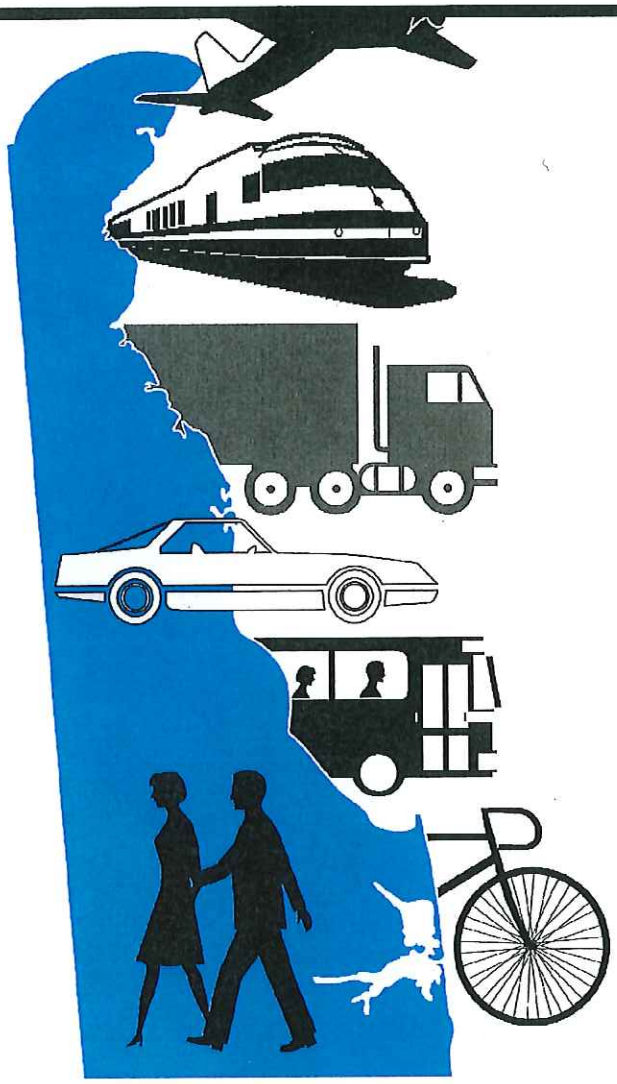
# Delaware
# *Integrated*
# Transportation Management
# Strategic Plan



Prepared for: **Delaware Department of Transportation**

Prepared by: **Parsons Brinckerhoff Quade and Douglas**

In Association with: **Howard/Stein-Hudson Assoc.**

**Columbia Telecommunications Corp.**

Printed 1/6/98 3:36 PM

**December, 1997**

# Delaware Integrated Transportation Management Strategic Plan

**Prepared for:**

**Delaware Department of Transportation**

**December, 1997**

# Table of Contents

# List of Exhibits

# What This Plan Is Intended To Accomplish And How It Is Organized

This report presents Delaware's Integrated Transportation Management (TM) Strategic Plan and the associated Priority Actions required to implement the plan. An "integrated" transportation management system is one that incorporates all modes of transportation in Delaware (roadways, transit, rails, ferries, airports, ports, etc.) into a seamless transportation system that enhances the movement of people and goods throughout the state and meets the needs of DelDOT customers. The purpose of this plan is to guide the implementation of the integrated transportation management system and traveler information projects in a way that meet the state's transportation needs.

## Integrated Transportation Management – Saving Time, Saving Lives, Saving Money

Delaware's transportation system is facing critical challenges. Residents are relying more and more on the automobile to get around the state. The rural character of the state and current development patterns are discouraging the use of alternative travel modes. Delaware's economy is growing, bringing in more service sector jobs, which often require more travel. Trucks moving freight in and through the state are delayed in heavily congested roads, raising the costs of those goods. And as the transportation network becomes more burdened, funding resources are harder to come by. Federal transportation dollars are constrained and public resistance to taxes continues. The ability to build new transportation infrastructure is restricted by costs, environmental issues, and reduced land availability.

To meet these challenges, Delaware has recognized the need to find innovative solutions to save time, lives and money. Among the solutions this plan proposes are enhanced traffic management, traveler information and transit services more efficient operations and improved emergency and incident management. Advanced control, information and communications technologies, often referred to as Intelligent Transportation Systems (ITS), are among the tools necessary for meeting Delaware's transportation challenges. This plan is designed to guide the practical implementation of these applications.

## The Transportation Management Planning and Implementation Process

The transportation management planning process defines problems, needs and services applicable to the state, defines a system framework for implementation, and establishes an action plan and organizational structure to fund, phase, and manage the transportation management system. Three simple steps were followed to develop this plan: first, defining where are we today, second, establishing where we want to be in the future, and third, establishing a plan to get there. Two additional steps, to implement the action plan and to monitor the transportation system, also are required, but are not the focus of this plan. Each of these steps is discussed below.

## Step 1. Define Current Transportation Trends and Challenges

DelDOT views its customers as a valued resource. Interviews and focus groups aided in defining current challenges and opportunities for the transportation system. Information regarding the current transportation system and trends were retrieved from the Long Range Transportation Plan for Delaware and internal customer interviews.

## Step 2. Define Themes, & Vision of Transportation Management

The ideas and challenges of those interviewed and those who participated in the focus groups helped frame a future vision of Transportation Management. Many ideas and challenges expressed in the interviews were summarized in a Mission and Goals statement. Those same ideas and challenges were grouped into themes and expressed as strategies for implementing Transportation Management.

## Step 3. Define an Action Plan: Next Steps -- Achieving the Vision

The action plan identifies how to move from the customer stated challenges of today to achieving the vision of tomorrow. The action plan includes:

*Framework for Implementation:* The institutional and technical framework within which policy, coordination, technology and other issues are addressed.

*Priority Actions:* Actions and projects needed to implement an Integrated Transportation Management System.

*Investment Corridors:* Corridors in which transportation management was most critically needed and potentially most effective were also identified in order to guide investment decisions.

## Step 4. Implement Action Plan

Implementation of this plan will require the development of specific projects, the identification of funding sources for those projects and a phasing plan to ensure coordinated and efficient implementation.

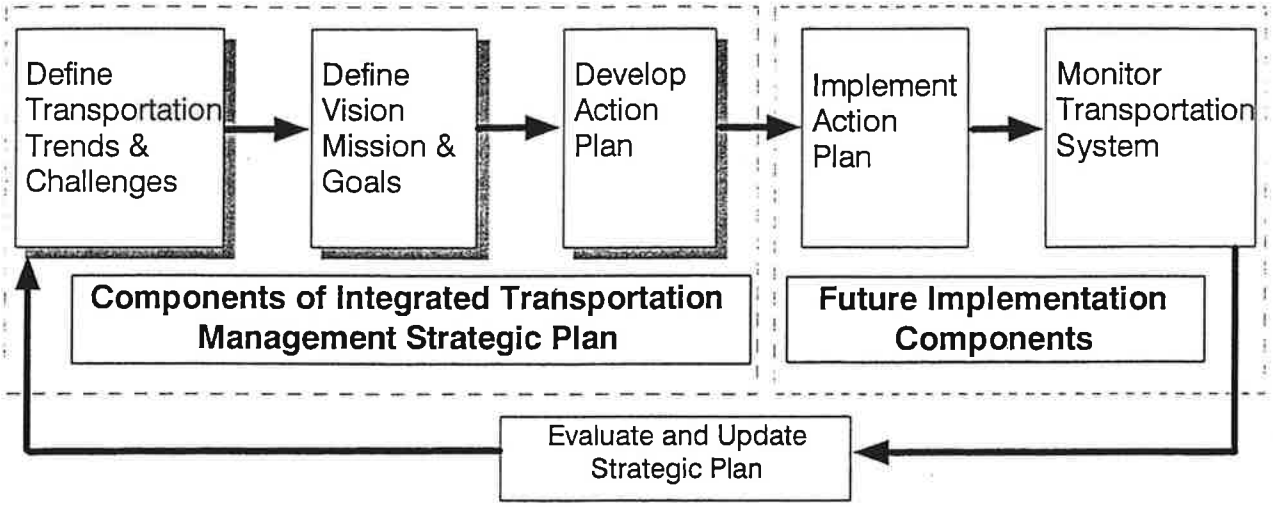



**Exhibit 1: Components of the Integrated Transportation Management Strategic Plan**

### Step 5. Monitor Transportation System

Once projects have been implemented, DelDOT must continuously monitor the transportation network to ensure that transportation management is producing the desired results. Data from this task will then be used to determine what changes, additions and improvements are needed to optimize the system's performance.

## How this Plan is Organized

The second section of this plan, "Why Transportation Management?", explains what transportation management is and how technology can be used to improve transportation management. We also discuss the experiences of other states and regions currently using transportation management strategies. The section concludes with a discussion of Delaware's transportation trends and challenges.

The third section, "Delaware's Vision of Transportation Management," sets forth the goals and vision of transportation management in Delaware and lists four primary strategies for implementation.

The fourth section outlines the "Next Steps" for achieving Delaware's transportation management vision. It explains the services transportation management applications can provide, creates a framework for implementation, describes the component's of Delaware's transportation management system, lists some actions and necessary tools required for deployment, and describes the transportation investment areas for Delaware.

# Why Transportation Management?

## WHAT IS INTEGRATED TRANSPORTATION MANAGEMENT?

### Definition

Integrated Transportation Management is a multi-modal approach to improving the movement of people and goods. Transportation Management often uses modern technology (often referred to as Intelligent Transportation Systems (ITS). Public agencies and private sector entities, both alone and in partnership, are able to provide for safer, quicker and more efficient travel. Some of its benefits include:

### Safer Travel

ITS can make travel safer. For example, new traffic control systems can reduce the number of vehicle stops, minimize changes in vehicle speeds, and improve traffic flow, which all help reduce the number of accidents. Other applications anticipated in the future include collision avoidance systems which warn drivers when they are too close to the vehicle in the adjacent lane, which can also reduce the number of accidents.

### Fewer Traffic Jams

Transportation management centers reduce traffic jams and travel time by continuously monitoring current conditions and automatically adjusting speed limits, traffic signals, freeway ramp access, lane use, and transit schedule in response to actual demand. Fewer traffic jams result in safer, less stressful driving conditions.

### Improved Travel Flow

A driver with a toll debit card attached to his vehicle can travel through toll plazas without stopping. His toll charges are deducted automatically from a prepaid account. Other travel fare collection systems, like smartcards, allow bus, ferry and train fares, transfers and other fees to be charged to one card.

### Better Travel Information

At home, en-route, or at work, travelers have access to real-time, accurate information about transit, train, and flight schedules, roadway conditions, and other travel information.

## Improved Inter-modal Coordination

With the help of better travel information, travelers can make better decisions as to mode choice. For example, if a traveler is aware that his or her regular route to work is congested, he or she may opt for taking transit that particular day. Schedule and fare information provided in real-time makes train and bus transfers more convenient. Transportation managers benefit as well, as they can maximize the system's efficiency by coordinating their activities across travel modes. For example, traffic managers can provide buses traveling behind schedule with longer "green time" at signalized intersections to help buses to get back on track.

## Easier Travel

In vehicle navigation systems tell car, truck, and transit drivers how to best reach their destination and provide alternate routing choices during congestion or incidents.

## Quicker Emergency Response

Transportation management centers with monitoring equipment may detect, verify and thus respond more quickly to incidents on the state's transportation system. Together, with emergency response partners, i.e. Department of Public Safety, Volunteer Firemen's Association, and Department of Natural Resources and Environmental Control, incidents are cleared more quickly and thus congestion reduced and safety increased. In the future, travelers in need of aid can benefit from communication and information technology which, among other things, can automatically send mayday signals to dispatch centers so trained emergency staff may locate the incident more quickly. Cellular call-in programs such as #77 and motorist call boxes may also be used to facilitate emergency response.

## Improved Passenger and Freight Management

Bus, freight and emergency vehicle tracking systems allow companies to track vehicles and communicate directly with drivers.

## Faster Freight Deliveries

Transportation Management provides for automatic tracking of containers, electronic weighing and inspection of commercial vehicles while in motion, and electronic issuing and monitoring of transportation permits.

## Reduced Costs

Transportation Management technologies allows DelDOT to make more efficient use of existing resources by automating functions, sharing real time information, and improving safety. It also helps save private companies save money through improved freight delivery. Consumers save money through cheaper products and more efficient travel.

## THE CASE FOR CHANGE...

Delaware's transportation system, like so many others around the nation, is experiencing a number of competing pressures and demands. DelDOT customers prefer a transportation system that supports, not impedes, their high standards for quality of life, including employment opportunities, a sense of community, quality education and the protection of its cultural and natural resources.

Traffic on Delaware roadways is increasing. The need for transportation construction and increased maintenance is rising, while funding is not increasing at a similar rate. The role of governments in transportation is changing with states and local communities gaining more responsibility for transportation decision making, and shouldering more of the financial burden as well.

Roadway capacity or system throughput varies continually. The capacity of a roadway represents the maximum number of vehicles which can reasonably be expected to traverse a single point in an hour. By definition, the capacity of a roadway assumes good weather, good pavement conditions, and no incidents exist. This means that, on a daily basis, the actual capacity of the roadway is in a state of flux. The most obvious example would be when an accident requires the closure of one or more lanes, however, it could also be the result of rain, snow, sun glare, construction (on and off the roadway), and many other situations. Transportation Management allows DelDOT to approach this phenomenon with the following: monitor the roadway system to detect these conditions, provide information to motorists so they can alter travel patterns, and adjust control systems (i.e. adjust signal system timing) to help improve operations.

As a result, travelers are losing time -- delayed on congested highways and local streets. They are losing their sense of safety and security -- death and injury on highways remain high and aggressive driving, much of it brought on by the frustrations of congestion, is on the rise. And they are losing money -- in wasted gasoline, higher prices for goods and increased insurance rates.

Funding constraints and the need for transportation to become more seamless and integrated, along with the rapid development of technology to provide or enhance critical transportation improvements, has made traditional approaches to transportation awkward, difficult, and, in some cases, obsolete. Proven transportation management strategies using control, monitoring, information and communication technology can provide real solutions to these challenging problems -- saving time, saving lives and saving money.

Transportation Management Systems nationwide have lowered accident rates, reduced travel time, and increased transit ridership[1]. Current technologies allow agencies to collect and disseminate real time information and to improve network efficiencies through the use of adaptive control systems.

[1] Statistics in the section "The Case for Change" are from the U.S. Department of Transportation

Exhibit 2 below highlights some of the many quantifiable benefits this technology can provide.[2]

**Exhibit 2: Summary of Transportation Management Benefits**

| Transportation Management Component | Measure of Effectiveness | Potential Improvement |
|---|---|---|
| Traffic Signal System | Travel Time | Decrease 8 -10% |
| | Travel Speed | Increase 14 - 20% |
| | Delay | Decrease 17 - 37% |
| | Number of Stops | Decrease 1 - 35% |
| | HC Emissions | Decrease 4 – 10% |
| | CO Emissions | Decrease 5 - 13% |
| | NOx Emissions | Degradation 4% |
| | Fuel Consumption | Decrease 6 -12% |
| Incident Management | Incident Clearance Time | Decrease 5 - 8 minutes |
| | Travel Times | Decrease 10 - 42% |
| | Vehicle Delay | Decrease 300,000 hours per year |
| Traffic Information | Travel Time | Decrease 17 minutes (20%) in incidents |
| | Delay | Decrease up to 1900 vehicle-hours |
| | HC Emissions | Decrease 25% for diverted drivers |
| | CO Emissions | Decrease 33% for diverted drivers |
| | NOx Emissions | Decrease 1.5% for diverted drivers |
| Transit Management | Travel Time | Decrease 15 - 18% |
| | Fleet Size | Decrease 4 - 13% |
| | On-time performance | Increase 12 - 28% |
| | Incident Response Time | Decrease 40 - 50% |
| Transit Signal Priority | Travel Time | Decrease 5 - 8% |
| Red Light Enforcement | Number of injuries/fatalities | Decrease 50% |
| | Number of Accidents | Decrease 20 - 80% |

Now, transportation agencies like DelDOT have a wider range of tools at their disposal to improve the movement of people and goods, especially in areas where new construction is impractical or impossible.

## Saving Time

Nationwide, Transportation Management technologies are being used to reduce congestion and increase mobility.

- In Lexington, KY, traffic management strategies have reduced stop-and-go traffic delays by 40 percent.
- Ramp metering systems in Seattle and Minneapolis have cut travel time in these regions by as much as 37 percent.

[2] This table is based on national benefits data compiled in September 1996 by the Federal Highway Administration, U.S. Department of Transportation. The improvements shown are illustrative only. Delaware may experience similar levels of improvements for each component, however, each component should be evaluated on Delaware specific projects.

- Abilene, Texas reported a 37 percent reduction in delays and a 14 percent reduction in travel time after modernizing signal systems along heavily traveled routes.
- Drivers in Oakland County, Michigan save an average of five minutes on a 24-minute commute, thanks to the areas advanced traffic management and traveler information system. That's an average of 50 minutes per week and 43 hours per year.

In addition to these control strategies, travelers are saving time by making better-informed travel decisions. Real-time, accurate information on highway congestion and bus and train schedules allows users to determine which mode of transportation will get them to their destination fastest.

- In Baltimore, Maryland and Portland, Oregon, bus and transit vehicle tracking devices and improved dispatching systems have cut transit riders' travel time by 10 to 18 percent and has increased on-time performance by 12 to 23 percent.
- Kiosks in Los Angeles (originally installed to alleviate travel problems after an earthquake) provided travelers with transportation information. Fifty percent of the users requested bus and train information. The kiosks were so popular, the "temporary" kiosks were brought back after the earthquake repairs were completed and are still in use.

Other jurisdictions are reporting reductions in accident clearance times, increased rush hour speeds, and improved tollbooth throughput.

- Richardson, Texas reduced average incident cleanup times by 5-7 minutes by providing tow truck drivers with closed-circuit TV (CCTV) video feeds from the accident scene.
- In Chicago, the city's incident management system has reduced the time needed to clear incidents by 50 percent.

## Saving Lives

Through the implementation of coordinated and timely incident responses, many states and local communities have been able to reduce response times, reduce secondary accidents, and improve safety. The USDOT estimates that reducing the time it takes to notify emergency management personnel of a freeway accident from the current national average of 5.2 minutes to 3 minutes would reduce fatalities 10 percent annually. Jurisdictions around the nation are discovering similar benefits:

- Minneapolis reports that it has reduced incident response time by 8 minutes, wrecker response time by 5-7 minutes and fatalities in urban areas by as much as 10 percent.
- Maryland reports that its CHART program substantially reduces traffic delays by cutting accident clearance times. The state estimates that for every dollar spent on the program, it receives $10 in economic benefit.
- Oakland County, Michigan's traffic management system has reduced injury accidents by 6 percent, and total injuries by 27 percent. Serious injuries have dropped dramatically -- virtually no serious injuries have been reported.

## Saving Money

In addition to saving time and lives, Transportation Management saves money. Travelers are

saving money in reductions in wasted gas and insurance rates. Transportation agencies are reducing expenses. USDOT estimates that an incident management system that costs $600,000 to operate can generate $1.4 million in benefits each year. Electronic toll collection systems increase fare collection by as much as 30 percent, cut operating costs by as much as 90 percent, increase vehicle or roadway capacity by 250 percent and reduce fuel consumption by as much as 12 percent[3]. They also slash data collection costs by $1.5 million to $5 million annually. Transit management systems show a 45 percent annual return on investment and reduce fleet sizes by 2 to 5 percent, thanks to more efficient bus use.

- The State of Oklahoma was able to save $170,000 in operating costs annually at each electronic tollbooth after installing an Electronic Toll Collection (ETC) system. In addition, this system increased tollbooth throughput and thereby reduced congestion levels while increasing customer convenience.
- New Jersey Transit estimates that its electronic fare payment system has reduced the annual cost of handling cash fares by $2.7 million.
- A similar electronic fare collection system in Atlanta generated about $2 million in savings.

A recent study published by the Intelligent Transportation Society of America (ITS America) and the U. S. Department of Transportation (USDOT) estimates that nationwide installation of in-vehicle crash avoidance systems could save the national economy $27 billion annually.

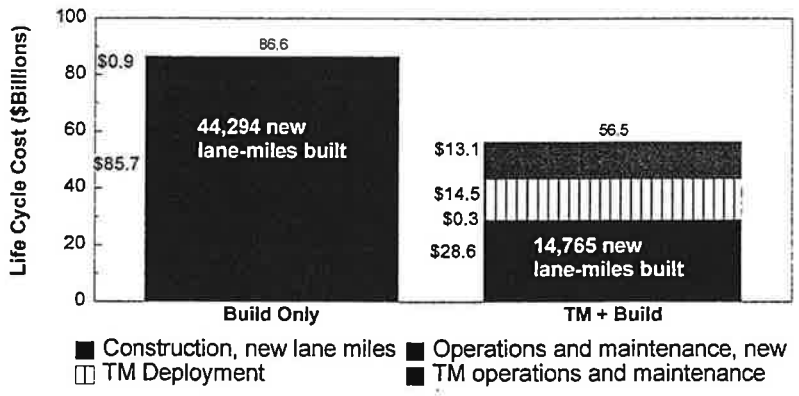



Exhibit 3: Twenty year life cycle costs of "build only" versus "build plus TM"

Further, a separate study[4] published in ITS World compared investments made in new construction to investments made in transportation management related initiatives. Exhibit 3 compares the life cycle costs of the two comparative investments.

The study reviewed 50 major urban areas which contains about half the population of the United States. The results of the analysis showed several interesting things:

- Using "building new lanes" as the only answer to congestion is very expensive.
- Transportation Management alone cannot solve all future transportation and mobility problems.

[3] Delaware expects its existing toll transaction costs to remain at $.18 per transaction and ETC costs to be approximately $.09 per transaction.

[4] *ITS Versus New Roads: A Cost Effectiveness Study,*1997, McGurrin, Shank. July/August 1997, Volume 2 Number 4, ITS World, Duluth, Minnesota.

- To achieve a 30% increase in throughput, Transportation Management plus "building new lanes" together significantly may reduce costs to the taxpayers. Benefits must be computed on a project specific basis.

- Construction of new facilities may be delayed, thereby decreasing the overall life cycle cost of the facility.

Exhibit 2 shows that reductions in travel time are expected for five of the six components listed, with benefits ranging from 5% to 42%. These improvements not only reduce congestion levels and improve efficiency, but they represent an indirect cost savings to the traveling public. This cost savings comes from reductions in gas usage, wear and tear, and most importantly in the value of time itself. This is because every moment which a person does not spend on the transportation network, is available for a variety of other tasks, including work, errands, household jobs/chores, and relaxation. Some Delaware specific examples of how this money savings can be estimated are displayed in Exhibit 4:

| Route | Limits | Length of Segment (miles) | Daily Traffic (vehicles) | Average Travel Time | Time Savings (sec) | Daily Time Savings (hours) | User Cost Savings ($ per year) |
|---|---|---|---|---|---|---|---|
| US 40 | SR 72 to SR 1 | 4 | 40,300 | 7 min 53 sec | 14.2 | 158.96 | $ 291,439.30 |
| SR 2, Kirkwood Highway | Anna Way to SR 7 | 4.3 | 36,700 | 8 min 10 sec | 14.7 | 149.86 | $ 274,750.27 |
| SR 7, Limestone Road | SR 4 to SR 2 | 0.9 | 35,900 | 3 min 22 sec | 6.06 | 60.43 | $ 110,795.42 |

**Exhibit 4: Potential annual user-cost savings on three Delaware route segments.**

Further, the above examples can be used to estimate the impact that Transportation Management will have on the transportation network as a whole. If it is assumed that the above savings are representative of the entire "Critical 250 miles" network (see page 51 for a discussion on the Critical 250 miles), then a rough estimate can be made for Delaware's most important roadways. For example, based on the route segments in Exhibit 4, the average User Savings per mile of roadway is about $ 73,585.33. For the entire Critical 250 mile network, this would result in a savings of approximately $ 18,396,331.25 annually.

It is important to recognize that these estimates assume each vehicle is occupied by only one person, and that the assumed travel time savings attributable to Transportation Management is equal to 3%. Travel time savings used in this analysis were assumed to be less than what other agencies have realized from such a system (i.e. 8 to 10%). This estimate does not reflect potential savings from Incident Management strategies, which reduce non-recurring delays, and savings potential when two or more strategies are in place, such as when there is a control system working in conjunction with a traveler information system.

This analysis uses average travel time which was taken from actual field studies conducted by DelDOT. Time savings may vary throughout a day-long period over a peak and off-peak period. Adaptive signals have been placed along Kirkwood Highway and changes in travel time have been documented as varying during peak hours from increasing travel time on some segments to decreasing travel time by as much as 31.2% on other segments. Average Daily Traffic is the number of vehicles to pass a point on a highway (in both directions) for the "average day". User cost savings was computed assuming all individuals' time is worth the minimum wage at $ 5.15 per hour.

Increased pressures on the nation's transportation system are forcing transportation providers to find new ways to improve service, save money, increase safety, expand travel choices and increase mobility. Transportation management technologies are giving these providers the tools they need to meet these demands.

This plan will lay the foundation to enable Delaware to experience the same types of benefits as other communities around the nation.

## SUMMARY OF TRANSPORTATION TRENDS AND CHALLENGES

Effective transportation management plans are those that are driven by the challenges, needs and concerns of DelDOT customers. They are also those which take advantage of existing transportation infrastructure and the plans and programs underway in the area. Thus, an understanding of Delaware's existing transportation environment is critical. This section discusses current travel and transportation trends in Delaware and the current status of the state's transportation network, by mode. It also summarizes the perspectives of various Delaware transportation users.

### Travel and Transportation Trends

The Statewide Transportation Plan identified a number of broad travel and transportation trends directly affecting Delaware's transportation network. Among the findings:

- Congestion and delay is more widespread, resulting in lost time and lost productivity for individuals and businesses during commute trips, business trips and for delivery of goods and services;
- Increased use of the street and highway systems hastens deterioration, shortens the useful life of facilities and increases the cost and frequency of maintenance, repair and associated inconvenience to travelers. Between 1980 and 1990, vehicle miles of travel increased 55 percent, or 4.5 times faster than the growth in statewide population. On average, over 77 percent of Delawareans drive to work alone in their cars;
- Air quality is below federal standards. Both New Castle and Kent Counties are designated as "severe non-attainment" areas for ozone, due in large part to motor vehicle emissions.
- Increased auto ownership and the resulting emphasis on accommodating the automobile, has detrimental effects on transit use and limits service for citizens that cannot or choose not to drive.
- The continuing shift from manufacturing to a service-based economy, together with the suburbanization of jobs, is changing transportation needs for both people and goods
- The transportation needs of the key economic sectors that make up Governor Carper's five-point plan (finance, agriculture, manufacturing, tourism and retail) are similar in terms of requiring access but are dissimilar in terms of geographic focus and modal orientation
- The system of goods movement throughout the state, now dominated by truck transportation, cannot be brought into better balance without improvements to the rail freight system, airport access and operations, the Port of Wilmington, and access to intermodal facilities – most of which require a regional approach to solutions
- Although ridership has been steadily increasing over the past 4 years and paratransit continues to serve its customers, much of the public transit system is underutilized
- Bicycle and pedestrian access has been discouraged both by development patterns and highway design practices
- Cross roads communities in rural areas lack transportation options and access to services

- Adequate evacuation capacity is not available to bay and ocean front residents and visitors
- Interstate and regional trips have gained significance, as has the importance of coordinating with other agencies for services and facilities serving regional needs
- Traditional transportation planning tools do not provide for the evaluation of alternative modes and market segmentation.

In addition to these trends, the Statewide plan also identified a number of constraints within which these trends and challenges must be addressed:

- Constraints in the financial resources available for transportation investment
- Constraints in the human resources required to plan, design, construct, and operate transportation services and facilities
- Constraints in the availability of land and related environmental impacts of system expansion
- Constraints in the ability of both existing communities and undeveloped areas to absorb the impacts of increased development and the resulting traffic
- Constraints in the willingness of the public to make trade-offs today that are necessary to protect and enhance mobility and access in the future.

## Modal Concerns and Condition Assessment

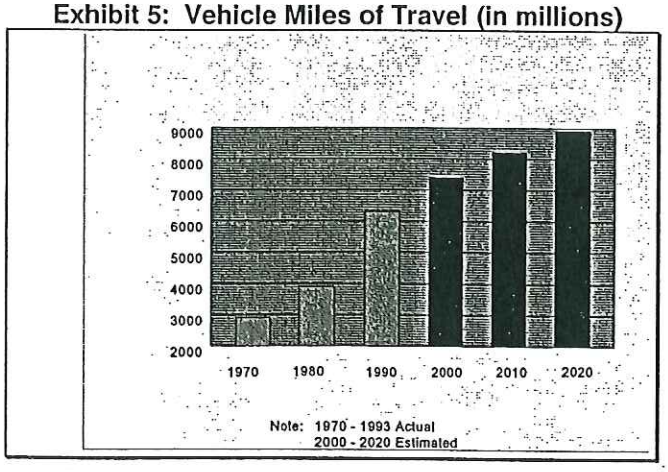
Delaware has an extensive and multimodal transportation network. The current conditions and concerns and ongoing transportation management initiatives of each mode are highlighted below:

### Roadways

Trends

Delaware's transportation system has experienced tremendous traffic growth with little increase in the highway network. Between 1980 and 1994, annual vehicle miles traveled (VMT) in Delaware increased from 4,221 million vehicle miles (MVM) to 7,025 MVM, a jump of more than 66 percent. During the same 14-year period, the number of route miles increased by only about 7 percent. This growing reliance on the automobile is challenging DelDOT's ability to reduce congestion and maintain the infrastructure.

**Exhibit 5: Vehicle Miles of Travel (in millions)**




On-going Initiatives

DelDOT has several initiatives underway which use technology to improve roadway operations. These programs involve advanced traffic signal systems, Traveler Advisory Radio (TAR) stations, a combination of CCTV and dynamic message signs (DMS),

commercial vehicle electronic screening and registration and electronic toll collection (ETC). The current status of each program is described below:

- DelDOT has three installations of a traffic adaptive signal control system in New Castle County, with additional installations programmed for each of the next several years. A fourth system was brought on line in the Churchman's area in the fall of 1997. The traffic adaptive signal control systems adjust signal timings in response to real time traffic demands, improving system efficiency and traffic flows. The state has eight permanent and two mobile TAR stations statewide. They provide motorists with information about accidents, congestion, special events, and flooding.
- DelDOT has plans to install eight CCTV cameras and five DMS signs in the I-95 and SR 1 corridors. These installations will monitor traffic for incidents and congestion and provide motorists with real time information about roadway conditions.
- DelDOT is also part of a collaboration between state highway agencies which will install a coordinated Electronic Toll Collection system along the I-95 corridor from New York to Delaware. The system will allow users to pay tolls electronically and without stopping, increasing both customer convenience and tollbooth capacity. System users will have a single account which can be used anywhere in the multistate system.
- DelDOT has been awarded a grant to participate in two of the I-95 Corridor Coalition's Commercial Vehicle Field Operational Tests. These projects will test the feasibility of commercial vehicle electronic screening and registration technologies. These technologies enable trucks and other commercial vehicles to be automatically registered and screened for clearance through several states without the need to stop.

**Public Transit**

Trends

Transit ridership has varied over the past decade, decreasing between 1986 and 1991 before increasing again in 1994. The Delaware Long Range Plan lists five areas in which public transit can target improvements. These are:

- Service Area - 7.4 percent of land area and 46 percent of population lives within one-quarter of a mile of a fixed route transit service.
- Service Hours - most existing service is weekdays only, with limited evening and weekend hours.
- Coordination among Services - some areas are served by more than one transit agency, for example Sussex County is served by the DRBA trolley and services which are operated, managed or coordinated by DelDOT .
- Multi-Modal connections - adequate, well maintained, intermodal transfer facilities are important to promote efficient and safe transit use.

On-going Initiatives

Several initiatives are under way which will improve the quality of public transit service in Delaware. These use a combination of new and existing technologies, including:

- The construction of intermodal rail facilities, including a new passenger station in the Churchman's Crossing area and between Newark and Wilmington.

- An evaluation of the costs and benefits of installing a Bus Smart Card system. This system would allow passengers to pay bus fares electronically, eliminating the need for exact change and increasing user convenience, as well as provide transit managers with more accurate real-time data on passenger loads and usage
- An RFP (already issued) for engineering services to investigate the use of an Automatic Vehicle Location (AVL)/ Automatic Vehicle Identification (AVI) system on transit vehicles. The initial phase of the RFP involves the development of specifications for the purchase and installation of a two way radio system to replace the current antiquated system. These technologies have allowed transit agencies to increase customer convenience and efficiency while reducing operating costs on fixed route and paratransit systems nationwide. AVL/AVI systems provide fleet managers with information on the location of vehicles and allows managers to dispatch those vehicles to their customers. In addition, this data assists managers in developing fixed routes, by creating a log of where transit need is greatest.

**Ridesharing Facilities and Services**

Trends

Carpooling and vanpooling is an effective way to reduce the number of vehicles on Delaware roadways. In 1990, about 43,000 workers used ridesharing as their primary means of commuting, about 12.9 percent of all workers, near the national average of 13.4 percent.

On-going Initiatives

There are currently three ridesharing programs and 41 park-and-ride lots statewide. These include:

- The Transportation Management Association of New Castle County - This organization promotes commuting alternatives and assists businesses in developing ridesharing programs, under contract to DTC.
- Vanpool - DTC administers a vanpooling program where groups of 10 to 12 state employees commute in each van.
- Park-and-Ride Lots - DelDOT administers 41 lots and over 2,000 spaces statewide.

**Bicycle and Pedestrian Facilities**

Trends

As of 1990, more people in the State of Delaware walked to work than rode public transit, indicating a need to provide adequate facilities to support pedestrian traffic.[5] Recently, patterns of development and street design have limited bicycle and pedestrian travel choices. There is a lack of adequate sidewalks, paved shoulders, pathways, and exclusive lanes which promote convenience for these travel modes.

[5] According to the Delaware Long Range Transportation Plan

**On-going Initiatives**

There are currently no existing ITS initiatives for bicycles and pedestrians.

**Ferry Service**

Trends

Ridership on the Lewes-Cape May ferry (operated by the Delaware River and Bay Authority(DRBA) has increased substantially over the last 10 years from around 700,000 trips in 1980 to more than 1.2 million in 1996. Ridership is expected to continue to increase in coming years, due to both capital improvements and marketing initiatives. The Long Range Plan identifies two areas in which ferry service could be improved. These are making improvements to the roadway network in the Lewes area and improving multi-modal connections to ferry service.

On-going Initiatives

DRBA currently operates a shuttle bus service between the Lewes Terminal and Rehoboth Beach to satisfy peak needs.

There are currently no specific plans to use ITS in ferry service.

**Rail Freight**

Trends

Delaware has 288 miles of active rail lines and six railroad freight companies, with the volume of freight on most of the state's rail lines being utilized well below capacity. In addition, improved connections with the Port of Wilmington would allow shippers greater flexibility and increase modal competition. As expansion efforts increase the volume of goods the port handles, increased rail competition will provide a cost effective shipping alternative. In is important to note, however, that these active rail lines are single lines which limit their directional capacity. The necessary improvements required by the Port of Wilmington would require substantial capital investments.

On-going Initiatives

DelDOT has initiated an effort to develop several plans including a freight/goods movements plan, an Intelligent Transportation Systems/Commercial Vehicle Operations Mainstreaming Business Plan, and a Rail Plan. These efforts are aimed at identifying necessary and appropriate ITS strategies for freight and goods movement in Delaware. In addition, DelDOT is an active participant in the I-95 Corridor Coalition's CVO Working group and Field Operational Tests (including Electronic Clearance, CVO Roadside Safety and CVO Safety Management). DelDOT will continue to support multi-state coordination efforts which promote efficient use of the rail network and investigate implementation effects of systems to Delaware.

**Shipping Facilities**

Trends

The Port of Wilmington is undertaking several capital and marketing improvements which will expand its business. Sufficient rail and trucking capacity is essential to providing port customers with efficient service.

On-going Initiatives

Shipping applications of ITS are not included in the Capital Transportation Improvement Program. DelDOT supports those activities which streamline intermodal shipping and positively effect the movement of goods through ports.

**Aviation Facilities**

Trends

Delaware's aviation facilities currently operate well within their capacity. Significant opportunities exist to expand the use of these facilities, so long as sufficient ground transportation services and facilities exist.

On-going Initiatives

There are currently no existing ITS initiatives for aviation facilities.

## Customer and Market Segment Perspectives on Transportation

In addition to reviewing the transportation network, DelDOT approached its internal and external customers for their input into the transportation management plan. This was accomplished by holding focus groups with three major market segments and conducting interviews with both internal and external customers.

Three main market segments: commuters, tourists, and goods movement provided perspectives on user needs through two focus groups and 9 supplemental interviews. These three market segments represent very important users of Delaware's transportation system. Each segment uses the transportation system in different ways and each has specific system needs . Given the numbers of participants who responded to focus group invitations, the commuter and tourist representatives were combined into one group. Supplemental telephone interviews were used to round out the input from a broad range of interests. They included major employers, chiefs of police, representatives from a transportation management association and the local media.

Participants provided their thoughts on the top priority problems and needs that should be addressed through transportation management, particularly using advanced technology and improved communication and coordination. They also reflected on the long-range vision of the future for Delaware's transportation system. The Appendix presents a list of the focus group and interview participants, along with an outline of the topics covered. The following is a summary of the major topics of emphasis from the focus groups and interviews, with common points across market segments as well as distinctions between segments noted. Because interviewees' comments differed substantially from those that emerged in focus groups, they are summarized separately.

## Focus Groups' Identification of Priority Needs and Obstacles to be Overcome

Although participants in both focus groups identified capacity problems such as the lack of alternative routes and lack of adequate infrastructure as priority problems, several transportation management priorities did emerge. Access to information, whether it is tourist-related information or real-time information on accidents, was a priority. For the goods movement focus group participants, creating an effective forum for their concerns and issues to be brought forward was its highest priority. Signage for tourist facilities and individual communities was the tourist/commuter group's highest priority problem. Both groups mentioned the need to maintain existing roads as critical to keeping the system running well.

Consistent with both focus groups' emphasis on the need to expand the existing system in the discussion of priority problems, the groups said obstacles to eliminating highway bottlenecks and congestion include lack of money, local opposition, and inertia at DelDOT. Other barriers to overcome to solve problems and meet needs were identified. Communication internally at DelDOT as well as externally with users of the transportation system was called a major obstacle to smooth operations. Major-event traffic was identified as a clear opportunity to use simple communication techniques to minimize congestion, but getting sponsors to buy into it and to make the effort to communicate to attendees was seen as an obstacle.

The goods movement focus group felt that the lack of an effective communications forum to deal with a myriad of issues was its biggest obstacle. Without a forum to communicate with each other and with DelDOT and other agencies, it was felt that it would be difficult to get more carriers involved, especially smaller companies, and it would be harder to address the lack of internal focus within agencies on the priorities and needs of the goods movement sector. Further, there was an expressed interest in remaining active with DelDOT in the future to ensure meaningful deployment of future technologies.

## Interviewees' Identification of Priority Needs and Obstacles to Overcome

Interviewees showed markedly different attitudes from the two focus groups when they responded to the same set of topics and questions. While it was difficult for the focus group participants to consider transportation management options because of their emphasis on adding capacity, interviewees more readily identified priority problems and needs. Interviewees highlighted transit services, land use planning, and institutional and organizational issues. They noted that the historical attitudes and mindset of DelDOT as road builders hinders progress in developing a transportation management perspective and in addressing multimodal needs and transportation-land use relationships. Gaps in transit service were noted, which compounds the difficulty of implementing system management strategies which will yield service improvements and more efficient use of the overall transportation system. Several interviewees addressed the need for improved organizational processes, including coordination and communication.

## Internal Customer Perspectives

To gain input from internal customers, 18 interviews were conducted with leaders and staff from various DelDOT departments and offices, including headquarters and field staff, policy, planning and operations staff, and highway-related and DTC staff. Common themes that ran

through the interviews were the desire for excellence, the need for pragmatism, the desire for Delaware to be on the leading edge, but not the "bleeding edge" of advanced transportation management, the need to integrate and coordinate efforts across functional boundaries, and the importance of selecting top priorities for action and demonstrating success and benefit to transportation system users.

Internal customers stressed repeatedly the need for improved information, including databases and inventories, information technology, and the coordination and sharing of information among internal users. They see this as crucial to providing better service to transportation system users and to enhancing internal management practices, ranging from budgeting and performance monitoring, to personnel and equipment management.

Interviewees also shared many ideas on what they thought their customers wanted and needed. They see the top priority needs as: real time, reliable information on such things as transportation options, system performance, and travel delays and disruptions; based on such information, the ability to make informed choices of travel mode(s), times, and routes; good, convenient access, both to information and on the transportation system; time savings; and seamless intermodal coordination.

The internal customers perceived a wide array of benefits arising from transportation system management, including better services to customers, reduced delay, improved efficiency and time savings, better system management, improved decisions on investment choices, and better performance tracking and monitoring. Among the obstacles to be overcome, resource constraints and delays in the procurement process were most often mentioned.

Respondents also commented on an array of lessons from experience, including:

- the need to get early wins;
- the importance of tailoring approaches to different parts and needs within the state;
- the importance of people and technology;
- the benefits of starting small and allowing adequate start-up time, and then expanding efforts in size and scope;
- the need for training and education to support deployment;
- the importance of user friendliness; and
- the need to revisit programs and technology periodically to see that they are still on target.

# Delaware's Vision of Transportation Management

## MISSION, GOALS AND VISION

Effective transportation management requires transportation providers and users to adopt a shared mission and vision for Transportation Management in the state. It also requires that they support shared goals. These foundations are critical to ensure that the resulting system meets the needs of all stakeholders.

### Mission

DelDOT, in consultation with its internal and external customers, has developed a mission statement to provide overall guidance and direction to the Department's approach to Transportation Management.

*To develop a balanced, cost-effective, integrated Transportation Management System that enhances the safe and efficient movement of people and goods by monitoring and controlling transportation flow, providing customers with real time travel information, facilitating incident management, improving customer service, increasing travel choices, and seamlessly integrating with neighboring systems through the practical application of technology, procedures, and policies .*

### Goals

To fulfill DelDOT's transportation management mission, the working groups and focus groups of transportation customers (including DelDOT employees, commuters, tourist representatives and goods movers) developed the following goals. DelDOT's transportation management system will respond to customer needs by:

- Reducing congestion and delay;
- Improving the safety of the transportation system;
- Reducing operating costs by improving the efficiency of planning, operations and maintenance; and
- improving system performance.

### Vision

As a result of implementing an integrated transportation management system, transportation managers will be able to better control traffic flow, increase transit and rail use, and improve coordination among state, regional and municipal transportation partners. Delaware travelers will be able to access a wide array of real-time information through a variety of devices and

services. This information will be multi-modal and easy to acquire and use. The use of technology in transportation monitoring, control and information management and delivery will become routine. Traffic signals will be fully integrated and will respond to real time traffic conditions. Applications such as electronic toll collection, real-time information, roadside and in-vehicle travel information will be widely used. Vehicle location and navigation systems will be commonplace on passenger vehicles and fleets. Delaware transportation information and services will be accessible through the Internet. Travelers will have reliable information to make smart travel decisions for all modes of transportation. Transportation agencies will be coordinated and integrated in their approach to managing and controlling transportation, all working in concert to provide the most efficient transportation system possible. This coordination will also allow agencies to more effectively manage assets and personnel. Travelers will benefit from a statewide organizational structure that supports the changing needs of all transportation stakeholders.

This vision was developed through outreach efforts and is believed to meet Delawarean needs. In addition, this vision is consistent with the goals set by federal transportation legislation and national organizations, including the U.S. Department of Transportation and the Intelligent Transportation Society of America (ITS America).

## National Perspective

The Intelligent Vehicle Highway Systems Act within the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 established the IVHS (now called ITS) program. The goals of the program are to:

- Improve the safety of the nation's surface transportation system;
- Increase the operational efficiency and capacity of the surface transportation system;
- Reduce energy and environmental costs associated with traffic congestion;
- Enhance present and future productivity;
- Enhance the personal mobility, convenience and comfort of the surface transportation system; and
- Create an environment in which the development and deployment of ITS can flourish.

In order to focus and accelerate the deployment of ITS in the United States, a national goal was established by ITS America, in cooperation with the U.S. Department of Transportation in December, 1995. This goal is to complete deployment of basic ITS services for consumers of passenger and freight transportation across the nation by the year 2005. The private sector will lead in the development of reliable and affordable Intelligent Transportation Systems. The public sector will lead in the deployment of core intelligent transportation infrastructure to meet essential public needs, forming innovative partnerships with the private sector where appropriate. The Intelligent Transportation Systems developed and deployed will be integrated, inter-operable, and inter-modal.

Importantly, the implementation of the DelDOT Integrated Transportation Management Plan will help to achieve these important national goals.

## TRANSPORTATION MANAGEMENT STRATEGIES

Delaware's existing transportation infrastructure and customer needs form the foundation of four strategies to guide the implementation of Transportation Management in Delaware. The strategies presented here highlight areas in which Transportation Management can help DelDOT make more efficient use of its existing transportation infrastructure. These strategies will be focused in areas of the state where the need is greatest and where implementation of these projects will yield the greatest synergy. For example, heavy commuter traffic congestion is particularly severe in a number of municipalities, including the Wilmington, Dover and Newark areas. Thus, strategies to alleviate such congestion will be used in these areas and along route to get to these areas such as I 95, US 40, SR 2 and US 202 . Seasonal and tourist travel have significant impacts particularly along beach routes such as SR 1 or other major corridors such as US 113 and US 13. In addition, travel along these routes affect otherwise quiet communities along them such as US 13 in Seaford and US 301 in Middletown. Tactics to improve seasonal and tourist travel will be focused in these areas. Improved transit access is a concern throughout the state, and, as a result, transit strategies will be targeted throughout the state. While all areas of the state are included in the Transportation Management Plan, this approach will enable DelDOT to leverage limited funds more effectively.

### *Strategy* – Create the Necessary Infrastructure to Support Transportation Management

A critical step in the implementation of effective transportation management is to create the infrastructure to monitor and control the transportation network. Among the actions required are:

**Implement a centralized Transportation Management Center (TMC)**

Develop a Transportation Management Center that will serve as the central facility for the integrated operations and management of the transportation system. The primary functions of the TMC will be to oversee transportation operations including management and coordination of the traffic signals, transit fleet operations and serve as a central communication point for DelDOT. The TMC will ensure statewide communications for all DelDOT offices and mobile units. The TMC will also serve as the central information point during major incidents, special events and emergencies. The TMC will coordinate transportation management activities with other agencies.

**Implement real-time transportation control systems that reduce congestion and increase mobility**

Increase the operating efficiency of the transportation network and reduce travel time and delay, by, among other things, installing traffic adaptive signal and bus priority systems, providing on-demand transit, and speeding the collection of toll and transit fares.

Achieving this goal will require existing highway control systems (such as toll collection, signal systems, reversible lanes, lane use strategies, ramp metering, parking, and commercial vehicle management) to be enhanced to include a full array of systems for both highway and transit

operations. Transit systems can benefit from the use of computerized dispatching, dynamic route scheduling, electronic fare payment and maintenance management.

**Monitor the transportation network to assess system performance.**

Provide for the collection of critical information regarding the transportation network's performance. Sensors, detectors, cameras, and other monitoring devices will collect information about congestion, incidents, transit ridership, transit schedule adherence, weather conditions, seasonal traffic problems, special event transportation problems, and other information. The information will be used to determine appropriate control strategies necessary to optimize system performance. System monitoring is especially important for incidents, seasonal and recreational periods and special event situations, when transportation patterns and volumes are unpredictable and significantly disrupted.

Achieving this goal will require DelDOT to increase enhance the number of monitoring devices currently in place and coordinate the collection of this data.

**Establish a dependable communications infrastructure**

The communications infrastructure is the backbone on which Transportation Management systems are built, connecting all network elements into one seamless system. This is accomplished through various voice, data and video systems communicating with each other, allowing for the quick, easy, and reliable exchange of information between systems. Transportation Management Center personnel can then use the information they receive to provide accurate and rapid communications with incident management personnel and with control and information systems located throughout the network.

The communications backbone is fundamental to all other strategies because it supports the communications necessary to collect and distribute real time information or to monitor and control the transportation network. In order to achieve this, DelDOT must concentrate on building an integrated system which allows for future expansion.

## *Strategy - Disseminate real-time, accurate information and allow customers to make informed decisions regarding travel route, travel time and mode choice.*

Real time information available to customers and operators of the Delaware transportation network and other regional systems is a critical element in the development of an effective transportation management system. The types of information to be collected and distributed include: real time travel schedules and transit schedule adherence, traffic accident/incident information, special event information, traffic volume and congestion information, travel time information, and tourist information. DelDOT personnel will use this information to monitor and track system performance and respond better to customer needs. System users will benefit from increased access to timely information regarding travel options, and will be able to make cost effective decisions regarding travel mode (i.e. transit, car, bicycle or pedestrian), travel time and route choice.

Developing such a system will require DelDOT to provide convenient, easy to access and reliable information. There are several Transportation Management tools available to increase

the efficiency and convenience of transportation. For transit users, these tools range from information phone lines, web sites, personal digital assistants, and kiosks to systems that dynamically schedule para-transit vehicles.

Roadway users can access information through various sources and at key locations along commuter and tourist routes. Dynamic Message Signs (DMS) and Traveler Advisory Radio (TAR) stations can give travelers the information they need about incidents and congestion at key points along the network and assist them in finding alternative routes. Other wireless technologies and in-vehicle devices will provide travelers with even more information sources. In addition, travelers can access information before they begin a trip, allowing them to make informed decisions about when to leave, what mode of travel to use and, in some cases, whether to make the trip at all. Telephone, broadcast and cable TV, broadcast radio, the Internet, personal digital assistants, and other technologies make this possible. These measures will encourage different travel times, alternate routes, and encourage the use of travel modes other than the personal vehicle.

## *Strategy – Develop Partnerships to Support Transportation Management Activities*

Transportation management is more than video cameras, variable message signs and fiber optic cable. Effective transportation management requires the cooperation and coordination of people and institutions, as well. Among the activities DelDOT should initiate are:

**Implement coordinated, timely incident response and special event management.**

Approximately 60 percent of all delay on roadways is due to non-recurring congestion (construction, special events, weather, accidents). Incident and special event management programs provide coordinated strategies among emergency, fire, police and transportation personnel, which reduce response times and minimize the duration of lane closures due to accidents and incidents. It has been estimated that closing one lane of a four-lane freeway can increase travel times by 55 percent. A systematic and informed approach to handling these situations can reduce traffic delays, improve mobility, and increase safety.

The key to implementing a coordinated incident and special event management system is the development of strong ties with public safety personnel, including fire, police, 911 dispatchers, and others with a vested interest in transportation system safety. To ensure a truly coordinated response, DelDOT should implement an incident management team composed of police, fire and rescue, natural resources, and transportation agencies.

**Work Closely with Partners, Counties, and Local Agencies**

Effective transportation management requires a truly integrated approach – from all modes, all levels of government, all members of the community, and regional partners. For these reasons, DelDOT will work closely with sister agencies throughout the state, with local government agencies, community groups, private organizations, and regional alliances in implementing these transportation management strategies. DelDOT will actively seek the involvement and input of these partners to assure that transportation management plans and projects meet the

needs of Delawareans and positively contribute to the state's quality of life. Close coordination is crucial to the success of the system.

## *Strategy* – Develop Internal Capacity to Support Transportation Management.

**Develop staff training and organizational structure to support implementation.**

A successful Transportation Management System depends greatly on the ability of the staff and the system to meet the daily needs of customers. Thus, DelDOT needs a highly-skilled and well-equipped staff with the necessary training and resources capable of operating and managing the system. This requires a regular commitment to training and a process to identify sources for financial and personnel needs. DelDOT has begun this process through the creation of the Transportation Management Team (TMT), a group of key transportation managers who will advise DelDOT on the organizational, staffing, and reporting responsibilities of the integrated transportation management system. Other organizational, educational and management strategies will be required to sustain and expand the system over the long term.

**Remain active in regional and national initiatives, and share new technologies to ensure DelDOT's transportation system is continually enhanced.**

In the rapidly evolving field of transportation management, it is critical that DelDOT stay abreast of new ideas and share experiences with other jurisdictions and agencies in order to maintain a practical and responsive system. This will enable DelDOT to avoid repeating the mistakes of other regions and build on other successful systems. This networking also will allow DelDOT to establish a strong foundation for future cooperation with other agencies and systems throughout the mid-Atlantic region.

DelDOT can further this goal by continuing to participate in professional organizations such as ITS America, the Institute of Transportation Engineers, the American Association of State Highway and Transportation Officials, and enacting programs to encourage the same cooperation within the state as well.

**Mainstream Transportation Management Activities with Existing Transportation Planning, Pre-construction, Construction and Operations Activities.**

Transportation Management does not occur in a vacuum. To realize the full benefits of transportation management, TM must be fully integrated into the transportation planning processes (including access management, transportation impact studies), the design and construction of new transportation facilities (including reserving conduit for future communications etc.), and the purchase of new equipment (buses, maintenance equipment). This "mainstreaming" will be implemented in close cooperation with state, local and municipal partners, the business community, environmental and growth management interests, regional entities such as the I-95 Corridor Coalition, and neighborhood groups. Doing so will ensure that DelDOT proactively meets the needs of its customers, efficiently manages its resources, maximizes the benefits to be gained from an integrated transportation management system, and lays a solid foundation upon which Delaware can build sustainable development.

# MEASURING PROGRESS

## Performance Measure Characteristics

Performance measures have been established to assess the degree to which the plan's mission, goals and objectives are met, and to evaluate the effectiveness of individual transportation management services. Performance measure characteristics have been established to guide the future selection of performance measures for monitoring progress of this plan. It should be noted, however, that due to the nature of transportation management, some services may not lend themselves very well to such a quantitative evaluation. In such cases, a qualitative approach may be necessary, for example by conducting an attitudinal survey of transportation users. Services that are prime candidates for such evaluation would include those that provide traveler information of some kind of another.

Some Performance Measure Characteristics Include:

*quantitative;* the system's performance will be evaluated using "hard" data such as speed, volume, and transit ridership.

*measures outcomes;* performance will be monitored based on transportation system outcomes and not device outputs.

*easy to measure;* system performance will be measured with the data at hand, or with data that are relatively easy to collect allowing for both an effective "before" and "after" evaluation, and would avoid the expense and effort of data collection simply for the sake of assessing the performance of a particular strategy.

*meaningful to the largest possible audience*; this condition is especially important considering the large number and variety of stakeholders in Delaware.

## Performance Measures

The following performance measures have been identified for the Delaware Integrated Transportation Management Strategic Plan. For each performance measure, a brief description is provided, as well as a discussion of major concerns with a particular measure.

- **Change in total travel time.** This measures the total time that is spent traveling by all vehicular traffic on the regional surface transportation system. This performance measure would be most appropriate to assess system-wide performance and progress toward congestion reduction and commercial vehicle operations goals. This is a quantifiable measure.

- **Change in delay.** This measures the increase in the time required to travel a certain distance beyond the travel time required under "ideal conditions". A decrease in delays would imply congestion reduction. This performance measures would be most appropriate to assess performance of individual projects or specific corridors, such as those involving arterial traffic operations, toll collection, and parking, as well as larger-scale projects such as incident management programs. This is a quantifiable measure.

- **Change in accidents.** This measures the change in the number and/or type of accidents

that occur, and may apply to system-wide or project-specific evaluation. It would be most appropriate to assess progress toward safety goals; however, since accidents are a major cause of congestion, it could also be an indicator of congestion reduction. This is a quantifiable measure.

- **Change in cost.** This is a quantitative measure, measuring changes in operations cost, user cost, or construction cost.

- **Change in travel patterns.** This measure would be used to assess the impact of various route guidance and information dissemination strategies. It would be appropriate for a system-wide or project-specific evaluation of progress toward traveler information and incident management goals. It is a quantitative measure.

- **Information reliability.** This measure would be used to assess the quality of the traveler information being provided, as well as the degree to which the information is being used in making travel decisions. It would be appropriate for system-wide evaluation. It is a qualitative measure.

- **Change in average arterial speed.** This measure would measure the average travel speed of all vehicular traffic on non-freeway sections of the regional transportation system. It would be appropriate for system-wide evaluation of certain ITS strategies, and assess progress toward arterial operations goals. Since a large share of transit operations occurs on the arterial network, this measure could be an indicator of transit system performance as well. This is a quantitative measure.

- **Change in emissions.** This measure would be used to measure emissions impacts on a system-wide basis, and assess progress toward environmental goals. It is a quantitative measure. It should be noted that emissions measurements may be derived from other performance criteria, including vehicle miles traveled and speed.

- **Change in transit ridership.** This measure would measure transit ridership, and be used on a system-wide basis, primarily to assess strategies in the area of traveler information dissemination and transit operations. It is a quantitative measure.

- **Schedule adherence.** This measure would be used to measure on-time performance of the transit system. The measure is quantifiable, and could be used on a system-wide basis, for example to evaluate strategies such as signal pre-emption and Automated Vehicle Location (AVL) strategies, and transit operations goals in general.

- **Change in incident response time.** This is a quantitative measure, measuring impact of incident management strategies. This would primarily be evaluated on a system-wide basis.

**Exhibit 6: Performance Measures ***

| Performance Measures | Detailed Measures |
|---|---|
| Change in Total Travel Time | • Change in automobile travel time<br>• Change in transit travel time<br>• Change in person travel time |
| Change in Delay | • Change in waiting time for modal transfers<br>• Change in automobile delay<br>• Change in transit "in motion" delays<br>• Change in person delay |
| Change in Accidents | • Change in the total number of accidents<br>• Change in the number of primary/secondary accidents<br>• Change in the severity of primary/secondary accidents |
| Change in Cost | • Change in operations cost<br>• Change in construction cost<br>• Change in system user cost |
| Change in Travel Patterns | • Change in number of transit users<br>• Change in number of ridesharing programs<br>• Change in number of ridesharing customers<br>• Change in average vehicle occupancy<br>• Change in toll facility volumes<br>• Change in motorist route |
| Information Reliability | • Change in motorist perception of reliability<br>• Change in transit user perception of reliability<br>• Change in number of requests for information |
| Change in Average Arterial Speed | • Change in automobile arterial speed<br>• Change in transit vehicle arterial speed<br>• Change in number of traffic violations |
| Change in Emissions | • Change in total emissions<br>• Change in number of reported vehicular violations<br>• Change in number of reported regional violations |
| Change in Transit Ridership | • Change in number of riders, total system<br>• Change in number of riders, per route<br>• Change in revenue/cost ratio for MTA<br>• Change in number of "non-captive" riders<br>• Change in cost per passenger for MTA |
| Schedule Adherence | • Change in number of "on-time" arrivals, per route<br>• Change in number of "on-time" arrivals, system-wide |
| Change in Incident Response Time | • Change in time required for incident detection<br>• Change in time required for incident verification<br>• Change in travel time for first responder<br>• Change in time required for incident clearance |

* Performance measures noted above are potential measures. Some measures listed above may not be practical because data is not readily available.

# Next Steps: Achieving the Vision

Effective transportation management requires a systematic, coordinated and integrated approach. The strategies identified above must be prioritized and implemented in a manner which

- Provides near-term solutions to Delaware's most critical transportation problems;
- Serves as a foundation for the implementation of additional services (information gathering applications are generally a necessary prerequisite to information dissemination applications); and
- Makes efficient use of scarce resources (financial, personnel, etc.)

Experience has shown that the most effective transportation management systems are those which apply systems engineering principles where problems and needs are identified, the services needed to meet these needs are determined, the means for delivering those services is established and a framework for service delivery is created. This is the approach taken in developing this plan. The previous sections of the document have established the needs and problems to be met. This section will describe the various services transportation management systems can provide to transportation users and managers.

## SERVICES TRANSPORTATION MANAGEMENT SYSTEMS CAN PROVIDE

The Federal Highway Administration has identified several individual services that can be implemented by travelers and transportation providers, such as travel and transportation management, electronic payment, emergency management, etc. Users of these services may include: travelers by any mode, operators of transportation management centers, transit operators, MPOs, commercial vehicle owners and operators, and the state and local governments.

Transportation management systems focus on combining system management technologies with the existing transit and roadway infrastructure to provide the most effective use of transportation facilities. These services will help maximize the utilization of the transportation network already in place. A comprehensive solution to transportation problems may require additional construction as well as transportation management infrastructure development. The strategic deployment plan identifies how transportation management will be integrated into Delaware's total transportation improvement plan.

The transportation management services described below are the building blocks of an efficient and user-responsive approach to deploying transportation management. The functions to be provided by the infrastructure include: traffic monitoring, vehicle monitoring, inter-agency coordination, communications, individual traveler interface, payment systems, variable message displays, traffic control, navigation, database processing, and in-vehicle sensors/devices.

### Travel and Transportation Management

These services support two key functions: travel information management and transportation systems management, in which infrastructure owner/operators play a principal role. These services include public transportation operations. These services share common functions such as control (including traffic signal systems), detection, monitoring, and communications.

### Travel Demand Management

These services provide information and incentives to manage transportation demand—principally on a pre-trip basis—and encourage the use of more efficient travel times and modes (such as high occupancy vehicles).

### Emergency Management

Emergency Management services are those generally provided by police, fire and rescue, and transportation agencies. These services use the common functions of vehicle monitoring, navigation, communications, response, and control.

### Electronic Payment

This service provides financial support for deployment of many other services, both within and outside the transportation arena and involves both public and private organizations.

### Commercial Vehicle Operations

These services improve the efficiency and safety of commercial fleet operation, benefiting both States and the motor carrier industry. CVO services use advanced computer and communications technologies to improve safety and productivity.

### Advanced Vehicle Control and Safety Systems

Most services in this category are provided through the automobile industry (together with the public sector) and advance improved vehicle safety. With the exception of Automated Vehicle Operations, most of these User Services are characterized by near-term reliance on self-contained systems within the vehicle.

## A Framework for Implementation

A key element to an effective transportation management strategy is the transportation management framework, through which specific projects and activities are accomplished. A framework describes what a system does and how it does it, providing the general structure within which the transportation management process occurs.

Individual applications provide incremental benefits and improvements to the current transportation system. When tied together to form an integrated system, transportation management delivers much greater benefits and improvements.

The National ITS Architecture, developed by the Federal Highway Administration, provides a model for state and regional transportation agencies to develop a multimodal regional framework for transportation management systems. Like the Federal Interstate System, the National ITS Architecture is a blueprint that provides a top-down approach for developing a seamless transportation system. This statewide framework, based on the National Architecture, fosters a logical and organized approach to deployment that will ease implementation and save development, implementation, operations, integration and maintenance costs. The architecture supports the implementation of ITS user services.

Defining a transportation management framework for Delaware requires:

- an understanding of the problems being experienced in the Delaware region; identifying applicable services; identifying existing, planned, or foreseeable systems; and an understanding of how the physical framework (communication, transportation) can be impacted by socio-economic or institutional conditions; and
- a Vision Statement incorporating potential solutions, as discussed in the previous Section.

In Delaware the transportation network is managed largely by DelDOT. Some components of the transportation system, however, are the responsibility of other autonomous entities, such as private rails, some ferries, and some aspects of emergency and incident management, airports, and Port of Wilmington. A statewide framework -- identifying the various transportation management systems and the appropriate linkages between these systems -- is necessary to provide a "seamless" transportation network from the perspective of the traveler and to provide uniform regional communication among all Delaware transportation providers.

## Recommended Framework

The Delaware Integrated Transportation Management System will provide real time system control, monitoring and information that will improve the safety and efficiency of Delaware's transportation system. The implementation of this system will allow transportation managers to maximize the network's performance and give travelers the ability to make educated route, mode and travel time choices. Integrated transportation management will reduce the impacts of accidents, construction, incidents, special events, and weather by providing system managers with real time control, monitoring and information and improve coordination and response among Delaware transportation agencies. The Transportation Management system will provide accurate system statistics that can be used to more reliably plan for future transportation system requirements.

Delaware's transportation management system plays an important role at the local, state, regional and national levels. Locally, citizens and tourists will enjoy easier and safer travel and a higher quality of life. At the state level, improved coordination will optimize the system's performance, make more efficient use of transportation funds, and ensure that all Delawareans have access to convenient and efficient travel choices in all modes. The region will benefit from this integrated system by having a single contact point for coordinating multi-state transportation strategies. In particular, Delaware will be better positioned to participate in the I-

95 Corridor Coalition. It will now have a centralized transportation management center which can quickly and easily work with other neighboring states to manage the movement of people and goods along the I-95 transportation corridor. Nationally, the Delaware system will be a model for building and managing an efficient transportation network with diverse modal, environmental and regional needs.

The framework for Delaware's transportation management system is conceptualized in Exhibit 7. The diagram illustrates how various functions (transit, ports, roadways, airports, etc., listed in the boxes) interact with the transportation management center and provides some examples of the data and information to be exchanged between and among these functions (the lines between the boxes).

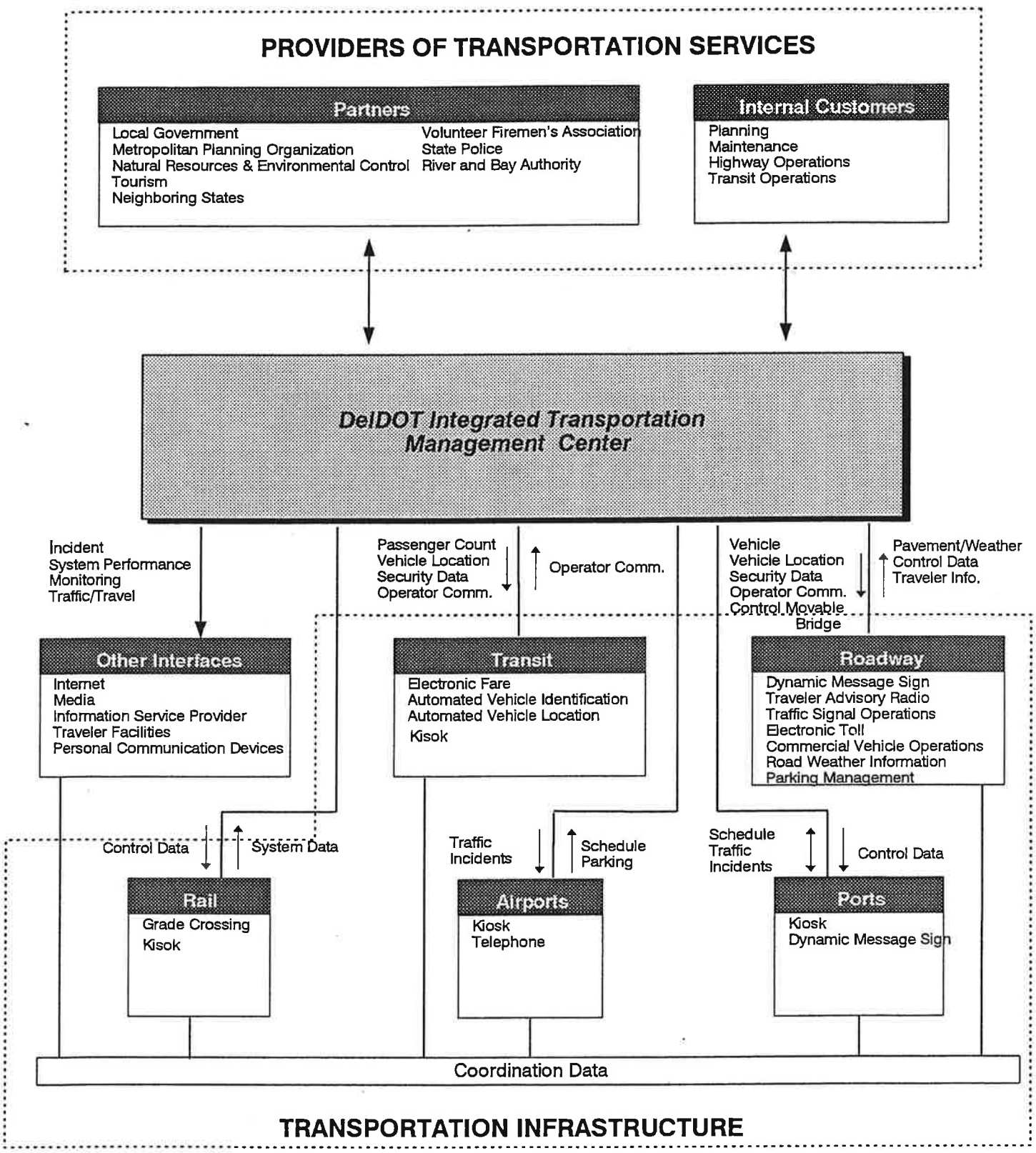



**Exhibit 7: Integrated Transportation Management Framework**

The transportation management process is conceptualized in Exhibit 8. The transportation

management process begins with transportation agencies observing and monitoring the Delaware transportation network. Technology aids throughout the network will collect and relay transportation data to the Transportation Management Center, the heart of Delaware's transportation management system. Transportation agencies receiving this information include DelDOT, DNREC, DEMA, Delaware Volunteer Firemen's Association, Delaware River and Bay Authority, Delaware State Police, Delaware Department of Tourism, MPOs, counties, and local governments.

These agency partners will share information about the transportation system among each other, as well as make this information available to national and eastern regional transportation partners, such as the I-95 Corridor Coalition and federal agencies responsible for some aspects of commercial vehicle regulation. This information will be used to make decisions about how to optimize the transportation system. For example, signal timing may be altered to increase traffic flow, buses may be given signal priority to ensure that they maintain their schedules, or vehicles may be rerouted around incidents. These control decisions will improve the movement of people and goods through the transportation system.

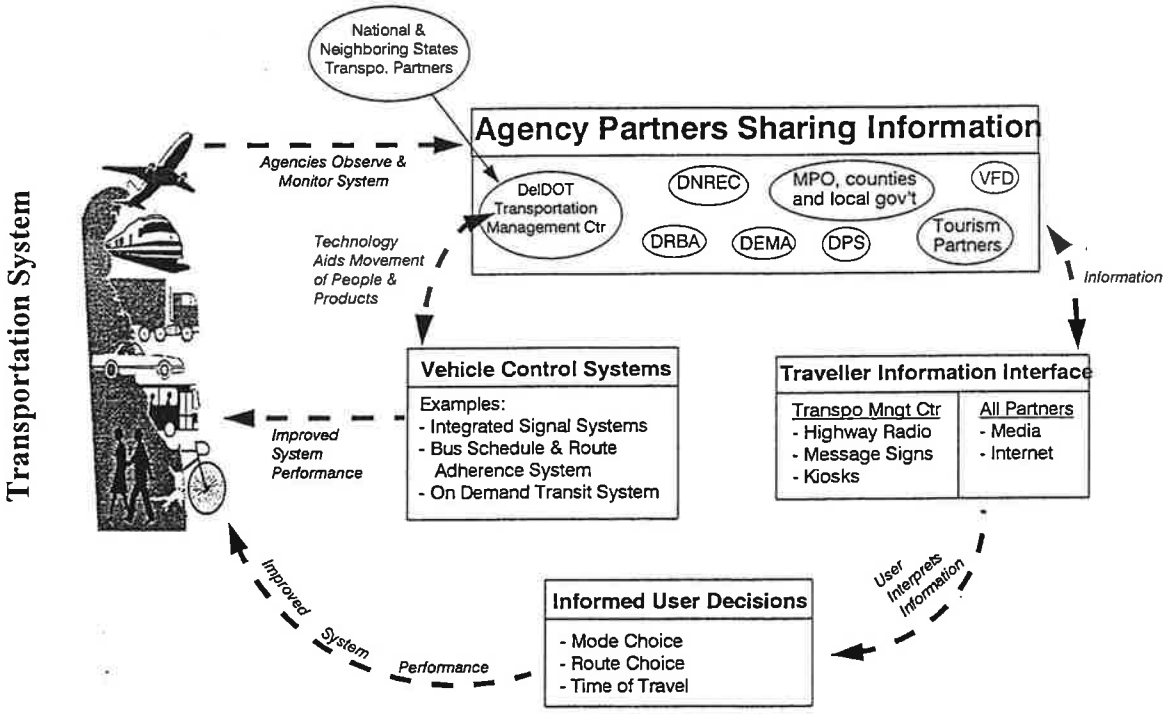



**Exhibit 8: Delaware's Integrated Transportation Management System Process**

The TMC will provide travelers with information on travel conditions, transit schedules, incidents etc. through a variety of devices, including Traveler Advisory Radio, Dynamic Message Signs, the Internet, and traveler information kiosks. The private sector will partner with DelDOT to provide value added traveler information. Transportation system users will interpret this information and use it to make informed decisions as to mode choice, route choice and time of travel. These individual user decisions also will help to optimize system performance.

The framework supports an integrated automated management and information system to

provide information at three levels:

Government to Government: Government to government transportation management and information would include information on and response to incidents, route diversion, signal coordination and signal priority for emergency and transit vehicles.

Government to Media: Government to media communication would include providing information to broadcast television, radio and cable stations, including real time traffic and transit information, video links, dynamic map databases, etc.

Government to Traveling Public: Information distributed to the traveling public would include real time congestion information, ridesharing, transit, rail and airline schedules, alternative route and mode information, special event, construction, road conditions, weather, and emergency information.

The transportation management system will be composed of multiple, integrated subsystems that provide for real time control, monitoring, and information. It will be based on an open system architecture and will feature a relational database management system and integrated geographic information system (GIS). The system will be supported by a sophisticated communications system that will include fiber optic and wireless technologies.

## Role of the Transportation Management Center

DelDOT plans for its Transportation Management Center (TMC) to coordinate operations and share information among its own personnel as well as various other transportation-related agencies, serving as the transportation interface among all such agencies in the state. The TMC will also serve as an interface between DelDOT and the media and public.

Much of the information of interest to transportation managers would be focused in the DelDOT TMC since state entities operate the major transportation facilities. As a result, representatives from Highway Operations, Delaware Transit Corporation, External Affairs, and the Department of Public Safety, including Delaware Emergency Management Agency and Delaware State Police, may be co-located in the TMC. Other agencies, such Delaware River and Bay Authority, DNREC, the Diamond State Port Authority, WILMAPCO and the Dover/Kent MPO may also have office space available within the TMC. Furthermore, it is expected that during peak period and major incidents, the Delaware Volunteer Firemen's Association and the Delaware State Police will also be present in the TMC coordinating their responsibilities for on-site incident management and dispatch of emergency vehicles on DelDOT facilities. Further, special events, such as Blue Rocks baseball, Dover Downs, State Fairgrounds events, holiday and summer beach traffic will require additional coordination among transportation managers, police, event personnel, and others. The TMC will provide a focal point for that coordination.

The TMC also will serve as an interface between systems outside of the area, such as the I-95 Corridor Coalition. The Coalition's activities include an information exchange network, development of standard operating procedures for notification of incidents and construction/maintenance activities having multi-member impacts, feasibility of regional communication centers, and commercial vehicle operations (e.g., standardized permitting). Delaware's TMC will provide a single point of contact and coordination to enhance its participation in these activities and minimize the impacts of traffic on I-95.

## Managing the System

Rather than create a new bureaucracy, the system can be managed by the Transportation Management Team, which consists of key transportation stakeholders in Delaware. This Team will meet on a regular basis (e.g., monthly) to share ideas, and address procedural and policy matters regarding management of the transportation network. The Transportation Management Team will ensure that all stakeholders (state, local and regional) are represented and included in transportation management decisions throughout the state and that the transportation needs of all transportation system users are effectively met.

## Role of Local and Regional Agencies

Effective transportation management requires the active support and involvement of DelDOT, other state agencies, and local and regional agencies. The New Castle and Kent County Metropolitan Planning Organizations and the Sussex County TPAC are also parts of this integrated transportation management plan. In addition to continuing its transportation planning coordination with these agencies, DelDOT will work with local governments in developing specific transportation management strategies, particularly during special events and summer beach season.

## Role of Private Entities

Effective implementation of transportation management in Delaware can be enhanced by encouraging new roles for the private sector. Private entities can provide investment capital, resource-sharing potential, special technical expertise and entrepreneurial experience in the provision of some transportation services, most likely in the information arena.

# COMPONENTS OF DELAWARE'S TRANSPORTATION MANAGEMENT SYSTEM AND PRIORITY ACTIONS NECESSARY FOR DEPLOYMENT

Effective transportation management systems are those which are implemented in phases and build on Transportation Management systems and components already in place. Thus, the actions necessary for phased deployment must be prioritized in some manner to ensure that the implementation of these transportation management applications are coordinated.

A number of factors must be considered in determining what steps should be taken in the short term to provide the core foundation for transportation management in Delaware. Those factors include:

Transportation Needs Addressed: DelDOT's early actions in implementing transportation management should address critical transportation inadequacies and the needs of DelDOT customers. The priority actions below will provide the means through which these needs can be satisfied.

Ease of Implementation: Early deployment actions should be relatively easy to implement. They should build on existing systems and plans for the state and leverage ongoing activities. The priority actions identified focus on expanding existing systems and take advantage of other plans and projects underway or planned.

Benefit: Early deployment actions should provide measurable benefits to transportation system users and customers. Benefits may include reduction in travel time, delay, vehicle miles traveled, fuel consumption, and the number of accidents and injuries.

Cost of Implementation: Given tight budgets, priority actions should be cost effective. They should result in sound, measurable benefits. These priority actions are those which produce results and present opportunities for long-term operating cost reductions.

Degree to Which Action Builds Foundation: An important consideration in determining priority actions is the degree to which the action will lay a foundation for the implementation of future applications. The priority actions below are all foundation building steps – providing Delaware with a "core infrastructure" of systems to deliver transportation management services.

Each subsystem -- control, monitoring, information, and communications -- is described below and applications within each are prioritized for short (less than one year), medium (1-6 years) and long (6 or more years) term implementation.

## Control Subsystem

Transportation Management typically requires traffic control or demand processing to effectively achieve its objectives. As such, transportation control strategies are critical to transportation management. Control functions include strategies to provide improved efficiencies on the transportation network, reduce or spread out demand, enhance traveler safety, and improve commercial vehicle operations. These strategies may be implemented for recurring conditions (e.g., peak period traffic congestion) as well as non-recurring (e.g., incidents, special events, weather) conditions.

Delaware's Transportation Management Center will be the centerpiece of the integrated transportation management system and the focal point for the system's control functions. The TMC will use advanced technologies to monitor and respond to data transmitted from key locations throughout the state. The main objectives of the TMC will be to:

- Monitor and direct the flow of traffic
- Operate and supervise highway, arterial, transit, and port systems
- Manage incidents from a transportation perspective
- Manage special events and seasonal transportation needs

Monitoring data from detection devices will be used to determine the state of the network. Traffic management and incident management systems will take these inputs and create the signal timing and phasing messages used to control traffic and transit. Transit management systems will send requests for signal priority in order to assist specific transit vehicles to stay on schedule. Emergency vehicles will also be able to request signal priority to speed emergency response. The TMC also will receive monitoring information from special event promoters reporting on large traffic generators; weather services on current and predicted weather

conditions; and fire, police and emergency personnel on incident information. Among the components which may make up the control system are:

**Integrated real time traffic responsive signal system:** These systems are capable of adapting to specific traffic conditions as they occur by selecting the appropriate control strategy from a suite of real-time traffic signal timing control strategies. Special signal timings can be implemented in response to weather, special events, and incidents.

**Reversible lane signal system:** Reversible lane signals enable traffic managers to maximize traffic flow by changing the direction of traffic in given lanes. For example, during the morning rush hour into Wilmington, reversible lane technology could be used to have three of four highway lanes feeding into the city, while during the evening rush three of the lanes could be directed out of the city. At all other times, the four-lane road would have two lanes in each direction.

**Lane use sign system:** Electronic lane use signs can be changed to allow different movements in response to actual demands.

**Ramp metering:** Ramp metering systems control access to highways by limiting the number and pace with which vehicles enter the highways. Most ramp metering systems limit access using signals which allow only one vehicle to enter the highway for each green signal.

**Electronic variable speed limit sign system:** These technologies automatically adjust speed limits as traffic and conditions warrant. For example, on particularly treacherous stretches of roads, speed limits may be lowered during inclement weather, and in construction areas.

**Transit and emergency vehicle priority system:** Vehicle priority systems can assist emergency vehicles reach those in need quickly and transit vehicles to maintain their schedules. These systems use automatic vehicle identification and location technologies to identify transit and emergency vehicles and automatically adjust signals when appropriate.

**Schedule and route adherence system:** These systems allow transit managers to monitor transit vehicles to ensure that they are maintaining their prescribed route and are staying on time. Managers can use voice and data communications to notify drivers that they are off course or off schedule and determine the nature and reason for the delay or route change. Managers can quickly insert vehicles down stream of incidents and congestion to maintain schedules.

**On demand transit systems:** These systems provide transit managers with the flexibility to optimize transit by knowing, in real time, where their customers are. Transit users can make trip requests, and transit vehicles can then be dispatched to pick them up.

## Monitoring Subsystem

Effective transportation control demands comprehensive system monitoring. Nearly all of the transportation management action items developed for Delaware depend on collecting, processing, and managing information on the transportation network. The importance of accurate and reliable monitoring information cannot be overstated. Monitoring data (including

speed, volume, density, travel time, queue length, classification, and vehicle identification and position) are used in real-time for making transportation management decisions, obtaining traveler information, and implementing appropriate control strategies. The information may also be stored for planning and historical analyses. Among the components which may make up the monitoring system are:

**Detection systems:** Detectors monitor the transportation system by counting vehicles, and monitoring speed and classification to assess traffic flow, sensing environmental and weather conditions such as snow and ice, and recognizing irregularities in traffic patterns to detect incidents.

**Video monitoring systems:** A variety of video systems are available to monitor traffic and transit systems. Video monitoring systems enable transportation managers to view selected transportation system segments to detect incidents, detect electronic toll violators and red light runners, and protect transit patrons.

**Motorist Assistance Patrols:** Part of a comprehensive incident management program, Motorist Assistance Patrols (MAPs), provide travelers in need with both human resources and equipment to assist them with flat tires, fender benders, emergency medical needs and other needs. In addition, MAPs provide critical reconnaissance on freeways and arterials, alerting transportation managers to incidents and emergencies throughout the transportation system.

**Observation balloons:** Delaware uses a 33-foot balloon carrying an observation camera for special event management.

**Aerial monitoring:** Delaware also is considering the use of aircraft to observe transportation system conditions.

**Automatic vehicle locating systems:** These systems use Global Positioning Systems (GPS) to automatically determine the location of transit vehicles and other vehicle fleets. Location systems allow transportation managers to track transit fleet movements, dispatch transit vehicles where they are needed and improve the efficiency and timeliness of transit operations.

**Electronic toll collection systems:** ETC systems allow travelers to pass through toll booths without stopping. Electronic readers at toll booths read tags located on vehicles and automatically deduct toll charges from a prepaid account. This reduces congestion at toll booths, a particular problem for commuters and recreational travelers during beach season. Electronic toll collection also provides a foundation for additional fare payment technologies which can be linked for easier travel. For example, the same card used to pay electronic tolls could eventually be used to pay ferry charges, transit fares, parking fees, etc.

**Commercial vehicle operations:** Efficient commercial vehicle operations are critical to Delaware's economy. CVO systems streamline regulation, inspection and movement of trucks and other commercial vehicles to create "seamless borders" for interstate commercial carriers. In addition, these systems aid in directing trucks passing through the state to highway and interstate routes, keeping them off local streets. Some specific CVO applications include: "weigh-in-motion" systems that enable trucks to be weighed while traveling at highway speeds, automatic credentialing, and roadside safety inspections. These systems require both coordination within the state, as well as with other states in the region. Delaware's Integrated Transportation Management System will aid in this coordination.

**Parking management systems:** These systems efficiently manage parking by tracking the level of occupancy, directing cars within the parking lot or structure and controlling the flow of traffic from parking lots to streets. These systems can be particularly useful during special events, when traffic densities are highly concentrated.

**#77 cellular reporting systems:** The "#77" disabled vehicle reporting system can supplement freeway monitoring programs. The system allows a traveler with a cellular phone to call the TMC and report incidents and congestion conditions. This information will be forwarded to the police, fire, or emergency personnel for dispatch if needed.

**Police monitoring:** Police monitoring is already a key component of Delaware's transportation management activities. With improved communication between police and the TMC, DelDOT can obtain better real time information and enhance the coordination of management strategies with police.

**Fire and EMS monitoring:** Like the police, fire and EMS personnel provide critical information to DelDOT concerning incidents and accidents. Again, improved communications links between these services and the TMC will enhance response.

**Utility and delivery company monitoring:** Utility companies and delivery services are constantly on the roads, both highways and arterials. These vehicles, equipped with probes, cell phones, or other technology, can provide transportation managers with important information on roadway conditions, congestion, incidents, and other transportation data.

**Traffic watch teams:** Citizens, also equipped with cell phones or probes, can support transportation monitoring by reporting real time information to the TMC.

## Information Subsystem

Traveler Information technologies provide travelers with real-time traveler information regarding roadway, transit, and traffic flow conditions. This information can assist travelers with trip planning, selecting the optimum mode or route, and dynamic decision making during the trip so as to improve the efficiency and convenience of travel. The extent to which the traveler accesses the available information depends not only on the timeliness and accuracy of the information, but also on the ease of access to that information. The applicable functions include: individual traveler interface, dynamic message displays, navigation, in-vehicle devices, as well as the monitoring, communications, and information processing functions. The four target groups of travelers include:

- Tourists visiting the area whose primary interface with the system will be pre-trip planning, while driving, at information centers, and in hotels. Specific Traveler Information technologies must deliver information that is predominantly tourist oriented (weekend, destination oriented, etc.).

- Commuters who reside in the area and travel to and from work every day. These travelers require information to be available in their work place, homes, and en route.

- Commercial Vehicle Operators traveling to, from and through Delaware, as well as along

the Eastern seaboard require information similar to commuters for general traffic conditions. In addition, commercial vehicle operators require information about CVO regulations and licensing requirements for the state of Delaware.

- Through traffic that is composed of people traveling through the area to another destination who desire to avoid local congestion or incidents. These people typically only contact traveler information while en-route.

Information can be disseminated to travelers in a variety of ways. Among them are:

**Traveler Advisory Radio (TAR):** TAR provides information to motorists through their car radios. TAR provides a relatively economical means of disseminating a significant amount of information on potential alternate routes or transportation system conditions. This "one-way mobile" communications can provide more specific traveler information at key locations on an immediate basis to a targeted group of users than is possible through traditional commercially broadcast traffic reports or DMS. Ten TAR stations are currently used to provide information regarding transportation conditions in Delaware. Static warning signs with flashers (activated for special warnings) supplement the TAR.

**Dynamic Message Signs (DMS):** The purpose behind dynamic message signs is to provide information regarding existing traffic conditions such that motorists can make intelligent route choices. Special applications are possible in Delaware focusing on both long-distance travelers and intermodal needs. Selected DMS, particularly those in advance of intermodal facilities, may be used to provide dynamic information regarding the availability of the facilities, e.g., park-and-ride lots, parking facilities, etc.

DMS should provide timely and accurate information which reflect the current conditions, and which can be used by the travelers to improve their trip time. DMS functions should be expanded to provide dynamic information to motorists regarding a variety of conditions, including: congestion, diversion, transit operations, general guidance information, maintenance and construction information, and roadway status.

**Internet Web site:** A Web site will be established for transportation information in Delaware. This type of access will make it easier for employees to check travel conditions prior to leaving their home or directly from their desk before leaving work. The Web site could include detailed area maps illustrating real time traffic conditions, "live" feeds from video cameras in specific locations, real time transit and rail schedules, construction, incident, special event, and weather information.

**Cable television:** Delaware will explore the potential for cooperating with local cable companies which, with DelDOT's TMC, could establish a dedicated traffic channel on cable television. Currently, cable companies throughout the United States offer channels to announce events, local weather conditions, and advertising of regional attractions. A similar channel could be established to display live traffic camera views, graphics, information about traffic congestion, routing information, and tourist site accessibility. This information would benefit area residents that could view the information before leaving home and tourists in the area that could access the information in their hotel rooms.

**Broadcast television:** A video connection with selected media is deemed valuable. Video

images can be transmitted for those locations where incidents are present, or for selected locations.

**Commercial radio:** Real time transportation information also will be distributed to commercial radio stations in Delaware, to provide travelers with current transportation conditions.

**Kiosks:** Kiosks are becoming an important traveler information communications device and have been adopted by many transportation agencies. Kiosks allow travelers to access current data on transit, road and weather conditions specific to a region, road and transit route maps, and current news regarding local and special events. When applied as part of a transportation management system, both static information (such as maps of all routes to areas of interest) and dynamic information (such as current transportation and weather conditions), can be updated by the TMC.

**Personal Communications Devices (PCDs), cellular telephones and paging services:** PCDs are small, portable, wireless devices for sending and/or receiving information. The most common examples of PCDs are the pager, which is used primarily for receiving information, and the cellular telephone, capable of two-way communications. The ongoing integration of portable personal computers and cellular telephone technologies is creating a device very suitable for use in traveler information systems. The PCD can access trip-planning services, get information on current travel conditions, perform routing functions, serve as an AVL beacon, and even monitor vehicle conditions. PCDs can provide a number of functions: trip planning, routing, traveler advisory, route guidance, and emergency services. These devices are intended to be privately-owned devices with access to information provided by the DelDOT's TMC center.

**In-vehicle displays:** In-vehicle information provided to the driver can include current vehicle position, real-time traffic flow conditions (e.g., areas of congestion, speed limits, travel times) on the driver's route and on alternate routes, as well as weather information. This in-vehicle information can be presented to the driver in several ways, including map displays, audio and textual information.

## Communications:

The statewide integrated transportation management system centers around the management and control of the entire transportation network and the collection, evaluation, and dissemination of traveler information. This information is, in turn, used to continuously monitor conditions on transportation facilities and to develop and implement appropriate strategies.

Data from various field devices (cameras, detectors, etc.) are passed automatically to the TMC, where it is merged with other data to provide a state-wide pool of transportation information.

To facilitate communication and information sharing among agencies and private entities, a sophisticated communications infrastructure, using fiber optic and wireless technology, is being developed. Information on the network will take on many formats including: text, electronic forms, data files, map-based graphic displays, voice, and video. Moreover, the information shared on the network will be designed to support coordinated incident and transportation management efforts, and provide traveler information on a statewide basis. The communication system will build on existing and planned statewide telecommunication systems.

# ADDITIONAL NECESSARY TOOLS FOR IMPLEMENTATION

## Internal Capacity

Internal capacity is an important resource in the creation and growth of any successful organization. In terms of transportation management, internal staff, skill levels, and decision making structure have an even greater role due to the rapid pace of technological improvements. People who are well versed in both what they are trying to accomplish with transportation management and in the underlying technologies which make everything possible are better able to assess and evaluate the needs and benefits of new equipment and ideas.

Some things that DelDOT should focus on are:

- Perform an assessment of existing and future staffing needs and requirements. As the Transportation Management Center and the transportation management system grows and increases its day to day functions, DelDOT will need to make the most efficient possible use of its staffing resources. This includes a comprehensive assessment of existing and future staff skills, and development of a training program which ensures that staff members have the required knowledge to most efficiently comprehend and perform their job. Also, with the difficulties and time frame associated with adding new positions, DelDOT will need to find ways to accomplish routine and periodic functions by other means. These would include re-deployment of existing staff, contracting, privatization, and automation, which can be valuable tools for completing many day to day and emergency functions.

- Organizational development must be evaluated to ensure that decisions, functions, and communications are clear, concise, and direct, and to ensure that decision making is occurring on the proper management levels. DelDOT must also ensure that local and regional partners are included in the decision making process.

- DelDOT will need to develop and promote "Champions" among the public and private sectors. Champions are people who understand both the goals and benefits of Transportation Management and are in a position to "spread the word". On the public sector side, these people could be members of the legislature, Congress or sister agencies, and in the private sector could work for the American Trucking Association (ATA) or the American Automobile Association (AAA). They will be the people who help push legislative agendas and educate peers regarding cost and time savings, and help DelDOT show its customers that Transportation Management provides tangible benefits to all system users

- DelDOT personnel should be actively involved in the USDOT Professional Capacity Building Seminars for ITS. These seminars provide transportation managers with information, skills and training necessary for successful implementation, operation and management of advanced transportation systems. In addition, other training courses and informational resources should be easily accessible by DelDOT's staff.

## Technology and Information Sharing

By forming cooperative ties with sister agencies and jurisdictions, DelDOT will be able to swap experiences regarding testing and implementation of new technologies. This is an important

aspect to maintaining a cutting edge system that also meets customers needs. Some steps that can be taken to achieve this goal in the short term are:

- Maintain an active membership in the I-95 Corridor Coalition. This is an excellent forum for evaluating and testing new technologies and systems.
- Coordinate with ITS America.
- Develop an annual Transportation Management/ITS meeting, including representatives from DelDOT, Delaware State Police, the University of Delaware, and Local Government agencies. On a yearly basis, agencies with a vested interest in the status of Transportation Management in Delaware could meet to discuss the status of current programs, new initiatives, and successes. This type of forum would provide a background for local agencies to learn, and hopefully implement, Transportation Management technologies within their jurisdictions.
- Create and administer an active technology users group within DelDOT and sister agencies, including the Technology Transfer Center, Delaware Transportation Institute, and Public Safety Representatives. This will allow people who use the Transportation Management systems to get together on a regular basis and discuss progress, problems and recommendations for future systems.

## TRANSPORTATION MANAGEMENT STRATEGIES ON THE HORIZON

Automated Highway Systems (AHS) are currently being explored in the United States. These systems use advanced technology that permits vehicles to travel on designated segments of highways automatically and without the need for driver control, allowing drivers to read the newspaper, use a computer, or even take a nap. While such a scenario is still several years away, the technology required to make it a reality currently exists and can provide important safety benefits. Among these technologies are sensors to detect the presence of vehicles in the front, rear and sides of vehicles and to maintain a safe distance between these vehicles and systems which can prevent vehicles from crossing into oncoming traffic or veering off the roadway. Delaware, as part of its transportation management program, will continue to monitor these exciting developments, and adopt those features which are proven, cost-effective, and which meet the needs of Delaware's citizens. The framework described in this report is designed to accommodate these technologies when they become available.

**Exhibit 9: Transportation Management Priority Actions**

| Delaware's Integrated Transportation Management System Priority Action Phasing | | | | |
|---|---|---|---|---|
| | *Begin Implementation In...* | | | |
| Action | In-Progress | Less Than 1 Year | 1 to 6 Years | 6 or More Years |
| **Traffic Management Center** | | X | | |
| **Control** | | | | |
| Real Time Traffic Control Systems | X | | | |
| Reversible Lane Management | | | X | |
| Ramp Metering | | | X | |
| Variable Speed Limits | | | X | |
| EMS Vehicle Priority | X | | | |
| Transit Schedule and Route Adherence | | | X | |
| On Demand Transit | | | | X |
| **Monitoring** | | | | |
| Detection | | X | | |
| Video Monitoring | | X | | |
| Motorist Assistance Patrols | X | | | |
| Observation Balloon | X | | | |
| Aerial Monitoring | | X | | |
| Automatic Vehicle Location | | | X | |
| Electronic Toll Collection | | X | | |
| Commercial Vehicle Operations | | X | | |
| Parking Management | | | | X |
| #77 Cellular Reporting | X | | | |
| Police Reporting | | X | | |
| Fire/EMS Reporting | | X | | |
| Utility/Delivery Company Reporting | | | X | |
| Traffic Watch Teams | | | X | |
| **Information** | | | | |
| Traveler Advisory Radio | X | | | |
| Dynamic Message Signs | | X | | |
| Internet | X | | | |
| Cable TV | | | X | |
| Broadcast TV | | | X | |
| Radio | | X | | |
| Kiosks | | | | X |
| Personal Communications Devices | | | X | |
| In-Vehicle Displays | | | | X |
| **Communications** | | | | |
| Fiber Network | | X | | |

## TRANSPORTATION MANAGEMENT INVESTMENT AREAS

This Strategic Plan builds a case for the long-term benefits and the need for better transportation management. Given limited resources, it is essential for DelDOT to focus its investments in areas where those investments can generate the greatest benefit and create the most synergy. Transportation investment, logically, should be made in areas where transportation needs are greatest and where the strongest foundations for future, expanded transportation management strategies can be built. All areas of the state are included. Commuter traffic congestion is a problem in a number of municipalities, including the Wilmington, Dover and Seaford areas. Seasonal and tourist travel has significant impacts particularly along resort area routes. Improved transit access is a concern throughout the state.

These investment areas were selected based on six factors: congestion, traffic volumes, presence of transit routes, extent of goods movement activity, seasonal and recreational travel demands, and use as an alternate or bypass route. Transportation Investment Area maps are included in the appendix.

As investments in larger projects are made, consideration to TM alternatives and solutions will be considered for inclusion in those projects. Further design and construction standards for application of transportation management technologies are being developed to streamline and mainstream TM activities.

**Exhibit 10: Transportation Management Investment Area Centerline Mileage**

| County | Roadway Category | TM Centerline Mileage | Total Mileage | TM Critical Mileage |
|---|---|---|---|---|
| New Castle | Interstate | 41 | 295 | 176 |
| | US highway | 56 | | |
| | Other Roadway | 198 | | |
| Kent | Interstate | 0 | 132 | 44 |
| | US Highway | 71 | | |
| | Other Roadway | 61 | | |
| Sussex | Interstate | 0 | 248 | 30 |
| | US Highway | 64 | | |
| | Other Roadway | 184 | | |
| Statewide Total | Interstate | 41 | 675[6] | 250 |
| | US Highway | 191 | | |
| | Other Roadway | 443 | | |

### Critical 250 miles

A sub-set of the Investment Areas identified above include Delaware's Critical 250 miles. These areas of immediate need represent the "core" network that will enable TM to work in

[6] The total statewide centerline mileage which DelDOT is responsible for is approximately 3,868 miles of state roads and 1,065 of suburban development streets.

Delaware. Although this critical network is expressed in mileage, it is representative of the entire transportation system needs including transit and other modes which make this plan *integrated*.

In an effort to get the most TM coverage and the highest return on initial investment, control, monitoring and information solutions are being pursued in those areas with high throughput needs. With throughput needs in mind, the critical mileage has been limited to those areas such as I 95, US 13/113 in Dover or SR 1, from Five Points to Rehoboth. In addition, limited monitoring/detection is being pursued in key locations of Kent and Sussex County.

Lastly, given rural nature of the many parts of the state, a mobile or portable capability will be provided to again maximize investments. Portable signs, portable TARs, and portable communications will be pursued for events such as Punkin' Chunkin' or race weekends. This plan will build on existing portable capability which exists today.

# APPENDIX

## LIST OF ACRONYMS

| | |
|---|---|
| AVI | Automated Vehicle Identification |
| AVL | Automated Vehicle Location |
| CAD | Computer Aided Dispatch |
| CCTV | Closed Circuit Television |
| CHART | Chesapeake Highway Advisories Routing Traffic |
| DelDOT | Delaware Department of Transportation |
| DEMA | Delaware Emergency Management Agency |
| DMS | Dynamic Message Sign |
| DNREC | Department of Natural Resources & Environmental Control |
| DPS | Department of Public Safety |
| DRBA | Delaware River and Bay Authority |
| DSP | Delaware State Police |
| DTC | Delaware Transit Corporation |
| DVFA | Delaware Volunteer Firemen's Association |
| ETC | Electronic Toll Collection |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| HAZMAT | Hazardous Material |
| ISP | Information Service Provider |
| ITS | Intelligent Transportation System |
| ITS-A | Intelligent Transportation Society of America |
| MPO | Metropolitan Planning Organization |
| PDA | Personal Digital Assistant |
| RFP | Request for Proposal |

| | |
|---|---|
| SCATS | Sydney Coordinated Adaptive Traffic System (signal control software). |
| TAR | Traveler Advisory Radio |
| TM | Transportation Management |
| TMC | Transportation Management Center |
| TMT | Transportation Management Team |
| USDOT | United States Department of Transportation |
| UTCS | Urban Traffic Control System (sometimes referred to as UTS) |
| WILMAPCO | Wilmington Area Planning Council |

## GLOSSARY

Adaptive Control Systems – Signal systems that have the capability of changing or adapting signal timing based on current traffic conditions.

Arterial – A major thoroughfare, used primarily for through traffic rather than for access to adjacent land, that is characterized by high vehicular capacity and continuity of movement.

Automated Vehicle Identification (AVI) – A system that transmits signals from an on-board tag or transponder to a roadside receiver for the automated identification of vehicles. AVI systems are used in electronic toll collection and other applications.

Automated Vehicle Location (AVL) – A computerized system that tracks the current location of fleet vehicles to assist in dispatching maintaining, scheduling, and answering specific customer inquiries, better enabling fleets to function more efficiently.

Bus Smart Card – Similar to a debit/credit card used for public transit. The "Smart Card" is embedded with a computer chip which can be used for a variety of fee payments and purchases. These do more than just store information, they may process information.

Closed Circuit Television (CCTV) – Television in which the signal is transmitted by wire.

Dynamic Message Sign (DMS) – Electronic sign that can change the message it displays. Used with traffic management systems.

Electronic Toll Collection (ETC) – The use of automatic vehicle identification (AVI) for non-stop toll collection.

Expert System – A control system which makes its own decisions about the control strategy to be implemented based on previous experiences and initial samples fed into the databases.

Fiber (optical fiber) – A medium used to transmit information via light impulses rather than through the movement of electrons. A single strand of optical fiber, the approximate size of a human hair, can carry thousands of digital voice conversations or data transmissions at the same time.

Global Positioning System (GPS) – A system that determines the real-time position of vehicles using satellite communications.

High Occupancy Vehicle (HOV) – Any vehicle containing more than one person, such as buses, carpools, and vanpools.

I-95 Corridor Coalition – A coalition of agencies from Maine to Virginia working together to improve mobility and safety along the Northeast I-95 Corridor.

Intelligent Transportation Systems (ITS) – The application of advanced electronic, computer, and communication technologies to improve the efficiency and safety of transportation systems.

Institute of Transportation Engineers (ITE) - An international educational and scientific association of transportation and traffic engineers, transportation planners and other professionals. The Institute facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of transportation by promoting professional development of members, supporting and encouraging education, stimulating research, developing public awareness, and exchanging professional information; and by maintaining a central point of reference and action.

ITS America - A nonprofit, public/private scientific and educational corporation which works to advance a national program for safer, more economical, energy efficient, and environmentally sound highway travel in the U.S.

Kiosk – In the transportation context, an interactive computer center for traffic or travel-related information. Usually located in shopping malls, hotels, airports, businesses, and transit terminals, kiosks provide pre-recorded and real-time information using text, sound, graphics, and video clips.

Loop Detectors – Sensors embedded below the surface of roads and highways that monitor the flow of vehicles and help authorities manage traffic and incidents. Loop detectors sense a change in inductance of it's inductive loop sensor caused by the passage or presence of a vehicle near the sensor.

Para-transit – Comparable transportation service required by the Americans with Disabilities Act (ADA) of 1990 for individuals with disabilities who are unable to use fixed-route transportation systems.

Signal Pre-emption – Primarily used for emergency vehicles, signal pre-emption is used to change a signal from red to green when prompted by a transponder from an emergency vehicle such as an ambulance or police car.

Real-time – A term used to describe up-to-date, minute-by-minute, traffic data, conditions or information.

Ridesharing – A form of transportation, other than public transit, in which more than one person shares the use of the vehicle, such as a van or car, to make the trip. Also known as "carpooling" or "vanpooling".

Services – User Services available to users of ITS equipped transportation systems as set forth in the National ITS Architecture.

Signal Priority – Primarily used for transit vehicles, signal priority is used to either shorten a red light or prolong a green light for a transit vehicle (equipped with a transponder) running behind schedule.

Smart Card – An electronic card with a computer chip embedded it its plastic used to make automatic payments, e.g., at toll points. It can be a pre-paid charge card, an account holder card, or a direct debit card.

Traffic Counters – Equipment that is capable of measuring and recording traffic characteristics such as vehicle volume, classification, speed, and or weight.

Transportation Management (TM) – A multi-modal approach to improving the movement of people and goods through the aid of modern technology.

Transportation Management System – A system that utilizes transportation management strategies.

Traveler Advisory Radio (TAR) - The transmission of localized traveler advisory messages using licensed frequencies.

Vehicle Probes – Vehicles equipped with AVI transponders that are used to monitor congestion levels on freeways and arterials.

Weather/Environmental Sensors – Sensors that are used to monitor weather and environmental conditions such as air quality, precipitation, and temperature.

## STRATEGIC PLAN INPUT

This appendix summarizes several approaches used to gain input from external and internal customers in developing this strategic plan. The project team expresses its appreciation to all of the participants for their time, effort, and helpful thoughts.

The Steering and Working Committees provided essential guidance and input through their meetings. Two focus groups were conducted, including 21 participants from the commuter, tourist, and goods movement market segments. The agenda for the focus groups and the list of participants are included in the following section, titled Focus Groups. The Interviews section presents the topics covered in interviews with 9 external and 18 internal customers, along with lists of the interviewees. In an effort to be undertaken shortly, additional input will be sought via several questions in a statewide survey to be conducted for DelDOT Planning.

### Focus Groups

Representatives from the following organizations were invited to participate in the focus groups:

American Automobile Association
American Trucking Association
Bethany/Fenwick Chamber of Commerce
Kent County Tourism
Car Autoport
Christiana Mall
Conrail Corporation
CSX Corporation
D&B Transportation
Delaware Department of Economic Development and Tourism
Delaware Motor Transport Association
Delaware State Chamber of Commerce
Delaware Transit Corporation
DelDOT Highway Operations
DelDOT Planning
Dover Air Force Base
Dover Downs
DuPont Corporation
Hewlett-Packard Company
Lewes Chamber of Commerce
Newark Police Department
Norfolk-Southern Corporation
Port of Wilmington
Rehoboth/Dewey Beach Chamber of Commerce
Sussex County Convention and Tourism
Sussex County Department of Economic Development
Transportation Management Association for New Castle County
WILMAPCO
Wilmington Police Department
WILM Radio

**Summary Agenda:**

1. Introductions and overview of the format and agenda
2. Overview of emphasis is on managing transportation system
3. Problems and needs, including priorities among them
4. Obstacles to overcome
5. Vision of the future

**Interviews**
Interviews with external and internal customers addressed these main topics:

customer needs
opportunities and benefits to be gained
problems and obstacles to overcome
potential early wins
opportunities to use technology to meet key goals
vision of the future

People from the following organizations participated in the internal and external interviews:

External:
Central Delaware Chamber of Commerce
Newark Police Department
Representatives for Major Employers
Smyrna Police Department
TMA for New Castle County
WILMAPCO
WILM Radio
Wilmington Police Department

Internal:
DelDOT Delaware Transit Corporation
DelDOT External Affairs
DelDOT Financial Management and Budget Division
DelDOT Highway Operations Division
DelDOT Planning Division
DelDOT Preconstruction Division

## KEY

TMIA Primary Routes

TMIA Bypass Routes

Critical Mileage


Transportation Management Investment Areas were selected based on the following six factors:

- Congestion
- Traffic volumes
- Transit routes
- Goods movement activity
- Seasonal and recreational traffic volumes
- Alternate or bypass routes

0 2.5 5

Miles

# Transportation Management Strategic Plan

## Transportation Management Investment Areas

## NORTH DISTRICT

October 15, 1997

DelDOT

PB 100 YEARS

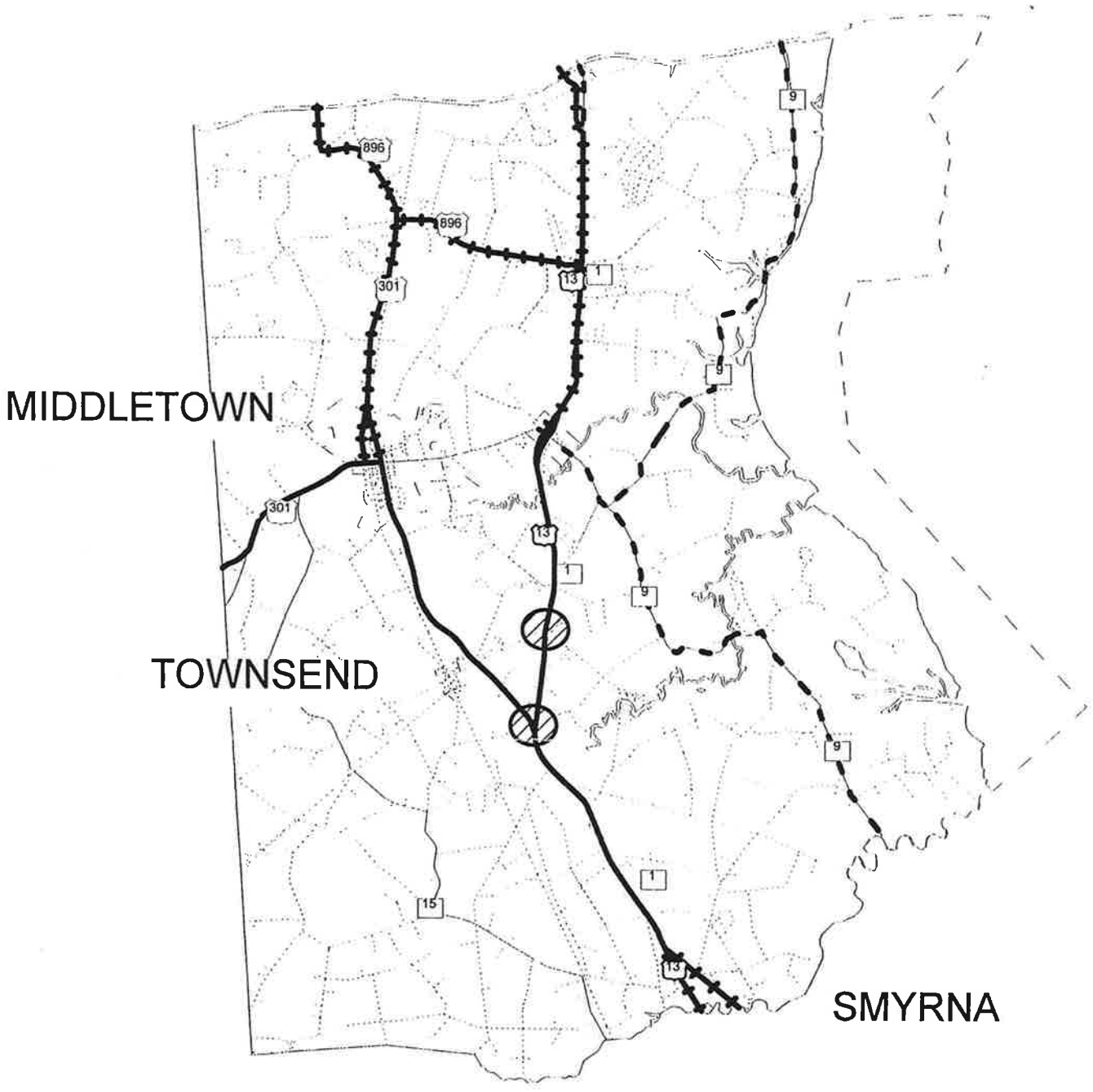
## KEY

TMIA Primary Routes

TMIA Bypass Routes

Critical Mileage

Monitoring Site




0 2.5 5

Miles

Transportation Management Investment Areas were selected based on the following six factors:

- Congestion
- Traffic volumes
- Transit routes
- Goods movement activity
- Seasonal and recreational traffic volumes
- Alternate or bypass routes

# Transportation Management Strategic Plan

# Transportation Management Investment Areas

# CENTRAL DISTRICT

October 15, 1997

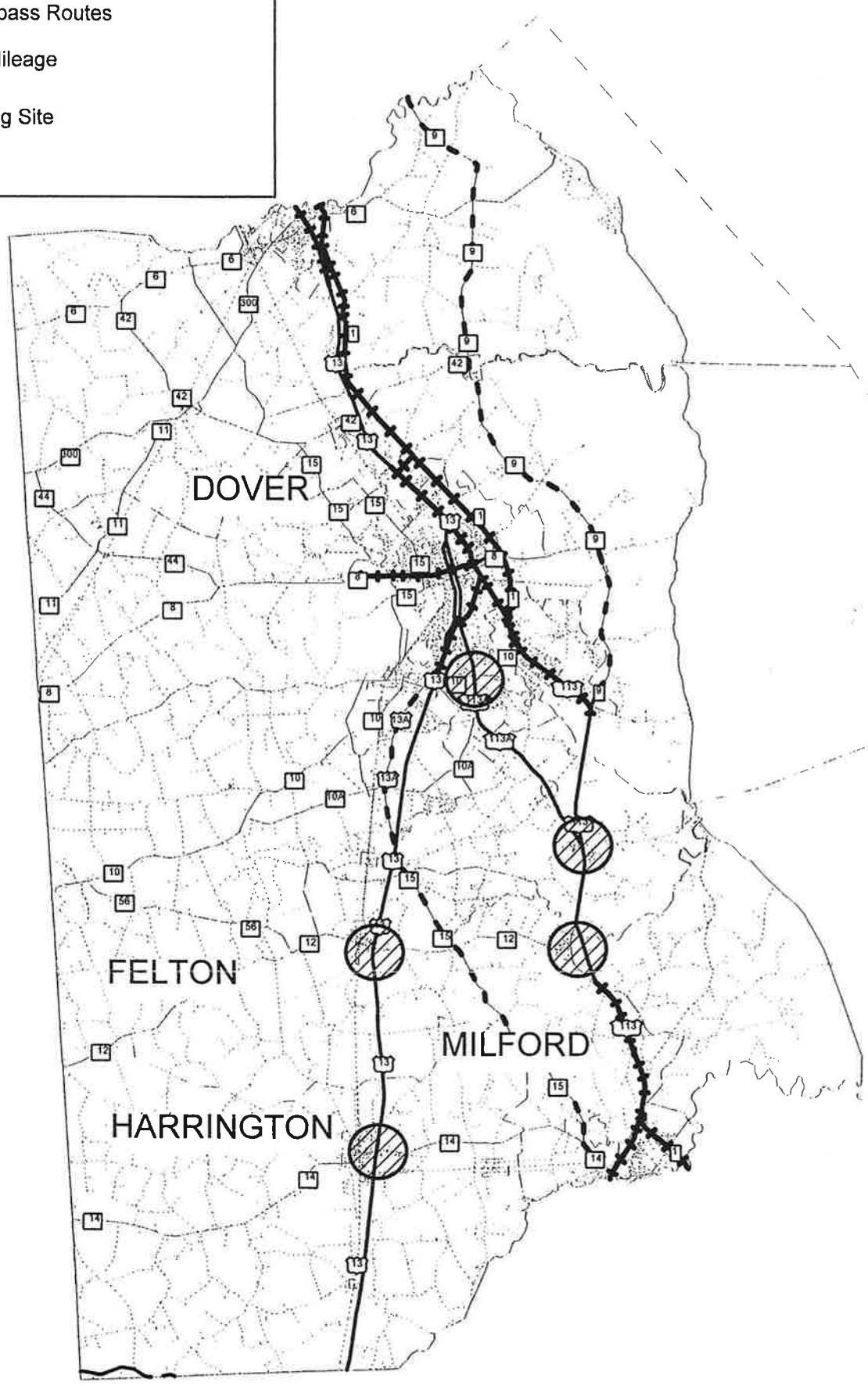
(New Castle County Portion)

DelDOT

PB 100 YEARS

## KEY

- TMIA Primary Routes
- TMIA Bypass Routes
- Critical Mileage
- Monitoring Site




0 2.5 5
Miles

Transportation Management Investment Areas were selected based on the following six factors:

- Congestion
- Traffic volumes
- Transit routes
- Goods movement activity
- Seasonal and recreational traffic volumes
- Alternate or bypass routes

# Transportation Management Strategic Plan
# Transportation Management Investment Areas

# CENTRAL DISTRICT

October 15, 1997

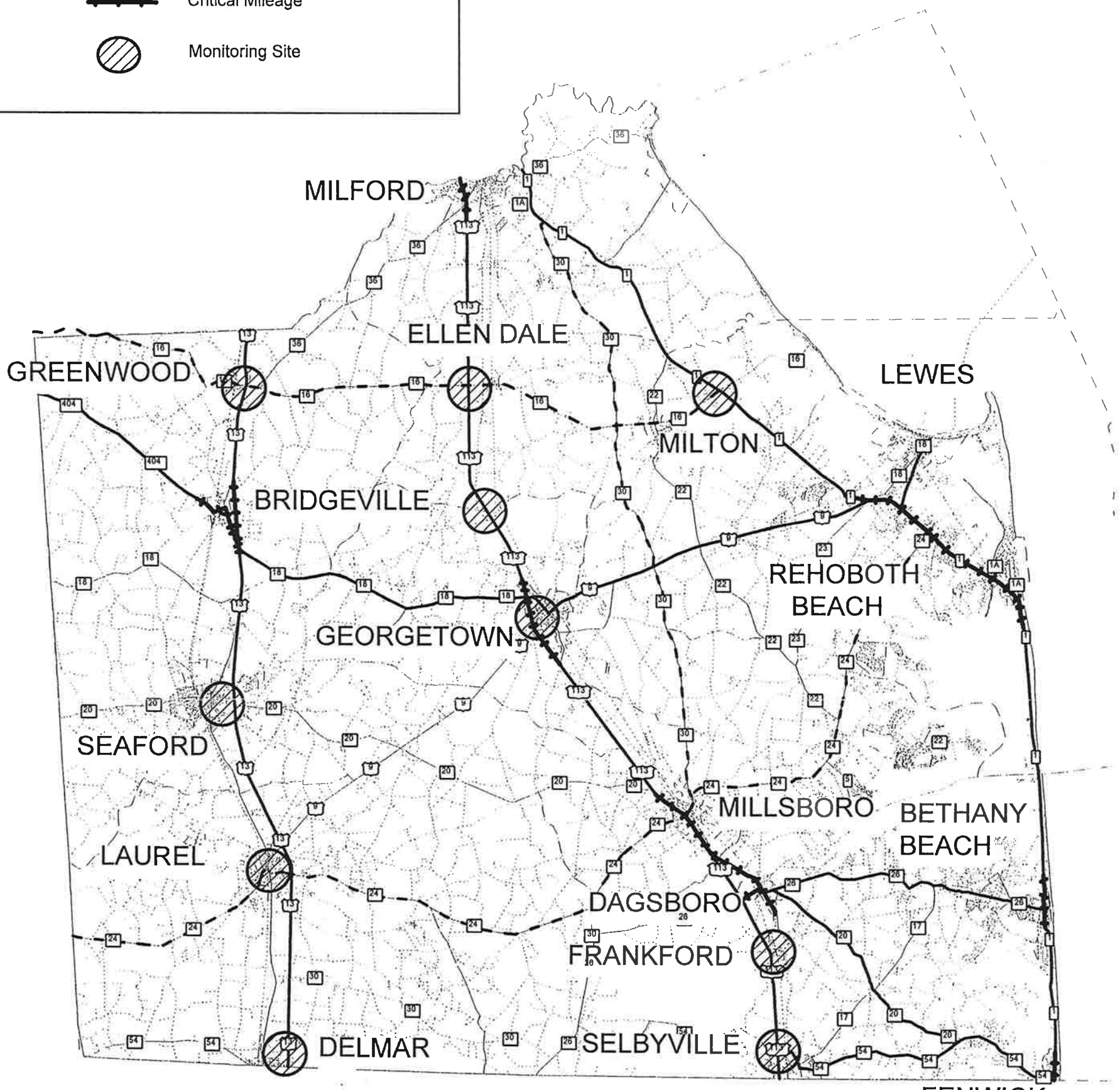
**(Kent County Portion)**

DelDOT

PB 100 YEARS

## KEY

- TMIA Primary Routes
- TMIA Bypass Routes
- Critical Mileage
- Monitoring Site




Transportation Management Investment Areas were selected based on the following six factors:

- Congestion
- Traffic volumes
- Transit routes
- Goods movement activity
- Seasonal and recreational traffic volumes
- Alternate or bypass routes

0 2.5 5
Miles

# Transportation Management Strategic Plan

# Transportation Management Investment Areas

# SOUTH DISTRICT

October 15, 1997

DelDOT

PB 100 YEARS

## KEY

North District Transit

Intercity Bus Service

☆ Park & Ride Lot


# Transportation Management Strategic Plan

## Transit Routes and Park & Ride Lots

# NORTH DISTRICT

October 15, 1997

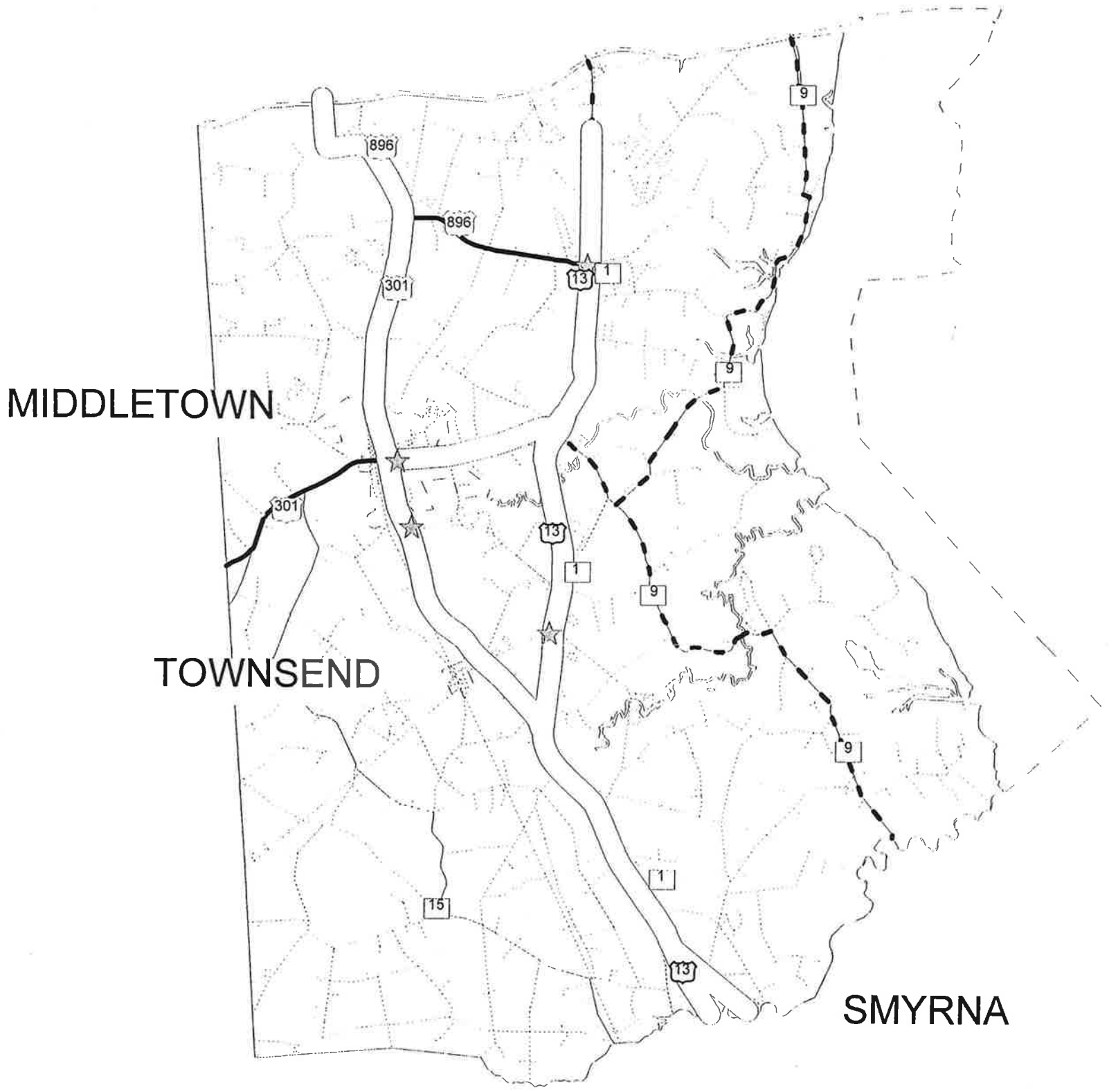
DelDOT

PB 100 YEARS

## KEY

Intercity Bus Service

☆ Park & Ride Lots




0 2.5 5

Miles

# Transportation Management Strategic Plan
# Transit Routes and Park & Ride Lots

# CENTRAL DISTRICT

DelDOT

PB 100 YEARS

October 15, 1997

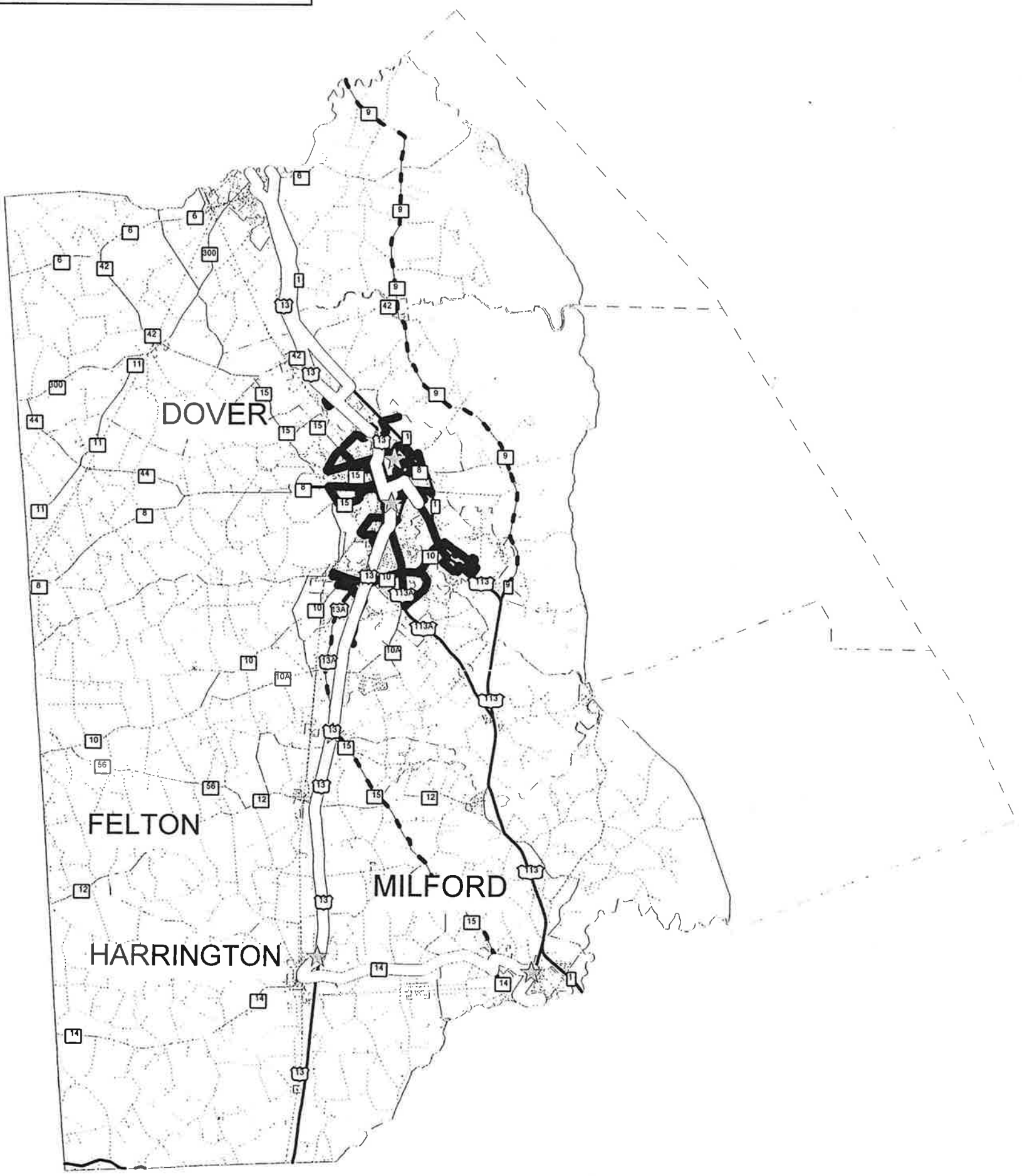
(New Castle County Portion)

## KEY

South District Transit - Dover

Intercity Bus Service

Park & Ride Lots




0 2.5 5

Miles

# Transportation Management Strategic Plan

## Transit Routes and Park & Ride Lots

# CENTRAL DISTRICT

October 15, 1997

**(Kent County Portion)**

DelDOT

PB 100 YEARS

## KEY

South District Transit

Intercity Bus Service

☆ Park & Ride Lots

MILFORD

ELLEN DALE

LEWES

MILTON

REHOBOTH BEACH

GEORGETOWN

SEAFORD

MILLSBORO

BETHANY BEACH

LAUREL

DAGSBORO

FRANKFORD

DELMAR

SELBYVILLE

FENWICK ISLAND

0 2.5 5

Miles

# Transportation Management Strategic Plan

## Transit Routes and Park & Ride Lots

# SOUTH DISTRICT

October 15, 1997

DelDOT

PB 100 YEARS

## KEY

Local Traffic LOS E/F
(Recurring Peak Period Congestion)

Seasonal Traffic LOS E/F
(Periodic Resort and Event Related Congestion )


**Transportation Management Strategic Plan**

**Congested Roadways**
**1993 Systems Planning Model**

# NORTH DISTRICT

October 15, 1997

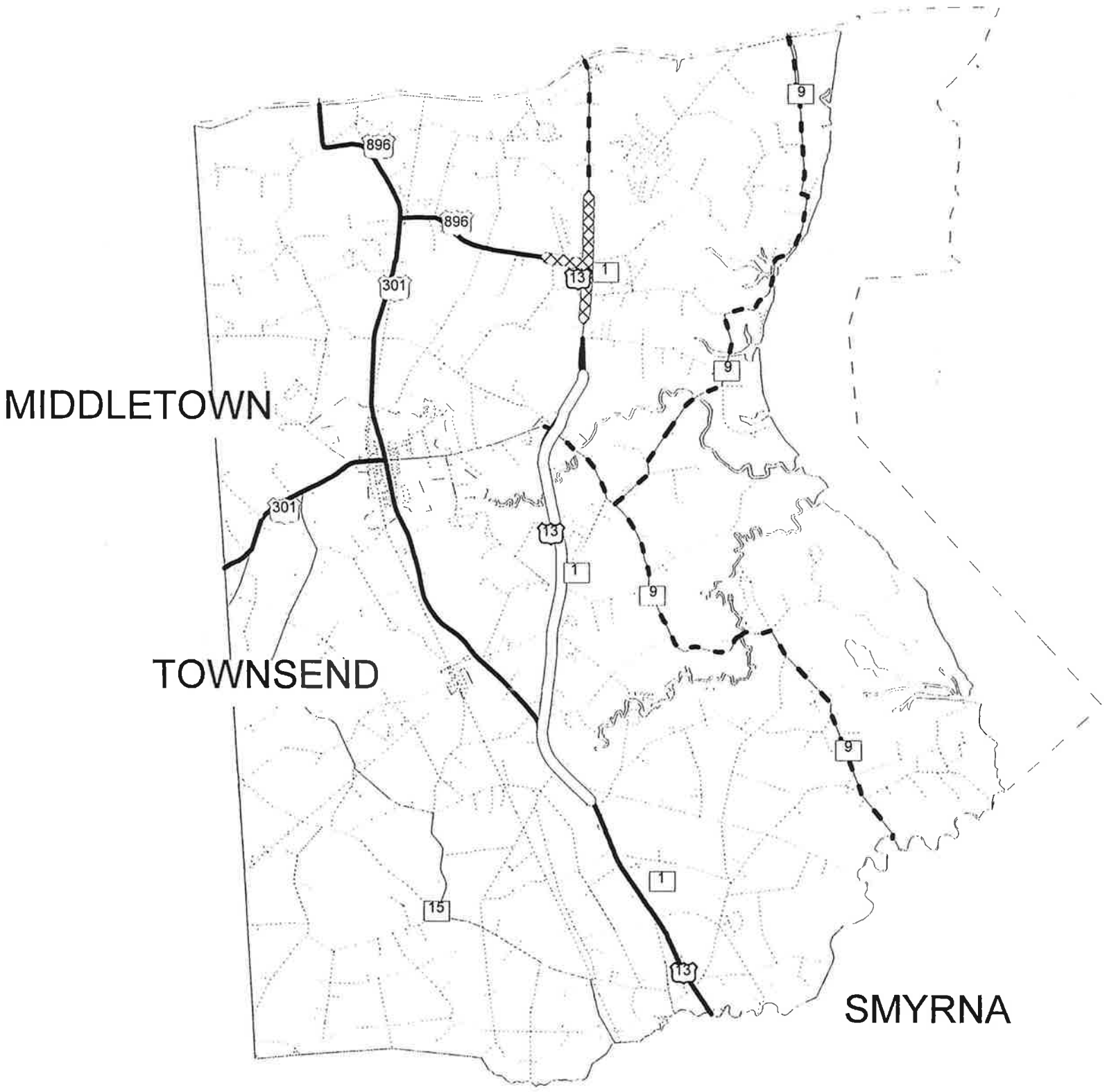
DelDOT

PB 100 YEARS

## KEY

Local Traffic LOS E/F
(Recurring Peak Period Congestion)

Seasonal Traffic LOS E/F
(Periodic Resort and Event Related Traffic)




0 2.5 5
Miles

# Transportation Management Strategic Plan

## Congested Roadways
## 1993 Systems Planning Model

# CENTRAL DISTRICT

October 15, 1997

(New Castle County Portion)

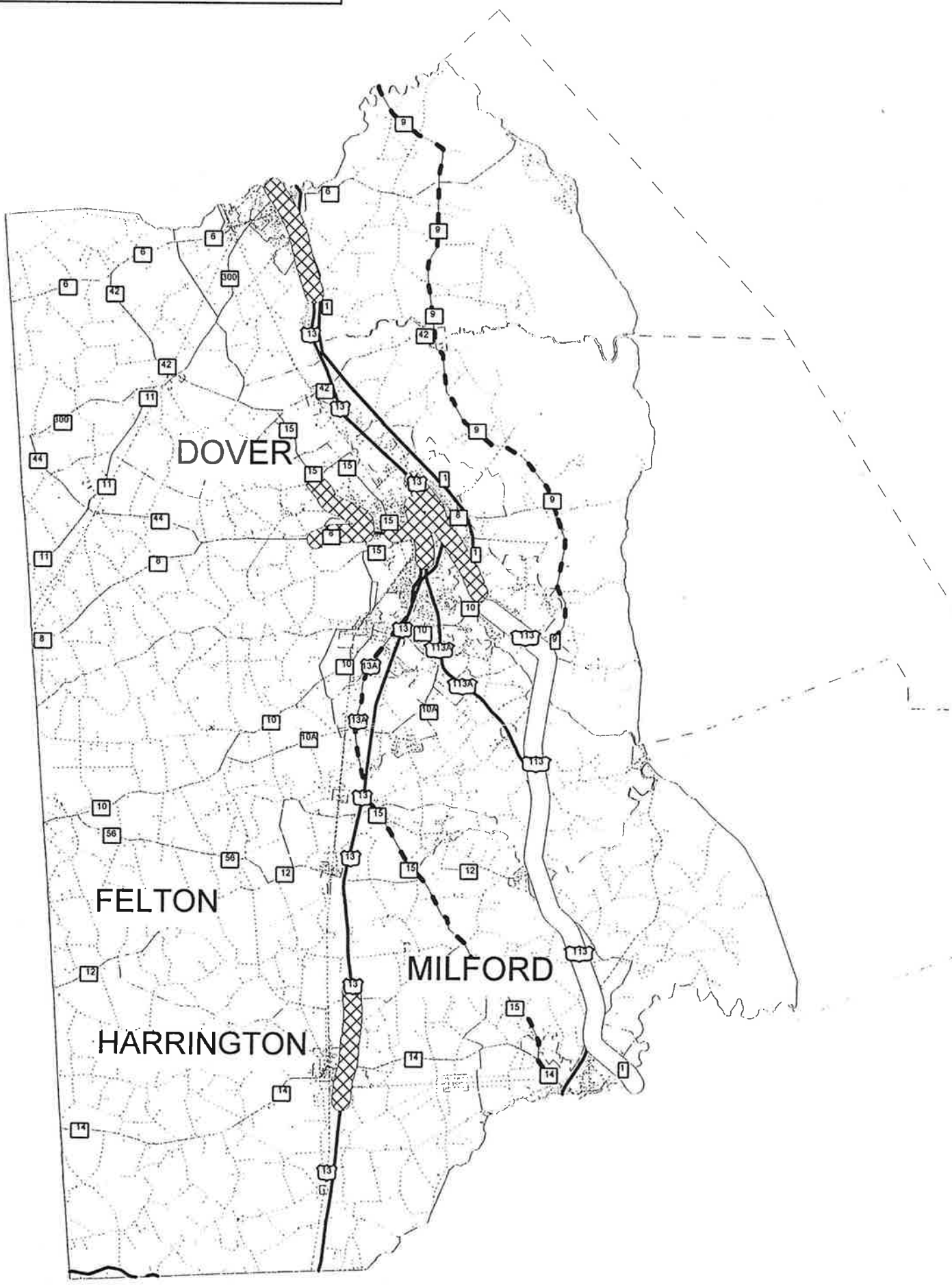
DelDOT

PB 100 YEARS

## KEY

Local Traffic LOS E/F
(Recurring Peak Period Congestion)

Seasonal Traffic LOS E/F
(Periodic Resort and Event Related Congestion)




0 2.5 5
Miles

# Transportation Management Strategic Plan

## Congested Roadways
## 1993 Systems Planning Model

# CENTRAL DISTRICT

October 15, 1997

**(Kent County Portion)**

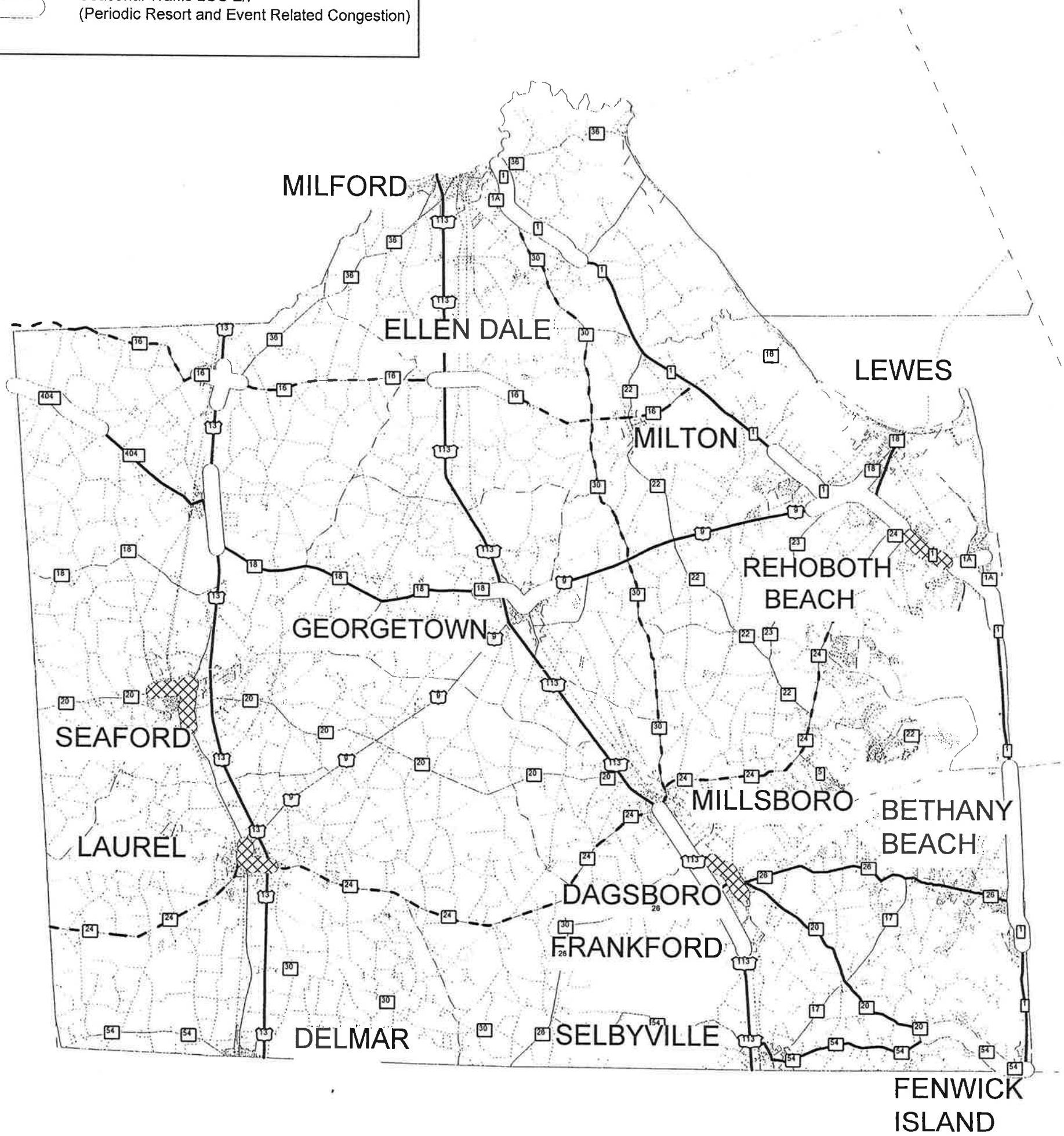
DelDOT

PB 100 YEARS

## KEY

Local Traffic LOS E/F
(Recurring Peak Period Congestion)

Seasonal Traffic LOS E/F
(Periodic Resort and Event Related Congestion)




0 2.5 5
Miles

# Transportation Management Strategic Plan

## Congested Roadways
## 1993 Systems Planning Model

# SOUTH DISTRICT

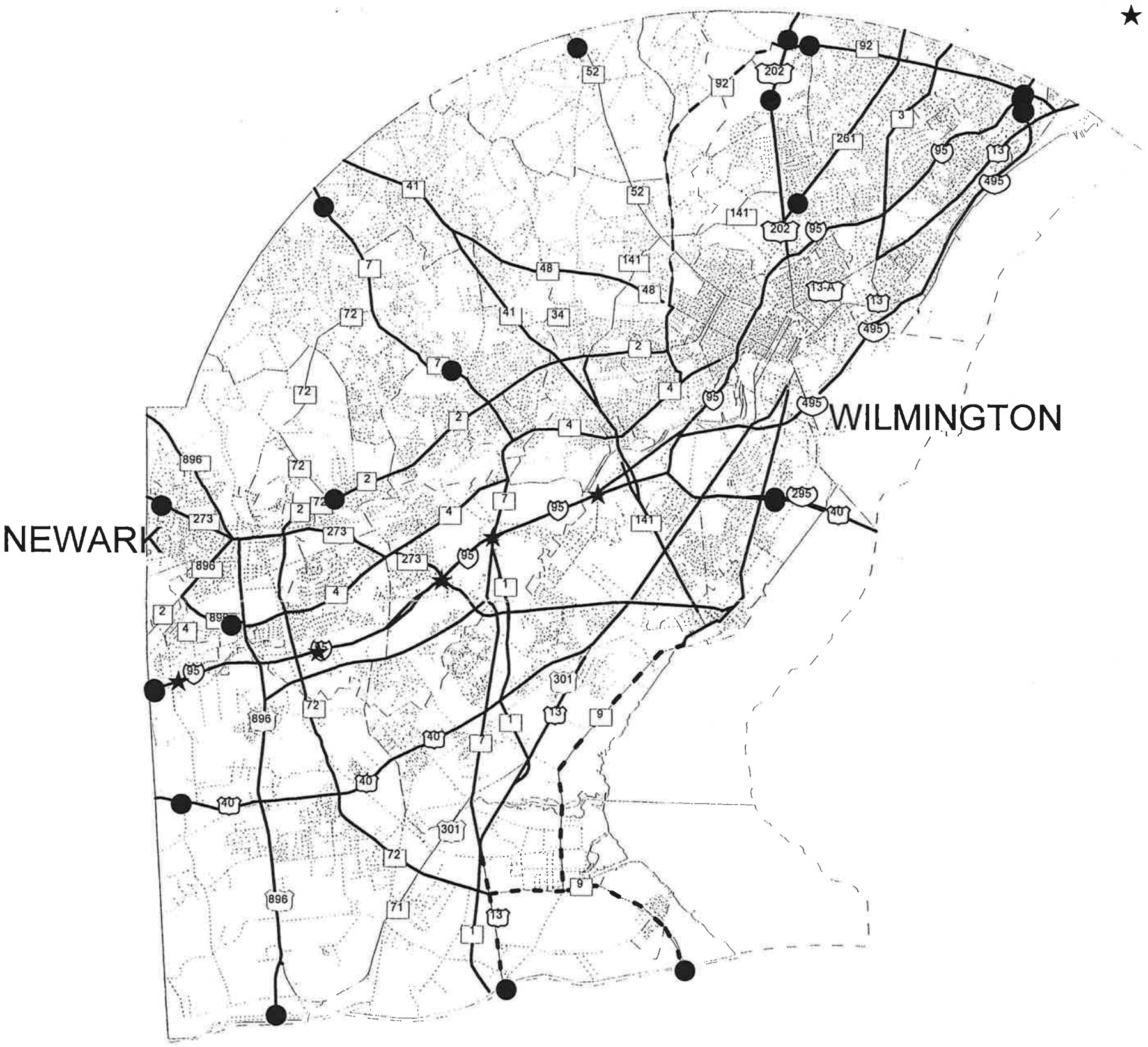
October 15, 1997

DelDOT

PB 100 YEARS

## KEY

- Traffic Counting Stations
- Traffic Monitoring Cameras (Programmed Construction 1998)




# Transportation Management Strategic Plan

# Existing System Monitoring

# NORTH DISTRICT

Printed: October 15, 1997

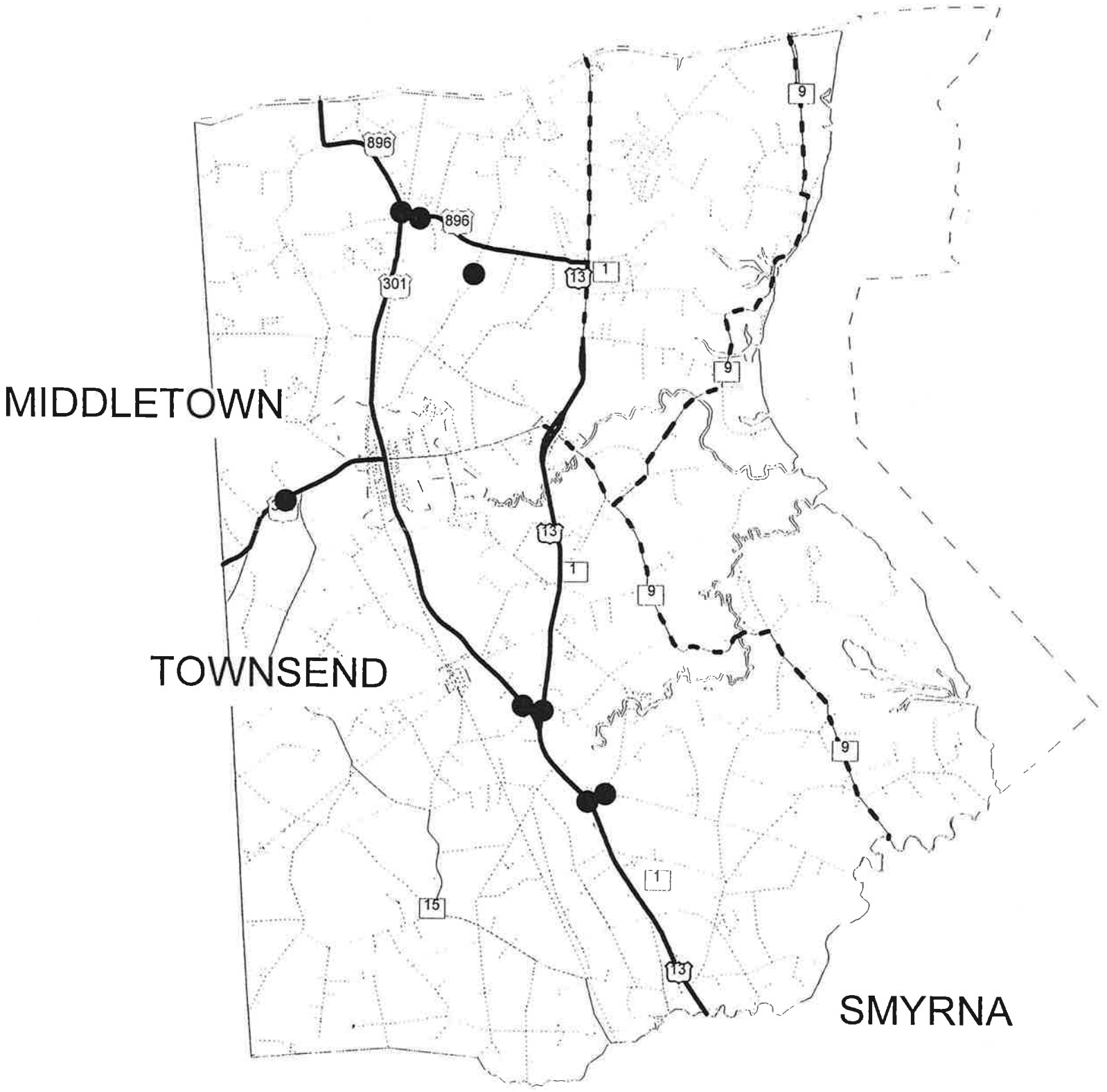
DelDOT

PB 100 YEARS

## KEY

● Traffic Counting Stations

★ Traffic Monitoring Cameras




0 2.5 5

Miles

# Transportation Management Strategic Plan

# Existing System Monitoring

# CENTRAL DISTRICT

(New Castle County Portion)

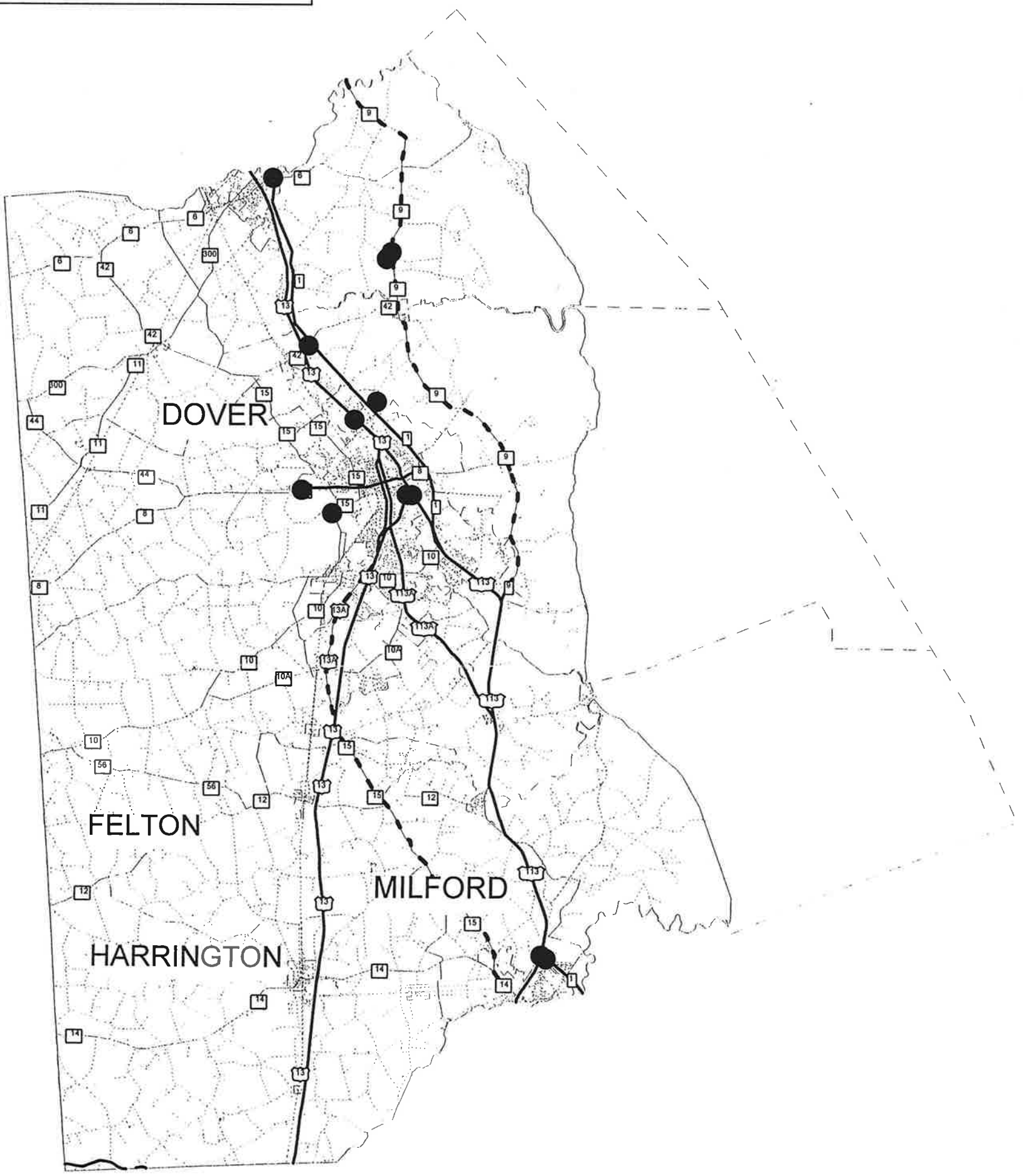
Printed: October 15, 1997

DelDOT

PB 100 YEARS

## KEY

- Traffic Counting Stations
- Traffic Monitoring Cameras




0 2.5 5
Miles

# Transportation Management Strategic Plan

## Existing System Monitoring

# CENTRAL DISTRICT

Printed: October 15, 1997

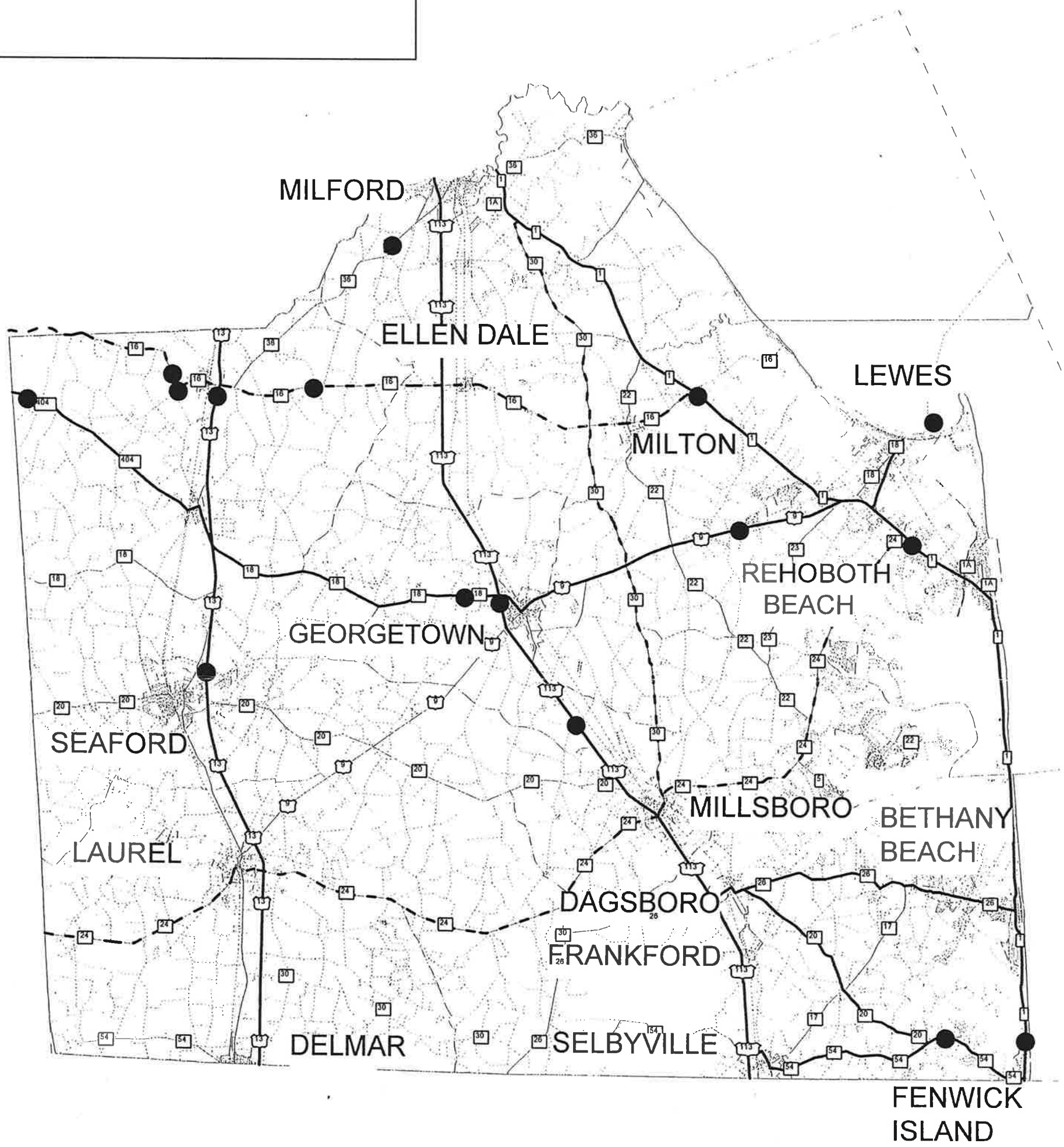
**(Kent County Portion)**

DelDOT

PB 100 YEARS

## KEY

- Traffic Counting Stations
- Traffic Monitoring Cameras




0 2.5 5
Miles

# Transportation Management Strategic Plan

# Existing System Monitoring

# SOUTH DISTRICT

DelDOT

PB 100 YEARS

Printed: October 15, 1997

## KEY

- UTCS System Software
- SCATS System Software
- MARC System Software
- Future System


Transportation Management Strategic Plan

# Coordinated Traffic Signals

## NORTH DISTRICT

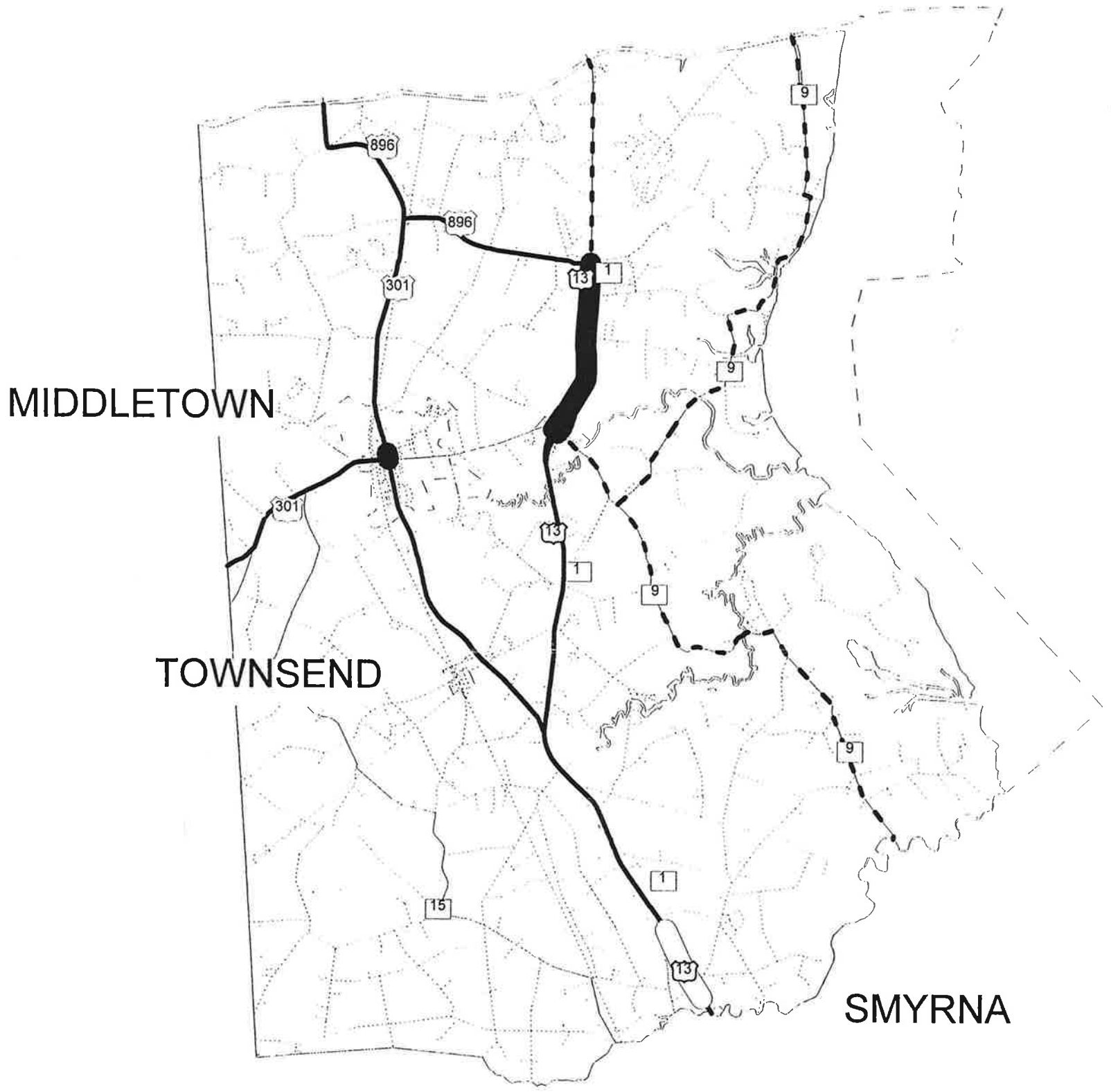
October 15, 1997

DelDOT

PB 100 YEARS

## KEY

- UTCS System Software
- SCATS System Software
- MARC System Software
- Future System




0 2.5 5

Miles

# Transportation Management Strategic Plan

# Coordinated Traffic Signals

# CENTRAL DISTRICT

October 15, 1997

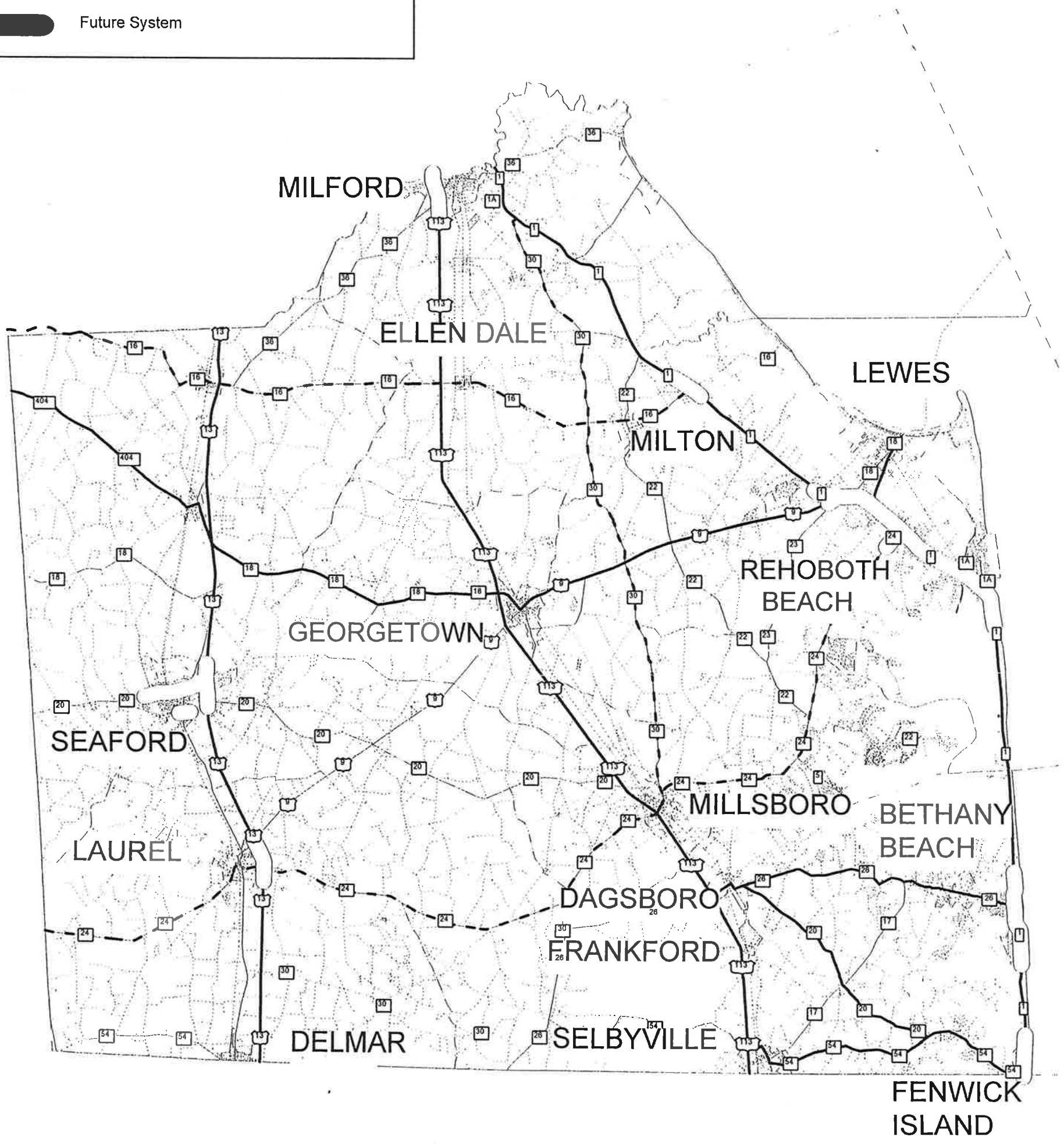
(New Castle County Portion)

DelDOT

PB 100 YEARS

## KEY

- UTCS System Software
- SCATS System Software
- MARC System Software
- Future System




0 2.5 5
Miles

**Transportation Management Strategic Plan**

# Coordinated Traffic Signals

# SOUTH DISTRICT

October 15, 1997

DelDOT

PB 100 YEARS