouse	Tree down
9/18/03	17:24	Chesterfield	Rt. 360 @ Skinquarter	Tree down
9/18/03	19:22	Chesterfield	NB Rt. 150 @ Rt. 10	Tree down
9/18/03	21:22	Chesterfield	2524 Scarborough Dr.	Tree down
9/18/03	15:28	Chesterfield	WB Rt. 60 east of Rt. 650	Trees down
9/18/03	19:27	Chesterfield	Rt. 76 @ Rt. 60	Tree down
9/18/03	18:33	Chesterfield	Chalkley @ Rt. 10	Tree down
9/18/03	22:30	Chesterfield	Rt. 288 south Rt. 1	Tree down
9/18/03	15:41	Chesterfield	Bloomsfield Rd.	Tree down
9/18/03	21:39	Chesterfield	Rt. 1 @ Reymet Rd.	Signal down
9/18/03	12:50	Chesterfield	Beechdale @ Orangewood	Tree down
9/18/03	19:45	Chesterfield	NB Rt. 150 before Belmont	Tree down
9/18/03	20:48	Chesterfield	20513 Ravenswood Dr.	Tree down
9/18/03	20:48	Chesterfield	Deer Meadow Rd.	Tree down
9/18/03	20:48	Chesterfield	Deer Run Ct. @ Deer Run Dr.	Tree down
9/18/03	20:48	Chesterfield	2200 Blk. Old Gun Rd.	Tree down
9/18/03	20:48	Chesterfield	2603 Regis Dr.	Tree down
9/18/03	20:48	Chesterfield	Battle Creek and Hull Creek	Tree down
9/18/03	20:48	Chesterfield	Turn Mill Dr. @ Dulles	Tree down
9/18/03	20:48	Chesterfield	2239 Chart Stone	Tree down
9/18/03	20:48	Chesterfield	Glen Garre Rd. of Rosemere	Tree down
9/18/03	20:48	Chesterfield	10900 Chalkley Rd.	Tree down
9/18/03	22:51	Chesterfield	Rt. 288 NB to Rt. 360	Tree down
9/18/03	19:39	Colonial Heights	NB MM 53.5	Tree down
9/18/03	22:48	Colonial Heights	NB Exit 54	Tree down
9/18/03	13:05	Dinwiddie	Rt. 460 w/ of Rt. 608	Tree down

DATE	TIME	COUNTY/CITY	ROUTE	PROBLEM
9/18/03	14:13	Dinwiddie	Rt. 632 b/t Rt. 460 & Rt. 631	Tree down
9/18/03	20:09	Dinwiddie	2513 Ford Ave.	Tree down
9/18/03	16:30	Dinwiddie	SB 85 @ Squirrel Level	Tree down
9/18/03	20:27	Dinwiddie	Rt. 460 WB b/t Rt. 622 & 608	Tree down
9/18/03	10:42	Dinwiddie	I-85 SB MM 53	Trees down
9/18/03	22:30	Dinwiddie	Rt. 751 near Rt. 460	Tree down
9/18/03	22:30	Dinwiddie	Rt. 460 @ Rt. 751	Tree down
9/18/03	16:38	Dinwiddie	I-85 NB MM 66	Tree down
9/18/03	17:37	Dinwiddie	I-85 NB MM 48	Tree down
9/18/03	16:41	Dinwiddie	I-85 SB MM 68-60	Tree down
9/18/03	14:46	Dinwiddie	I-85 NB MM 56-57	Tree down
9/18/03	15:49	Dinwiddie	Rt. 703	Tree down
9/18/03	20:48	Dinwiddie	Old Vaughan Rd.	Tree down
9/18/03	14:57	Dinwiddie	Rt. 751 @ Rt. 628	Tree down
9/18/03	16:56	Dinwiddie	SB Rt. 1 @ Rt. 460	Tree down
9/18/03	17:15	Goochland	I-64 EB @ Rt. 288	Tree down
9/18/03	17:15	Goochland	I-64 EB @ Rest Area	Tree down
9/18/03	20:12	Goochland	EB 64 east of Gum Spring	Tree down
9/18/03	17:24	Goochland	Rt. 632	Tree down
9/18/03	17:47	Greensville	NB Exit 11	Tree down
9/18/03	2007	Greensville	NB 5	Tree down
9/18/03	23:31	Greensville	SB/NB MM 24-0	Tree down
9/18/03	18:38	Hanover	SB MM 86	Tree down
9/18/03	19:03	Hanover	SB MM 86	Tree down
9/18/03	22:00	Hanover	SB MM 100	Trees down
9/18/03	22:48	Hanover	SB/NB MM 94-89	Tree down
9/18/03	22:57	Hanover	SB MM 100 – 89	Tree down
9/18/03	19:07	Hanover	SB 95 b/t 87- 84	Trees down
9/18/03	15:12	Hanover	WB 64 @ MM 167	Tree down
9/18/03	18:40	Hanover	NB 95 @ MM 100.5	Tree down
9/18/03	03:36	Henrico	NB MM 80-81	Tree down
9/18/03	22:51	Henrico	NB Exit 83A	Tree down
9/18/03	23:07	Henrico	NB Exit 81	Tree down
9/18/03	23:10	Henrico	NB MM 82.5	Tree down
9/18/03	23:11	Henrico	NB MM 81-83	Tree down
9/18/03	10:01	Henrico	I-295 NB MM 49	Tree down
9/18/03	14:00	Henrico	I-64 WB MM 182	Tree down
9/18/03	21:07	Henrico	Rt. 609 e/of landfill	Tree down
9/18/03	20:10	Henrico	I-64 EB MM 171	Tree down
9/18/03	14:16	Henrico	I-64 WB MM 172	Tree down
9/18/03	16:15	Henrico	I-64 WB MM 203	Tree down
9/18/03	16:15	Henrico	I-64 EB MM 203.5	Tree down
9/18/03	23:08	Henrico	I-295 SB Exit 22	Debris
9/18/03	19:14	Henrico	SB 95 so. Of MM 83	Tree down
9/18/03	13:21	Henrico	I-64 EB MM 176	Tree down
9/18/03	21:14	Henrico	I-64 EB MM 204	Tree down
9/18/03	21:17	Henrico	I-64 WB MM 178	Tree down
9/18/03	14:26	Henrico	I-64 WB Glenside @ Parham	Tree down
9/18/03	23:36	Henrico	I-64 WB MM 193	Tree down
9/18/03	14:46	Henrico	I-64 EB MM 177	Tree down
9/18/03	22:50	Henrico	Patterson @ Gaskins	Tree down
9/18/03	19:42	Hopewell	I-295 SB Exit 9	Tree down

DATE	TIME	COUNTY/CITY	ROUTE	PROBLEM
9/18/03	20:12	Mecklenburg	I-85 NB MM 12	Tree down
9/18/03	15:29	Mecklenburg	I-85 NB MM 17	Tree down
9/18/03	20:30	Mecklenburg	Rt. 710 N. of Rt. 49	Tree down
9/18/03	22:37	Mecklenburg	I-85 SB MM 16	Tree down
9/18/03	20:19	New Kent	Rt. 637 @ Rt. 249	Tree down
9/18/03	13:50	New Kent	Rock-A-Hawk Rd.	Tree down
9/18/03	15:48	New Kent	Rt. 60 WB e. of Rt. 106	Tree down
9/18/03	14:55	New Kent	WB 60 west of Rt. 155	Tree down
9/18/03	18:06	Nottoway	Rt. 460 WB @ Rt. 614	Tree down
9/18/03	20:20	Nottoway	Rt. 610 @ Rt. 153	Tree down
9/18/03	11:06	Petersburg	I-95 @ I-85	High water
9/18/03	23:05	Petersburg	I-85 SB @ I-95 split	Tree down
9/18/03	15:22	Petersburg	Bank St. on ramp to NB 95	High Water
9/18/03	20:48	Petersburg	Mill Rd. off Sandy Ridge Rd.	Tree down
9/18/03	16:57	Prince George	NB MM 45	Tree down
9/18/03	17:25	Prince George	NB MM 43	Tree down
9/18/03	19:38	Prince George	SB MM 45	Tree down
9/18/03	23:03	Prince George	NB MM 36 (Rest Area)	Tree down
9/18/03	23:45	Prince George	NB MM 43	Tree down
9/18/03	19:13	Prince George	Rt. 460 west of Rt. 156	Tree down
9/18/03	23:30	Prince George	Rt. 301 north of I-95	Tree down
9/18/03	03:50	Richmond	NB MM 71	Downed sign
9/18/03	18:22	Richmond	NB MM 74	Tree down
9/18/03	22:51	Richmond	NB MM 74	Tree down
9/18/03	23:11	Richmond	SB Exit 75	Tree down
9/18/03	23:58	Richmond	SB Exit 75	Tree down
9/18/03	23:58	Richmond	NB Exit 78	Tree down
9/18/03	19:07	Richmond	NB 95 @ Broad St.	High water
9/18/03	15:23	Richmond	I-64 EB @ Exit 79	Tree down
9/18/03	18:56	Richmond	I-64 EB @ I-95 SB Exit 79	Tree down
9/18/03	17:41	Sussex	NB MM 33	Tree down
9/18/03	14:07	Sussex	Rt. 460 WB/EB	Tree down
9/19/03	09:06	Charles City	18121 Horseshoe Rd.	Trees down
9/19/03	09:06	Charles City	Cypress Bank @ Rt. 614	Tree down
9/19/03	08:04	Chesterfield	Happy Hill @ Mistwood Forrest	Power lines down
9/19/03	01:44	Hanover	NB MM 88	Tree down
9/19/03	01:44	Henrico	SB MM 82	Tree down
9/19/03	02:54	Henrico	NB Exit 81	Tree down
9/19/03	06:08	Henrico	SB Exit 82	Tree down
9/19/03	02:41	Henrico	Brook Rd. On Ramp to I-95	Tree down
9/19/03	01:48	Henrico	Brook Rd. @ Richfood Rd.	Tree down
9/19/03	06:36	Henrico	Staples Mill @ Parham	Signal down
9/19/03	06:36	Henrico	Patterson @ Hollands Rd.	Tree down
9/19/03	00:12	Prince George	NB MM 43	Tree down
9/19/03	00:27	Sussex	NB MM 34	Tree down