Jurisdictional Maintenance Project

by

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March 2003

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Prepared for
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Executive Summary

This project addressed maintenance activities on transportation facilities involved with cleaning, patching, resurfacing, vegetation control, curbs, drainage, beautification, bridges, sidewalks, signals, lights, signs, snow plowing, structural adjustment, and signal and light energy usage. Capital improvements for new facilities, or major retrofit of facilities were not addressed. Pavement resurfacing is typically included in capital budgets but as it is related to preservation of existing facilities, it was included in the costs that were studied. There are large costs associated with maintenance of transit and para-transit facilities but these were not addressed in this project.

Maintenance costs and budgets must be examined together with the condition of transportation facilities and level of service provided. Insufficient or no maintenance can lead to large capital replacement costs and shortened life span for facilities and that is not cost effective over several years. Not performing core maintenance and preservation also can lead to an inefficient, complaint based mode of reactive operation.

With new information management systems planned in DelDOT there is progress toward tracking costs better and being able to better judge the condition of facilities and maintenance needs. Information systems for better decision support seem to be a few years away however. Maintenance cost figures were very difficult to compile and some remain a best guess from the information available. Measures of the condition of facilities were not available.

Delaware's ratio of staff per 1000 lane miles (and per signal and other facility) is lower than neighboring states. The Delaware highway system has grown nearly 16% in total lane miles between 1982 and 1999 but State maintenance forces have declined in that period. Maintenance budgets have risen only moderately in the neighborhood of 2%--approximately the rate of inflation--and for an extended time maintenance staff have operated under the assumption that no significant increase of funding would be made available to keep pace with increasing costs and new facilities. DelDOT has continued to work smarter and more efficiently over the last couple decades, and have been doing more with less.

Low staffing levels however, particularly in the Traffic Engineering and Management Section, are affecting efforts to perform necessary core maintenance activities and backlogs continue to grow. Increased staffing and funding in the neighborhood of $4 to $5 million to address

upgrades, backlogs, and preventive maintenance, would appear to be necessary to maintain current levels of service in the next decade. Facilities are still in good shape and in 1999, 74% of Delawareans rated the condition of Delaware's highways and roads as good to excellent, but current levels of maintenance and staffing would produce an overall transportation system in gradual declining condition. The most money, over $40 million per year, is spent on pavement resurfacing to maintain the condition of the roads. In the years 2003 to 2005 an additional $10 million is expected to be needed each year to maintain DelDOT's performance standard of having 85% of pavements in good to excellent condition.

Unlike most states, Delaware has no county road system and county agency that is responsible for transportation facilities. Municipalities statewide are responsible for most facilities within their boundaries and it was estimated that they spend about $17 million a year in maintenance activities. Responsibilities for specific facilities are the subject of a vast number of arrangements and understandings between the State and municipalities. Recent efforts by the legislature and government agencies to determine new policies for responsibilities seem to have declined over the past few years perhaps due to the complexity of unraveling existing arrangements and perhaps due to a lack of promise of any specific practical benefit for making new arrangements. Most new development across the state will be in low-density unincorporated areas and will therefore be the responsibility of the State.

Population is expected to increase about 7 to 8% over the next decade and vehicle miles traveled (VMT) is expected to continue to outpace population growth with an estimated 2.5% increase per year. There will be about a 10% increase in lane miles of expressway with the addition of new portions of Route 1. There will be about 1% increase in expected in other portions of the major road network, and about 5.5% is expected in new suburban roads over the next 10 years.

The Transportation Trust Fund was established in 1988 as a dedicated fund to finance the operations of DelDOT. Operations receives approximately 99% of its funds from the TTF. Of this, Highway Operations receive an average of 30% of the total Operations budget. DelDOT's disbursement to Operations is on par with the national average, despite DelDOT's above average ownership of roads. DelDOT spends an average $18,000 per road mile on maintenance, which is also close to the national average.

TTF revenue sources include toll revenue, motor fuel tax, motor vehicle documentation and registration fees, investment income, and federal funding. As a consequence of the disparate rates among the revenue components, their relative contributions to funds are shifting. In 1980, fuel tax revenues accounted for almost 50% of the revenue. By 2000, the contribution had waned to 35%. Delaware has enacted five fuel tax increases since 1980, taking the fuel tax in the state from 11 cents per gallon to 23 cents per gallon with the last increase of 1 cent in 1995. Registrations fees' contribution to total TTF revenue halved from 20% to 10% between 1980 and 2000, while documentation fees' share grew to 19% from 14%. The contribution from toll revenues is currently about 29%, which is double what it was in 1980. Toll revenue is the fastest growing component of the Trust Fund Revenue. During the period 1980-2001 toll revenues have grown at 10.5% annual average. Though the operation of the trust fund is intended to preclude support from the state coffers, transfers from the general fund do occur with about a total of $52 million transferred in FY98 thru FY00.

There is a funding squeeze on transportation across the nation. The cost of transportation infrastructure expansion and repair is rising faster than the main funding mechanism, the gas tax. The gas tax is typically set at a rate per gallon, but greater fuel efficiency has offset rising VMT to stymie the growth of gas tax revenues. Meanwhile, the cost of transportation infrastructure has been rising steadily as more vehicles are on the road and driving longer distances.

Based on estimates produced in this project the TTF will not have sufficient revenues to support required maintenance functions unless other expenditures are curtailed. Estimates suggest a near-term yearly shortfall of nearly $5 million rising to almost $8 million over the next years. Another concern is that cost estimates from the Pavement Management Program include an increase of $10 million that will be needed for resurfacing starting in the year 2003. The annual growth rate of the TTF of just over 2% is barely greater than current inflation, and costs for transportation infrastructure are increasing even faster. The need for transfers from the general fund will in all likelihood increase unless there are increases in the motor fuel tax, registration and documentation fees, and/or tolls. Based on the analysis of expenditure patterns, maintenance activities are already being constrained to a nearly fixed annual budget.

There are options available for increasing funding in the TTF. Increases in the motor fuel tax and registration fees have some relationship to the use of the transportation system, though the impact

would affect lower income residents disproportionately. Since these sources have fixed rates they should be periodically adjusted to reflect inflation and to avoid large increases. Increases in documentation may be more acceptable since the tax is probably proportional to income and has some inherent growth built in as vehicle prices increase. Toll revenues will need to be increased to ensure that debt service does not encroach on revenues required for highway operations. To the extent that tolls are paid by non-Delaware residents, the impact is exported. Developing additional revenue sources, such as claiming a piece of the corporation tax would ease funding pressure, however acquiring a share of other tax revenues would probably face considerable challenge in the political arena.

Planned and programmed transfers from the general fund may be an acceptable solution to the funding shortfall. Transfers have three appealing features: first, the negative impact of increases in the motor fuel tax and registration fees can be avoided. Second, the revenue structure of the general fund is probably proportional in its impact. Third, nearly 46% of the revenues are paid by non-residents or by the federal government through the deductibility of the state personal income tax. The proportion of TTF revenues paid by non-residents is substantially less.

Transfer of responsibilities or costs to municipalities to reduce the pressure on the TTF should be avoided. First, the revenue structures found in most municipalities tends to be one of slow growth and regressivity since revenues are dominated by the property tax. Second, municipal revenues can rarely be exported and are also not related to the transportation system per se. Third, the cost of delivering services at the municipal level may increase costs, reduce productivity, and eliminate any economies of scale.

Finally, the practice of simply not increasing maintenance activity to meet the growing need and/or decreasing the number of capital projects undertaken to a level supportable by current TTF revenue ultimately will increase costs and either degrade safety or reduce the quality of life in Delaware.

Introduction

In 1935 the State of Delaware accepted the responsibility of maintaining what previously had been the counties' system of roads establishing the system of highway operations that, with few modifications serves Delaware today. Over the years the number of miles of highway right of way and the number of facilities (e.g. roads, signs, signals, structures, sidewalks, drainage, etc.) within those right of ways have increased steadily. This project was initiated to review DelDOT's maintenance responsibilities and costs in light of the steady growth in Delaware. The project is also to assist in identifying appropriate means by which DelDOT can continue to provide adequate maintenance of the facilities it is responsible for. This project considers maintenance and operation of existing transportation facilities and not costs of new roads or capital improvements. Activities addressed include resurfacing of roads, cleaning and clearing, drainage, patching and repair of road surfaces, energy costs (signals and lighting), snow removal, beautification, vegetation control (mowing) and maintenance of signs, signals, lights, shoulders, curbs, sidewalks, and bridges

A goal in this project is to provide a presentation of the extent that DelDOT's policies and funding will satisfy current and future maintenance requirements. The report is divided into four sections. Section One provides an inventory of the transportation facilities maintained by DelDOT and a review of maintenance responsibilities. Section Two addresses a review of maintenance activities and costs, and provides cost projections for the next 10 years. Maintenance costs must be viewed together with the resulting condition or level of service of facilities that results from activities and investments, and Section Two includes discussion on whether current funding and activities are adequate and estimates costs expected in the future to maintain current conditions. An estimate of costs and maintenance that is the responsibility of the municipalities is also in Section Two. Section Three discusses funding for transportation facility maintenance and includes revenue forecasts. Section Four compares costs and revenues and addresses future funding solutions.

SECTION 1, Transportation Facility Inventory and Responsibilities

Section 1.1 A Review of Maintenance Responsibilities

The principal groups maintaining transportation facilities in Delaware are DelDOT, the municipalities, and property owners. This subsection reviews in general where maintenance responsibilities and activities lie. There are numerous exceptions in any one particular locale and the more closely one looks at responsibilities the more exceptions can be discovered and the more issues that arise. There are a number of varied agreements between municipalities and the State regarding maintenance responsibilities for specific facilities. Some of these represent a clear split of responsibilities for all facilities in the town (Rehobeth). With other municipalities, (Lewes) there are numerous separate agreements addressing specific facilities. Sometimes new agreements are generated each time facilities are added or repaired. Also at times for practical or political reasons, it may be appropriate or expedient for the State to offer or refuse maintenance services at various times under various circumstances. For example during an occasional snow storm DelDOT may choose to plow snow on roads within a municipality to insure service of the major travel ways. For the smaller towns that have only one or a few major roads running through them, it makes sense for DelDOT crews not to stop snow plowing at the town boundary but to continue on to clear the roadway. In some cases lighting or other remedies may be offered by the State to address a particular safety issue.

At various times, there has been some consideration at the agency and legislative levels of either transferring some transportation facility maintenance responsibilities of municipalities to the State, or transferring maintenance now the responsibility of the State to the municipalities. In general the focus of the State is the major road network rather than facilities that are more local in nature. For instance within the City of Wilmington, which is the hub of the State transit system and the connection point for many major transportation corridors, it is appropriate for the State to take a larger role with facilities within the City.

Municipalities do maintain facilities within their boundaries that primarily serve their residents such as lighting, snow removal, signs, and signals, as well as the drainage, patching, and paving on municipal streets, and there is an expectation that the municipalities will continue to bare these costs whatever the arrangement. Facilities in County suburbs are most often addressed through

the Community Transportation Needs Program (formerly the Suburban Street Aid Program) and in special cases DelDOT will assist, but otherwise facilities are primarily the responsibility of the subdivision residents and handled through civic organizations or some other mechanism. There may be considerations having to do with economies of scale for the State to take over more maintenance in local areas. In analyzing how to deal with costs in this study, the idea that municipalities could shoulder more or less maintenance costs or responsibilities as a solution to future needs does not seem likely or promising. During the study representatives of some municipalities voiced the opinion that if the State took over more costs and responsibilities within the corporate limits there would probably be a corresponding decrease in funds that go to the municipalities such as the Municipal Street Aid Fund. For municipalities to take more responsibilities for State Maintenance Roads within their boundaries without some compensation would present a hardship to residents and would probably interfere with the State's stewardship of the primary road network. Of concern though is the increasing suburbanization expected in the State and the types of demands that will be placed on the State for additional installation and maintenance of facilities. More suburbs may not mean more major roads but may require improvements and additions to the State maintained network.

A summary of transportation facility maintenance responsibilities follows.

DelDOT Responsibilities

- On State Maintenance Roads (the major and minor roads throughout the state), that are outside of municipalities, DelDOT handles all signal, sign, streetlight, road, shoulder, cleaning, drainage, and structures maintenance, and all pavement resurfacing, snow removal, beautification, and vegetation control. DelDOT also funds all energy costs for streetlights and signals for these roads. Shoulders and curbs would also be the responsibility of DelDOT on State Maintenance Roads outside of municipalities.
- On State Maintained Roads within municipalities, DelDOT handles all sign maintenance, curb to curb pavement repair, cleaning, drainage, and pavement resurfacing. On State Maintained Roads within municipalities DelDOT does not handle snow removal, though in cases of large snowfall, (4 inches and greater), DelDOT has assisted the municipalities.
- On expressways (I-95, I-295, I-495, and Route 1) DelDOT handles all signal, sign,

streetlight, road, shoulder, cleaning, drainage, and structures maintenance, and all pavement resurfacing, snow removal, beautification,and vegetation control.

- For all subdivision roads outside of municipalities, DelDOT handles all drainage and road patching from curb to curb. DelDOT is not responsible for snow removal, streetlighting, side walk maintenance, or other maintenance on subdivision roads. Pavement resurfacing in subdivisions is not part of DelDOT's yearly Pavement Management Program.
- DelDOT maintains 1327 bridges throughout the State, 73 bridges are maintained by other groups.
- DelDOT handles the maintenance of all toll plazas, storage facilities, headquarters, buildings, used for their operations.
- DelDOT is not responsible for sidewalk maintenance within subdivisions unless related to facilities in compliance with the American Disabilities Act.
- DelDOT is not responsible for any subdivision facilities that have not been approved and accepted as meeting standards.
- DelDOT does not pay cost for streetlighting in subdivisions or municipalities except under special arrangement, usually associated with safety issues.
- DelDOT indirectly assists suburban street snow removal by recouping some costs to subdivision associations accepted into the Subdivision Snow Removal Program.
- DelDOT indirectly assists with some maintenance for municipality responsibilities (see below) through funding in the Municipal Street Aid Program.
- DelDOT indirectly assists with some maintenance not otherwise handled on suburban roads such as pavement resurfacing through funding in the Suburban Street Aid Program.
- By agreement with municipalities, DelDOT has maintenance responsibilities different then as specified above that address specific arrangement on specific facilities.
- By agreement with local/subdivision maintenance corporations, DelDOT has maintenance responsibilities different then as specified above that address specific arrangement on specific facilities.
- A decision was made not to study maintenance costs and facility inventories associated with transit service in this project. DelDOT of course has a responsibility however to maintain ever growing transit facilities, bus stops, shelters, park and rides, transit centers, signs, etc.

The maintenance work done by DelDOT is the responsibility of the Division of Highway Operations. Each of the Division's three District offices perform all maintenance and construction administration activities within each district area. This Division also oversees expressway maintenance, construction, and toll operations, equipment management, and traffic engineering and field studies. District offices make many of the decisions of how to use resources within their area and also generate contracts for maintenance work to be done by outside vendors. Each district is further divided into Maintenance Areas that are shown in the map in figure 1 on page 8. The Southern District is made of areas 1 thru 5, the Central District is areas 6 thru 9, and the North District is areas 10 thru 12. The Districts correspond to the County boundaries with the exception that the area of New Castle County below the Chesepeake and Delaware Canal (maintenance area 9) is in the Central District. Inventories and costs available in this report are sometimes available by District and/or maintenance area. Often though, information cannot be summarized at any more detail than the District level.

Municipality Responsibilities

- On municipal roads, municipalities handle all sign, road, shoulder, cleaning, drainage, and structures maintenance, snow removal, and all pavement resurfacing.
- All signals within municipality boundaries, including those on State Maintenance Roads, are the responsibility of the municipality. All energy costs are paid by the municipalities. In some cases DelDOT crews maintain signals, but DelDOT is reimbursed by the municipality.
- All street lights within municipalities, including those on State Maintenance Roads are maintained by the municipality. The municipalities pay for all energy costs. Exceptions are by specific agreement with DelDOT. On occasion DelDOT will assume costs of lighting for safety measures.
- On State maintained roads, Dover, Wilmington, and Newark handle snow removal. DelDOT handles snow removal on all other State Maintenance roads within municipalities.
- Six bridges are owned and maintained by the City of Wilmington. Two bridges are owned and maintained by the Town of Milford. All other bridges in municipalities in

Delaware are maintained by other entities (mostly DelDOT).

- Through Federal or other programs, municipalities have resurfaced pavements and reconstructed curbs and sidewalks on State Maintenance Roads within their boundaries. This sometimes can be in the hundreds of thousands or dollars, even for small towns. Other maintenance operations (cleaning, street repair) may occur on occasion on State Maintenance Roads.

Property Owners Responsibilities

- In municipalities, homeowners are responsible for the maintenance of sidewalks in front of their properties. Generally speaking the city would handle major vegetation problems (dead trees) planted in the sidewalk that were causing a problem but would not do mowing around sidewalks. Of course, through taxes the residents of the city ultimately pay for all of the other services listed under municipality responsibilities.
- In unincorporated suburb areas, property owners are responsible for the sidewalks and vegetation up to the curb even though these areas may actually lie in the right of way of the road.
- Street lighting in subdivisions is paid for by the residents in New Castle County if they are part of the light district program. Costs are paid as an additional tax/charge based on the assessed value of the property and the type and number of lights in the subdivision, and this billing is handled by New Castle County government. Conectiv (the utility company) bills the County through a pole charge (handles all maintenance of street lights and an energy charge each month.
- Street lighting in unincorporated areas in Kent and Sussex if not on a State Maintenance Road must be paid for and maintained by residents or local associations.
- Maintenance associations, local development associations, and the like, handle other costs for needs in unincorporated areas such as snow removal.

Legislature Responsibilities

- Municipal projects are funded to an extent through the Municipal Street Aid Fund. How

these funds are used varies greatly and is decided by elected officials of the municipalities.

- Pavement resurfacing, sidewalks, and improvements in subdivisions are not the responsibility of DelDOT. This type of work, if not handled by homeowners, is handled through the Suburban Street Aid Fund and use of this money is determined by local legislatures.

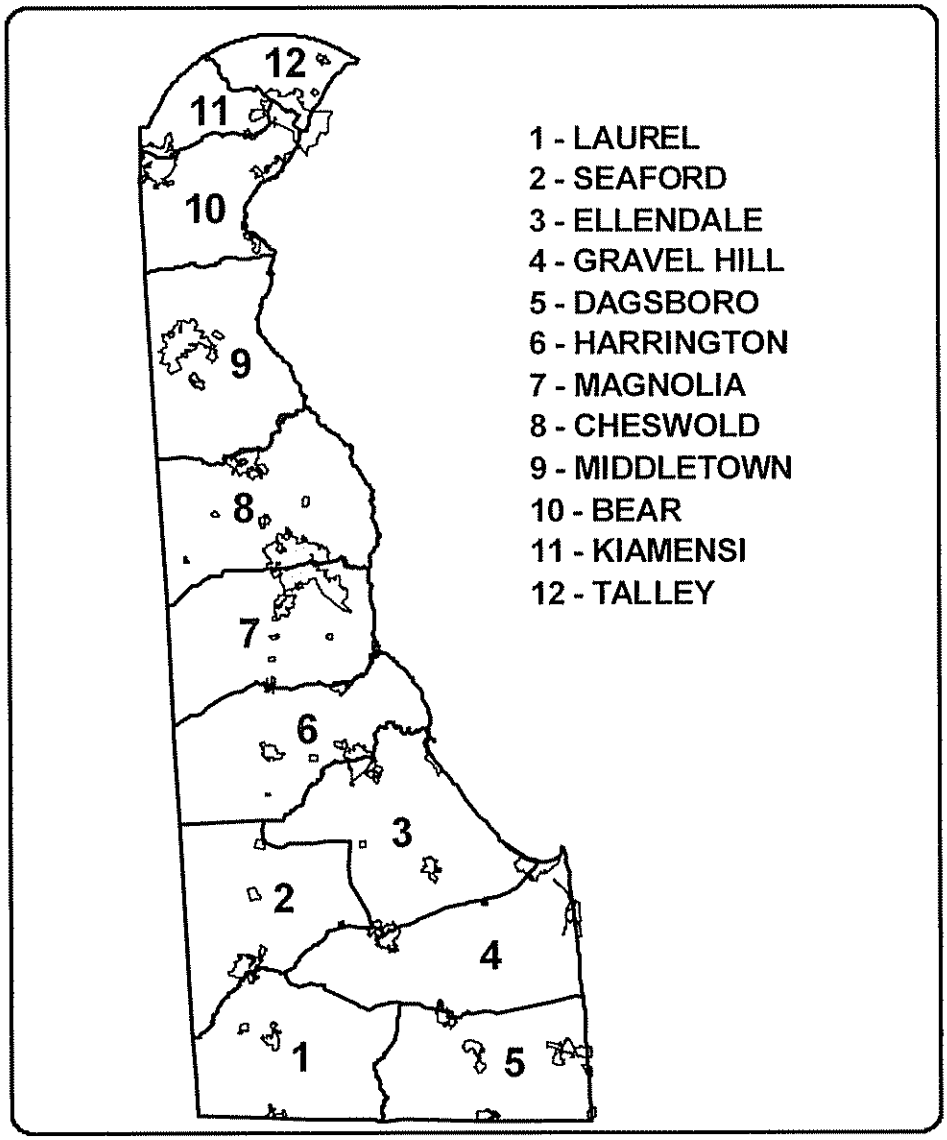
Delaware River and Bay Authority

The Delaware River and Bay Authority maintains about two and a half miles of road way on the Delaware side of the Delaware Memorial Bridge. This includes 18 small bridges that are maintained. Regular maintenance activities on this stretch cost about a couple hundred thousand dollars a year. DRBA is in the middle of a major multimillion-dollar rehabilitation program making numerous improvements to the approach to the Delaware Memorial Bridge and rehabilitating most of the smaller bridges. Getting any additional figures would require a substantial effort by DRBA and was not pursued in this project.

Railroad Companies

Railroad companies own and maintain 27 bridges in New Castle County.

Figure 1, Maintenance Areas



Section 1.2 Inventory of Transportation Facilities

As part of this project an inventory of transportation facilities was gathered . The focus was on roadways, signals, bridges, and street lights. All information was provided by DelDOT

DelDOT maintains 11,041 lane miles of road, 8,644 lane miles are State Maintenance Roads, 2,397 miles are suburban development roads. There are approximately 300 lane miles of Interstate Expressway and other freeway roads that are maintained. Approximately 680 route miles are designated as municipal roads and are maintained by the municipalities. With the exception of new portions of the Route 1 expressway to be completed around the year 2003, the major road network is in place and new roads are in suburban development.

There are 1400 bridges statewide, of which DelDOT maintains all but a small percentage. These bridges span waterways, roadways, and railways. The City of Wilmington maintains 10 bridges. Railroad companies maintain 35, with 34 bridges in North District. The Delaware River Basin Commission maintains 21 bridges in the approaches to the Delaware Memorial Bridge.

There are 921 signals that are maintained by DelDOT. There are about 250 signals maintained by municipalities.

There are about 250,000 signs that are maintained by DelDOT. There are a little over 30,000 signs maintained by municipalities.

A figure on the number of streetlights is difficult to determine. Some guesses can be made based on information that is available from energy costs. The number maintained in municipalities is probably between 15,000 and 20,000. DelDOT probably handles close to 10,000. There are probably about 10,000 to 15,000 in suburban light districts in New Castle County

Figures with inventory numbers are presented throughout this section, and were provided by DelDOT or the municipalities.

Facilities Maintained by the State

Figures 2 thru 4 provide summaries of DelDOT facilities.

Figure 2
Lane miles by Maintenance Area and District
Roads maintained by DelDOT

Location	Maintenance Roads	Suburban Development	Total	Percent of State
South A1	812.70	38.74	851	7.7
South A2	767.88	45.64	813.5	7.4
South A3	827.33	74.14	901.5	8.2
South A4	751.33	103.71	855.0	7.7
South A5	720.58	52.89	773.5	7.0
Total South	3879.82	315.12	4194.9	38.0
Central A6	791.9	22.7	814.6	7.4
Central A7	778.9	120.1	899.0	8.1
Central A8	760.8	49.0	809.7	7.3
Central A9	641.9	86.1	727.9	6.6
Total Central	2973.4	277.9	3251.3	29.4
North A10	921.4	706.6	1628.0	14.7
North A11	402.3	583.9	986.1	8.9
North A12	466.6	514.2	980.9	8.9
Total North	1790.3	1804.6	3595.0	32.6
Total Delaware	8,644	2,398	11,041	

Source: DelDOT Division of Planning and Policy

Figure 3
Lane miles by District by functional class
Roads maintained by DelDOT

	South	Central	North	State
Interstate	0	0	258	258
Other Freeway	0	29	17	46
Principal Arterial	418	305	530	1253
Minor Arterial	173	254	311	738
Major Collector	630	556	376	1562
Minor Collector	163	128	43	334
Local	2811	1979	2058	6848

Source: DelDOT Division of Planning and Policy

Figure 4
Lane miles by functional class
by Maintenance Area

Maintenance Area	Inter	Freeway	P.Art	Min. Art	MajCol	MinCol	Local
A1	0	0	53.6	11.1	146.6	58.1	582.1
A2	0	0	82.8	38.1	96.8	41.7	554.2
A3	0	-	154.7	7.1	122.4	28.2	589.0
A4	0	0	80.2	46.6	110.2	25.7	592.3
A5	0	0	46.7	70.6	154.0	9.1	493.1
A6	0	0	85.7	7.6	148.7	0.8	571.8
A7	0	11.8	83.8	38.8	159.6	49.5	555.4
A8	0	17.2	33.1	150.1	160.7	17.4	431.3
A9	0	0	101.9	57.7	87.4	60.2	420.7
A10	182.8	17.2	299.8	129.1	147.2	15.5	836.3
A11	0	0	141.8	73.3	112.8	11.3	646.9
A12	75.02	0	88.6	108.7	116.3	16.7	575.6

Source: DelDOT Division of Planning and Policy

Figure 5
Signalized intersections

Statewide	921
South District	179
Central District	143
North District	689

Source: DelDOT Traffic Engineering and Management (TEAM)

Figure 6
Transportation Mangement Center
Major components

61 miles of optical fiber
51 cameras
168 ITMS sensors statewide

Source: DelDOT Traffic Engineering and Management (TEAM)

Figure 7
Bridges

Area	Count
Statewide	1400
North District	487
Central District	372
South District	356
Expressway bridges	151
Municipalities	10
Private owned	6
Railroad Owned	35
DNREC owned	1
DRBA owned	21

Source: DelDOT

Figure 8
Number of signs

Statewide estimate	250,000 signs
North District % estimate	140,000 (rough estimate)
Central District % estimate	60,000
South District % estimate	50,000

Source: DelDOT Traffic Engineering and Management (TEAM) estimates based on 1999 work requests

Figure 9
Number of street light bulbs

Statewide estimate	40,000

Source: TEAM

Facilities Located in Municipalities

Figure 10 show the route and lane miles for DelDOT maintained roads in municipalities. As mentioned in the section summarizing responsibilities, DelDOT only is responsible for road patching, resurfacing, cleaning, drainage, and signs within municipalities for roads that are State Maintenance Roads. In many cases, DelDOT is responsible for 20% or more of the roadway in the municipality. In smaller towns, DelDOT is often responsible for more roadway within municipalities than the municipalities are themselves.

Maintenance of signals and energy costs in municipalities are the responsibility of the municipality. There are about 100 signals in towns across Delaware that DelDOT maintains, but the municipalities reimburse DelDOT for the costs of the maintenance. DelDOT is responsible for all maintenance activities on expressways (I-95, I-295, I-495, and DE Route 1) in and out of municipalities. Six bridges are owned and maintained by the City of Wilmington. Two bridges are owned and maintained by the Town of Milford. All other bridges in municipalities in Delaware are maintained by other entities (mostly DelDOT). No estimates were available for the number of signs in municipalities.

Figure 10
Road mileage within municipal boundaries

TOWN NUMBER	TOWN NAME	Municipal Route Miles	DelDOT Route Miles	DeLDOT Lane Miles
01	ARDEN	3.63	0.45	0.90
02	BELLEFONTE	0	5.47	10.71
03	BETHANY BEACH	19.93	2.97	8.34
04	BETHEL	1.74	1.25	2.50
05	BLADES	4.2	1.34	2.68
06	BOWERS	1.76	1.13	2.26
07	BRIDGEVILLE	7.86	3.42	6.84
08	CAMDEN	6.34	4.89	12.52
09	CHESWOLD	0.45	0.88	1.76
10	CLAYTON	5	3.22	6.44
11	DAGSBORO	2.54	4.30	9.66
12	DELAWARE CITY	8.15	0.85	1.70
13	DELMAR	6.19	1.95	3.90
14	DOVER	88.44	59.45	159.52
15	ELLENDALE	3.79	0.79	1.58
16	ELSMERE	15.81	2.72	9.44
17	FARMINGTON	0.21	0.68	1.36
18	FELTON	4.73	1.40	2.80
19	FENWICK ISLAND	5.95	1.03	4.12
20	FRANKFORD	2.75	3.04	6.08
21	FREDERICA	2.13	2.10	4.70
22	GEORGETOWN	23.23	12.30	29.39
23	GREENWOOD	3.86	2.78	7.02

Figure 10
Road mileage within municipal boundaries
(Continued)

TOWN NUMBER	TOWN NAME	Municipal Route Miles	DelDOT Route Miles	DeLDOT Lane Miles
24	HARRINGTON	12.08	5.28	12.02
25	HARTLY	0	0.93	1.81
26	HOUSTON	2.09	1.95	3.90
27	KENTON	0.94	1.06	2.12
28	LAUREL	11.76	6.42	12.84
29	LEIPSIC	0.67	1.83	3.66
30	LEWES	18.12	9.53	21.79
31	LITTLE CREEK	0.18	1.23	2.46
32	MAGNOLIA	0.13	1.00	2.00
33	MIDDLETOWN	15.02	4.33	8.66
34	MILFORD	30.81	16.19	39.83
35	MILLSBORO	10.48	5.57	14.53
36	MILLVILLE	0	3.05	6.10
37	MILTON	8.48	3.10	6.20
38	NEW CASTLE	17.38	3.92	10.34
39	NEWARK	63.57	26.52	69.86
40	NEWPORT	4.24	1.20	4.08
41	OCEAN VIEW	9.94	3.03	6.06
42	ODESSA	1.91	1.50	4.74
43	REHOBOTH	18.62	2.82	7.30
44	SEAFORD	32.52	11.37	29.90
45	SELBYVILLE	8.55	5.59	12.82
46	SMYRNA	20.94	7.79	20.10
47	SLAUGHTER BEACH	0.55	2.88	5.76
48	SOUTH BETHANY	9.82	0.90	3.60
49	TOWNSEND	1.45	1.12	2.24
50	VIOLA	0.67	1.07	2.14
51	WILMINGTON	146.88	30.54	123.55
52	WOODSIDE	0.24	1.49	2.98
53	WYOMING	4.34	3.03	6.06
54	HENLOPEN ACRES	3.61	0.26	0.52
55	ARDENTOWN	2.22	0.13	0.26
56	ARDENCROFT	1.01	0.66	1.32
57	DEWEY BEACH	0.6	6.21	14.34

Obtaining maintenance cost and inventory figures for transportation facilities in municipalities was difficult. Requests were sent out to all municipalities but only about a dozen responded. Figures for several of these were received only after repeated phone calls. Figure 11 below provides information on facilities that was available from towns.

Figure 11
Inventory for municipalities with population greater than 1000

Town	Signal.Int	Signs	Streetlights	Route Miles	2000 population
Wilmington	164	27,000	6800	146.9	72848
Dover	17	2,800	?	89.00	34546
Newark	38	?	2500	63.6	26463
Milford					6665
Smyrna					6426
Elsmere					5935
Seaford					5689
New Castle					5164
Middletown	3	2200	526	15.02	5116
Bethony Beach					4302
Georgetown					4114
Laurel					3814
Rehobeth					3218
Harrington					2376
Lewes					2295
Camden					2180
Dewey Beach					1997
South Bethany					1848
Delaware City					1682
Millsboro					1643
Milton					1459
Fenwick Island					1400
Bridgeville	0	200	?	7.86	1350
Selbyville	1	75	226	8.55	1335
Bellefonte					1243
Newport					1240
Clayton	0	300	350	5.00	1227
Wyoming					1080

Source: Mail survey of towns

SECTION 2 - MAINTENANCE COSTS

This section of the report focuses on maintenance costs and is divided into 4 subsections. First a summary of maintenance costs is presented that was derived from a review and analysis of data provided by DelDOT Highway Operations, DelDOT Traffic Engineering and Management (TEAM), DelDOT Pavement Management, and other groups in DelDOT. The goal was to investigate where maintenance dollars were going rather than simply using the budgeted amounts for each group. Next, a review of maintenance costs by the municipalities and local agencies is presented. The third subsection addresses the question of whether current levels of maintenance are sufficient. Finally, a 10 year projection of maintenance costs is presented with a discussion of how projected figures were derived.

Section 2.1 Summary of Maintenance Costs

This subsection will discuss the types of cost information collected and groups that provided the information, followed by a summary of current maintenance costs. The latter part of this section will discuss current costs and activities in more detail.

Maintenance Activities That Were Considered

Maintenance activities included in this study address activities that are not capital improvements of transportation facilities, but those that are of an upkeep or preservation nature. Maintenance activities can be grouped into categories as they are in the Division of Highway Operations Maintenance Management System as shown below in Figure 12.

In addition to the types of activities below, the maintenance of signs and signals, lighting, and all associated structures were considered as were energy costs for lighting and signals. DelDOT's Traffic Engineering and Management (TEAM) section's maintenance responsibilities include maintaining traffic signals, signs, highway lighting, structures, and pavement markings. Resurfacing of pavements as conducted as part of the yearly

DelDOT Pavement Management Program was also considered as a maintenance cost. While resurfacing is part of the capital improvement budget, it can be considered as a preservation of the level of service of the existing system. Public transportation facilities for transit or paratransit involve large maintenance costs but were beyond the scope of this study.

Figure 12
Maintenance Function Categories in the DelDOT Maintenance Management System

Mechanical Vegetation Control (mowing, brush, tree)
Chemical Vegetation Control (weed, brush, grass, insect)
Drainage - Open (ditching)
Drainage - Closed (system maintenance - flushing)
Maintenance of Traffic
Roadway Cleaning
Highway Apertenances
Travel Way and Shoulder Repair - Unpaved
Travel Way and Shoulder Repair - Paved
Incidents (vehicular)
Incidents (weather - Snow & Ice)
Incidents (Weather - Water / Wind)
Beautification - Rest Area / Picnic Area
Beautification
Clean Up
Personnel Functions
Materials Management / Movement
Bridge / Ferry / Structure
Building Maintenance
Equipment Maintenance
Multi-Modal Transportation System Maintenance

Who Was Contacted and Sources of Data

This project was to estimate maintenance costs handled by DelDOT and the municipalities, and any other local entities in Delaware. Unlike most other States, counties in Delaware are not involved in maintenance of transportation facilities. Representatives of groups listed in Figure 13 were contacted for information.

Figure 13
Groups /Programs Contacted for Information

DelDOT District Offices
DelDOT TEAM
DelDOT Pavement Management
DelDOT Expressways
Suburban Development Snow Removal Program
DelDOT North District Bridge
Suburban Street Aid Program
Municipal Street Aid Program
NPDES Program
Municipality public works and operations offices
New Castle County for light district costs
DelDOT Division of Planning for transportation facility

The DelDOT Highway Maintenance Management System was the source of the most detailed information and seven years of data from 1994 thru 2000 were available. Information from other DelDOT programs was kept in several ways, often in a number of spreadsheets, and staff provided summaries in meetings or over the phone.

Notes About The Information Gathered and The Expected Accuracy of Financial Information

Obtaining, understanding, and compiling the data presented in this report required months of effort but still must be considered as a "first pass." Obtaining more accurate or complete information would require substantial additional efforts. Total budgeted figures listed for the Division of Highway Operations and for sections within the Division is known but details about where maintenance dollars went is not known exactly and does fluctuate from year to year. Figures for specific maintenance categories in some cases could vary as much as $100,000 or more. Some costs could not be accurately estimated since for whatever reason the information was not tracked or the effort required was prohibitive.

It is very important to note also that the actual dollar amount spent on maintenance activities is only part of the story and measures or understanding of the condition of a facility or the level of service provided must be considered. Low expenditures in an area resulting in a decreased condition over time are actually deferring maintenance costs.

Deferred maintenance costs often lead to much greater future costs particularly when facilities are allowed to decline to the point where they require replacement or major overhaul. An actual budgeted amount for maintenance must viewed in terms of the overall condition of facilities at least at some system wide perspective.

One example of the difficultly in understanding costs is with maintenance work done in the State by contract arrangements with private firms. This information is currently tracked now by the particular vendor or by the many groups who make the contract arrangements. The data is not easily queried by the type of activity conducted. Without individual inspection of volumes of financial orders/invoices it is impossible to determine the amount of maintenance that has been contracted, primarily because the information is obtainable only by vendor or group making the requests, rather than by the specific activity addressed. This figure is in the millions of dollars and it is unknown how it has been changing over the years.

Other costs related to maintenance that are not presented in some of the figures in this report, are those for maintaining equipment to perform the various maintenance activities. DelDOT employs over 2000 pieces of equipment worth about $60 million in replacement that are involved in a range of functions. It would require extensive efforts to determine what portion of total equipment costs are for maintenance operations.

Data from the municipalities was difficult to obtain. Where information from municipalities was available, it was often for only one or a few years, or for only some categories.

Status and Upgrade of Information Systems at DelDOT

Improvements in information systems are vital to having a better understanding of current and future maintenance costs. In recent years, DelDOT has recognized the need to replace or improve out of date and less effective information systems, and a number of efforts are underway. DelDOT departments that were providing information for use in this study often noted the short comings of information systems and said that much more accurate and detailed information for decision support and cost analysis would be available in the future.

The DelDOT Highway Maintenance Management System provided yearly totals by maintenance categories by year , by district, and by maintenance area. DelDOT is in the process of replacing this system to increase reliability and effectiveness. One of the improvements will be features that will assist in estimates of the levels of effort and expenditure necessary to achieve particular levels of service or condition of facilities. Without an understanding of expenditures in relation to condition of facilities, it is difficult to judge the long-term effectiveness of maintenance programs. The current system lacks information processing and decision support capabilities, and each district office and the Expressways Section make their own respective decisions for allocating resources and prioritizing maintenance activities. New systems will also assist in tracking costs of maintenance activities for work that has been contracted to outside vendors. New information systems should significantly improve tracking and projection of costs.

DelDOT does not have a comprehensive management system to inventory and track the costs and maintenance histories of its installed traffic control devices, or to measure performance of its in-house staff and contractors to meet goals. No new systems are currently planned for the DelDOT Traffic and Engineering Management Section that handles maintenance to signals, lighting, signs, ITMS, and pavement markings, but staff indicated a great need and interest in a system that could assist them in tracking maintenance activities and costs.

A new pavement management information system is also being implemented within the DelDOT Pavement Management Group. Determining each year what pavements will be resurfaced requires a system that can take advantage of information about field condition measurements, past work that has been completed, modeled life of pavements, costs for various treatments, maintenance cycles, and a range of other information that all has to be inter-related to come up with the most cost effective program given limited budgets and service goals. Systems that can strategically determine yearly programs can save millions of dollars. They can also predict expected future conditions and costs. Once this system is operational over the next 2 years there will be a much better idea whether current funding levels will be sufficient to maintain service levels and whether there are backlogs or cycles that will produce cost spikes in the future.

A new equipment management information system is now being implemented at DelDOT that will provide information about inventories and costs of equipment in relation to their function/use.

Locating Where Maintenance Activities Are Occurring

This project was to address jurisdictions and features of jurisdictions where maintenance activities were occurring. This can be easier in the case of data from municipalities. Activities are then located within the incorporated area boundaries, and population figures, total lane miles, and inventories of facilities can be associated with these areas and maintenance costs. Outside of municipalities, DelDOT highway maintenance operations are sometimes the responsibility of maintenance crews focused within their local Maintenance Areas. DelDOT Highway Maintenance Department work in the State is performed by a group for each of 12 maintenance districts defined in the State, three float crews each representing a District (North, Central, South) and a few specialty groups such as the Smryna Rest Area, North Bridge and Building, Central District Express, and District 2 Beautification (District 2). A map of the Maintenance Areas is available on page 8. South District includes areas 1 thru 5, Central District contains areas 6 thu 9, and North District is areas 10 through 12. The North, Central, and South Maintenance Districts follow county lines with the exception that the area of New Castle County below the Chesepeake and Delaware Canal is part of the Central District.

It is difficult to determine costs to smaller areas than the Maintenance District level. There is a significant amount of work done by District Float Crews that range across districts, primarily specializing in activities such as resurfacing and patching pavements and bridge work. Maintenance crews in North District while working out of a maintenance Area office, specialize in operations such a pavement repair, drainage, or vegetation control conducted throughout the District to make the most of available equipment and other resources, and to take advantage of the relatively smaller district area to cover. This work is not referenced to a smaller area or facility. The DelDOT Traffic Section work on signals, signs, and lights was available only at the District level. Within some programs it would be possible through a very intensive process to find

specific records tying each operation to a particular facility, but such efforts are well beyond this project and the accuracy of the outcome would be suspect particularly in comparison to the many costs that cannot be specifically tied to smaller areas than a district. Therefore trends are analyzed only at the State and District level, or by type of activity.

Summary of Current Costs

A summary of costs for the year 2000 is presented below. Maintenance District expenses include work done by the North, Central, and South District offices and the Expressways group. Costs not shown in Expressways and not in the Highway Maintenance Management System include contracted maintenance and some construction. Within each item above are various cost breakdowns that are examined in more detail in the following portions of this report.

Figure 14
Year 2000 Maintenance Costs (x $1,000)
DelDOT Maintenance District Costs

Category	($ * 1000)
Costs Tracked in Highway Maintenance Management System	$21,791
Expressways	$ 5,378
Other District Expenditures	$10,192
TEAM	$8,602
Field Services NPDES Program	$ 205
Other Field Services	$ 1,962
Non-Maintenance – Division of Highway Operations	$13,132
Division of Highway Operations Total (items above)	$61,265
Pavement Management Yearly Program	
Road resurfacing	$29,858
Surface Treatment in Kent and Sussex	$ 2,000
Conversion of surface treatment to hot mix	$ 2,000
Suburban Development Snow Removal	$ 270
Suburban Street Aid (mostly capital projects)	$20,000
Municipal Street Aid (mostly capital projects)	$ 6,000
Municipality Maintenance	
Dover, Newark, Wilmington	$11,296
All other municipalities	$ 5,696 *
New Castle County Light District Costs	$ 2,450
North District Bridge	$ 1,500

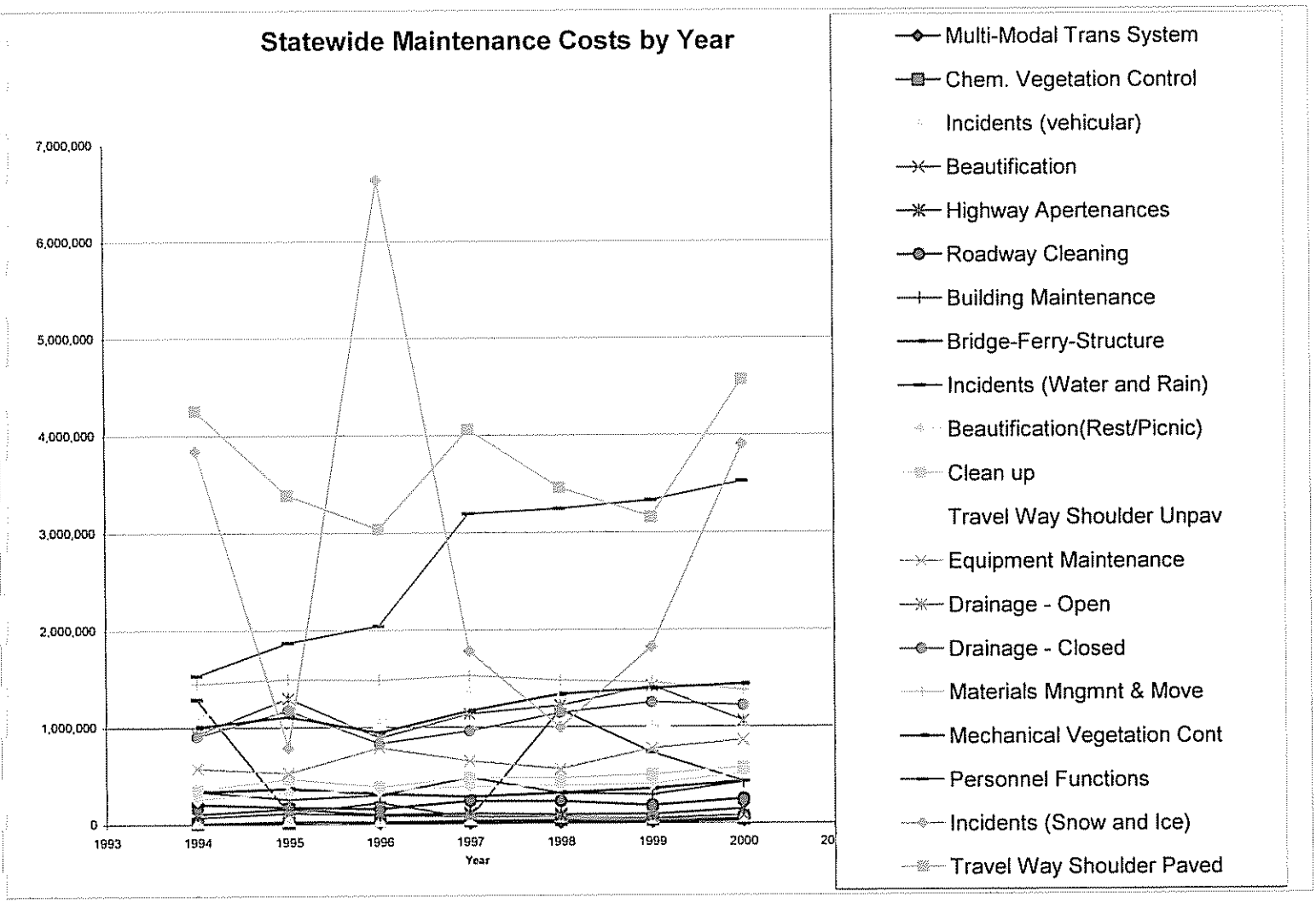
Source: DelDOT and municipal surveys
DelDOT Highway Maintenance Management System Data

* Estimate based on available data and $70 per person

The Highway Maintenance Management System has tracked district maintenance costs for the last several years. Statewide maintenance costs by year by activity category from the DelDOT Highway Maintenance Management Systems are shown on the next page in Figure 15. The Travel Way Shoulder Paved category covering all patching, surface treatment, and sealing of the roadways and shoulders is consistently the most costly. This is then followed by personnel costs of maintenance personnel associated with overhead type activities such as leave time, training, and administrative support. As seen in Figure 15, Personnel Functions cost would appear to have jumped by over $1 million between years 1996 and 1997. Actually there is a steady increase each year but the jump in 1996 to 1997 results from sick and vacation time being factored into costs for the first time. On the average Snow and Ice Incidents can also be a major cost that ranged from less than $1 million in 1995 to over $6.5 million in 1996.

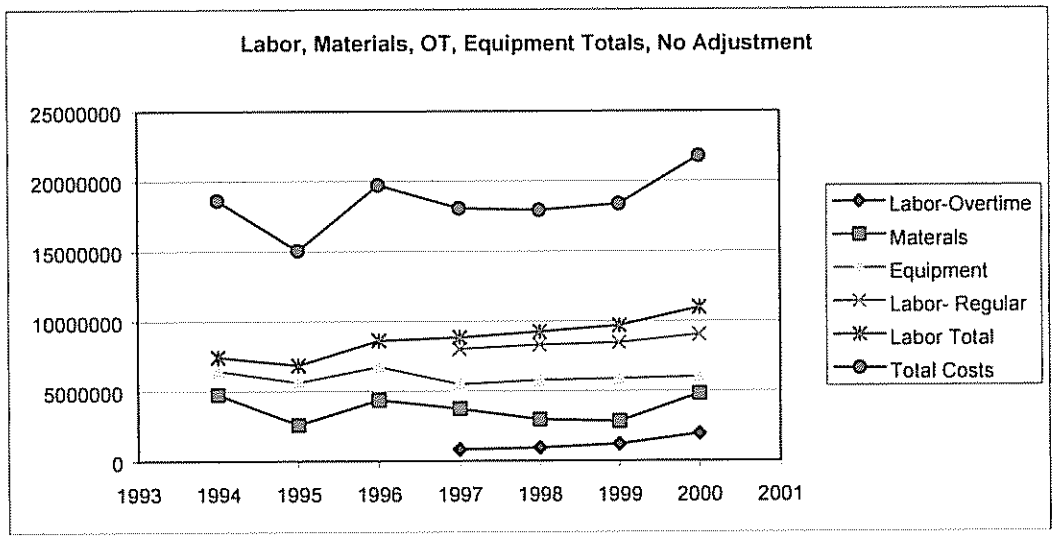
With the exception of weather incidents which incur highly variable costs that are sometimes offset with additional resources, the activities and costs are constrained by the overall budgets allotted as well as the fixed number of workers employed. Looking at any one maintenance category there maybe large changes from year to year but at the State or District summary level costs tend to show steady increases. If in one year large amounts of money are spent on travel way maintenance for instance, then there will be less activity/costs in another area such as drainage maintenance. There is always a trade off that can be found in the data. If maintenance crews spend more time in one type of activity, then they spend less time in another.

Figure 15


Statewide Maintenance Costs by Year
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1993
1994
1995
1996
1997
1998
1999
2000
Year
Multi-Modal Trans System
Chem. Vegetation Control
Incidents (vehicular)
Beautification
Highway Apertenances
Roadway Cleaning
Building Maintenance
Bridge-Ferry-Structure
Incidents (Water and Rain)
Beautification(Rest/Picnic)
Clean up
Travel Way Shoulder Unpav
Equipment Maintenance
Drainage - Open
Drainage - Closed
Materials Mngmnt & Move
Mechanical Vegetation Cont
Personnel Functions
Incidents (Snow and Ice)
Travel Way Shoulder Paved

As costs are limited to an extent by budgets and available personnel, the best way to view cost trends is by the major categories of Labor, Materials, and Equipment costs in the Maintenance Management System. Figure 16 shows 7 years of data. The figure includes costs for weather incidents, the fluctuations in travel way paving operations, and the jump in costs resulting with tracking vacation and sick time in the systems starting from the year 1996. Increases in total spending also include funds from the Pavement Management Program contribute over $2 million for surface treatment in Central and South Districts and $300,000 for patching. When these factors are removed there is less variation, as shown in Figure 17

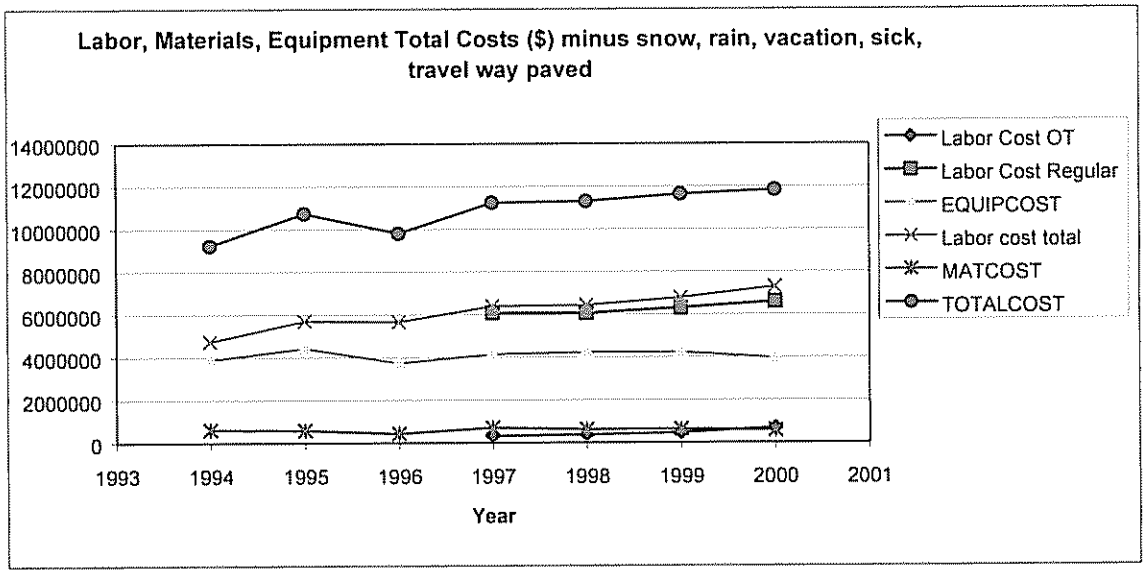
Figure 16
Statewide Maintenance Costs from the Highway Maintenance Management System, Costs ($) by Year



Category	1994	1995	1996	1997	1998	1999	2000
Labor-Overtime				808315	929841	1192419	1947337
Materals	4747946	2572409	4354837	3726920	2942487	2829628	4808413
Equipment	6447993	5617385	6749057	5487890	5769067	5875084	6005561
Labor- Regular				8027565	8294961	8467957	9028744
Labor Total	7454112	6852187	8607095	8835880	9224802	9660376	10976081
Total Costs	18629541	1504198 1	19710989	18050692	17936358	18365089	21790056

Source: DelDOT HMMS

Figure 17
Statewide maintenance costs,
excluding weather incidents, travel way paved, sick and vacation leave

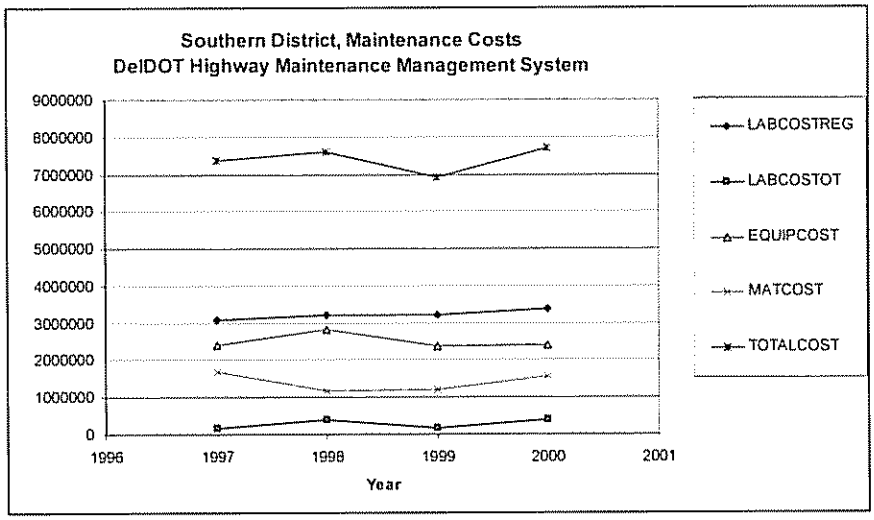


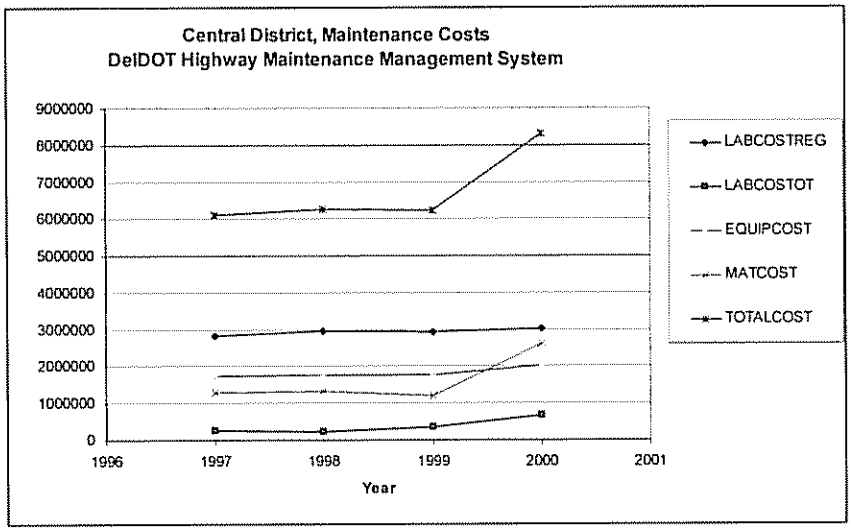
Category	1994	1995	1996	1997	1998	1999	2000
Labor Cost OT				316137	373075	465175	696518
Labor Cost Regular				6092744	6076657	6320267	6607044
EQUIPCOST	3891592	4437981	3728095	4148628	4237211	4230139	3963018
Labor cost total	4750769	5713955	5662789	6408881	6449732	6785442	7303562
MATCOST	618235	596550	427303	698146	623508	629922	578628
TOTALCOST	9240086	10748486	9818187	11255656	11310451	11645502	11845208

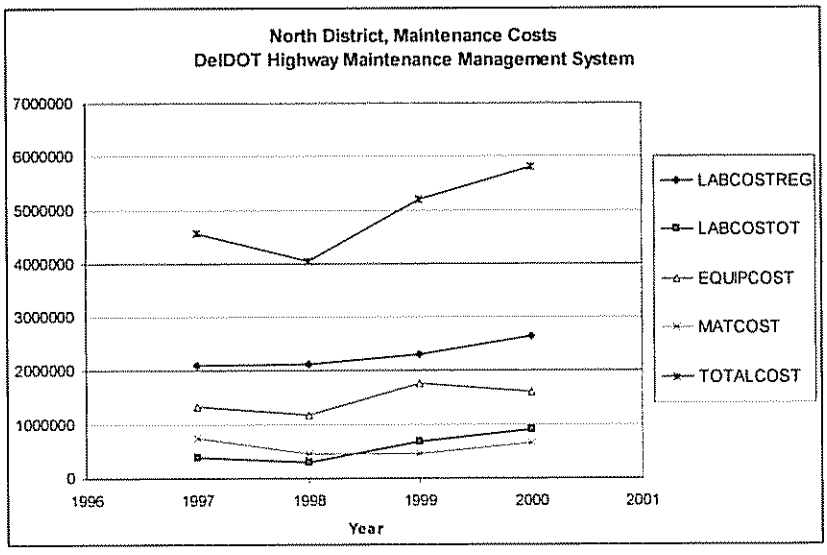
Source: DelDOT HMMS

The following figures show total costs by maintenance district. Fluctuations are primarily due to weather incidents and major resurfacing projects. The resurfacing of tar and chip roads in the Central District is evidenced by the jump in material costs between the year 1999 and 2000. In the North District a major change over the last few years is that much less vegetation control (grass mowing) has been contracted out. Between year 1996 and 2000, costs for vegetation control have increased by over $200,000. As budgets and personnel are fairly constant at the district level this means that more personnel and resources have been put in this area and less in others.

Figure 18
District maintenance costs ($)







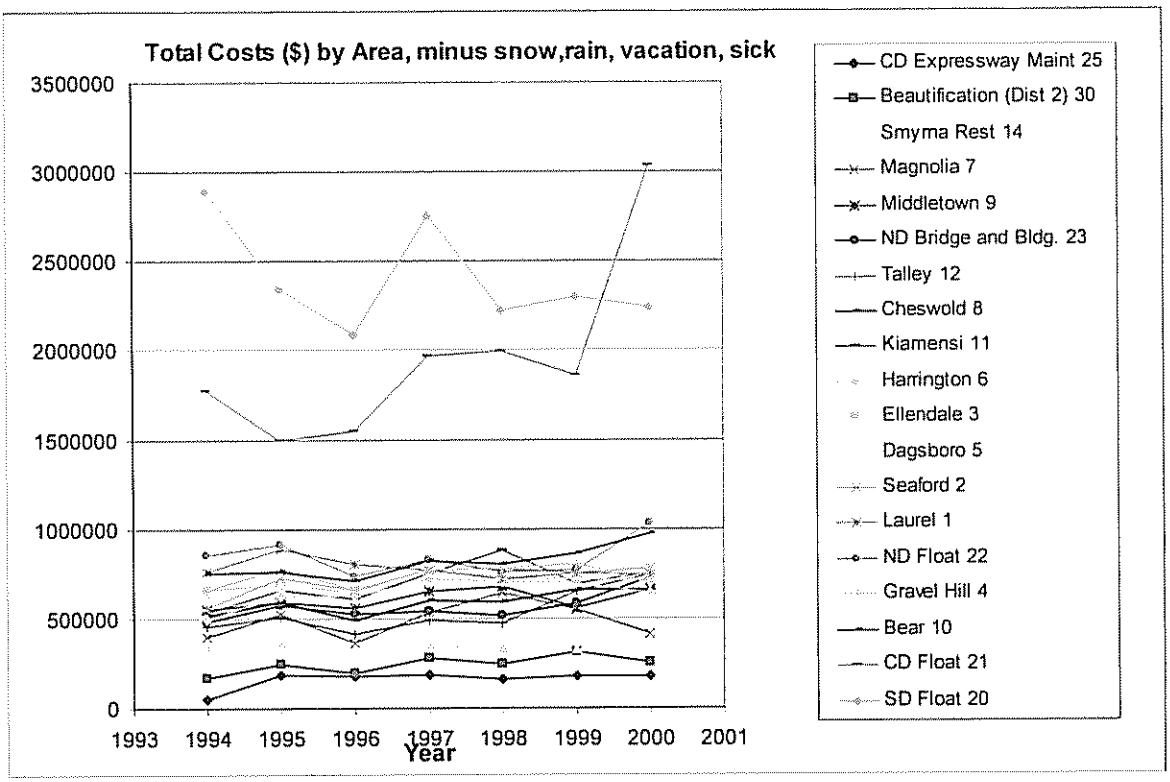
A breakdown of costs by Maintenance Area (group) for the year 2000 are shown below in figure 19. As in all years the float crews involve the highest costs. The float crews do a little of everything but by far their costs relate to weather incidents and travel way repair and resurfacing. This explains the high materials costs for float crew costs in figure 19. The tar and chip resurfacing effort in FY2000 in the Central District is also evident in the figure below and in figure 20 that shows yearly maintenance cost totals by maintenance group.

Figure 19
Labor, materials, and equipment costs
by Maintenance Area, year 2000

Area	Labor	Materials		Equip ment		Total Cost($)		Total
	Num	$	%Tot	$	%Tot	$	%Tot	
TURNPIKE	13	227	77	0	0	69	23	296
South Dist. H.Q.	47	40169	88	2485	5	2880	6	45535
NORTH DIST.HQ.	45	72198	90	4545	6	3320	4	80063
CENTRAL DIST.H	46	78495	68	12001	10	25609	22	116106
CENTRAL DIST.	25	172922	60	36224	13	77501	27	286648
S/W BEAUTIFICA	30	190961	60	20951	7	107828	34	319742
SMYRNA REST AR	14	375998	87	0	0	54005	13	430003
MAGNOLIA	7	345790	53	99595	15	208422	32	653808
NORTH BRIDGE &	23	692864	86	0	0	110452	14	803316
HARRINGTON	6	540880	58	129100	14	265152	28	935132
GRAVEL HILL	4	563492	58	142793	15	272136	28	978422
MIDDLETOWN	9	518197	52	193890	20	280190	28	992278
ELLENDALE	3	561589	56	105061	11	333645	33	1000295
LAUREL	1	506534	50	155523	15	345490	34	1007547
SEAFORD	2	533476	51	182457	18	324012	31	1039945
KIAMENSI	11	606079	58	157246	15	278773	27	1042098
TALLEY ROAD	12	587283	55	127451	12	347743	33	1062478
DAGSBORO	5	538201	50	154068	14	375555	35	1067825
CHESWOLD	8	524384	46	329933	29	276441	24	1130759
BEAR YARD	10	778016	59	126827	10	403362	31	1308207
NORTH FLOAT CR	22	816926	54	232343	15	452572	30	1501841
SOUTH FLOAT CR	20	1003510	39	812074	32	740081	29	2555666
CENTRAL FLOAT	21	927880	27	1783838	52	720312	21	3432032

Source: DelDOT Highway Maintenance Management System

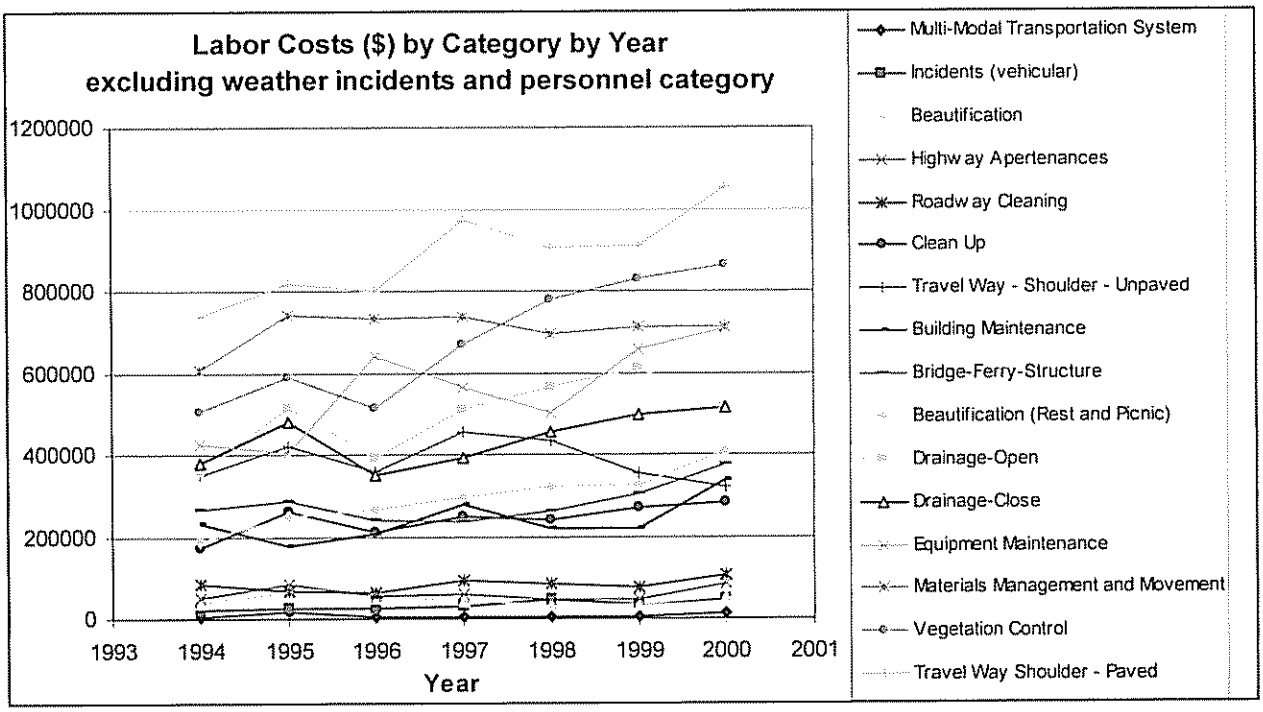
Figure 20
Maintenance costs from the Highway Maintenance Management System by Maintenance Group



As there is a limitation presented by the number of staff devoted to maintenance, it is interesting to look at labor costs by maintenance category from year to year.

Figure 21 shows the relative manner in which labor resources are used over the seven years of data. It does not include labor costs in the personnel functions categories that includes administration, and various types of leave and training, that are more than twice as large than most categories. Some of the variation in figure 21 seems to be due to weather incidents, for instance in 1996 there were major snow storms across Delaware and there is a dip in most category costs in that year (labor due to weather not shown below). In low snow years (1995, 1998) there are increases. The increased costs in vegetation control due the decrease in contracted services in the last few years is clear. There is a decrease in travel way unpaved work as more effort was put toward the paved portions of roads.

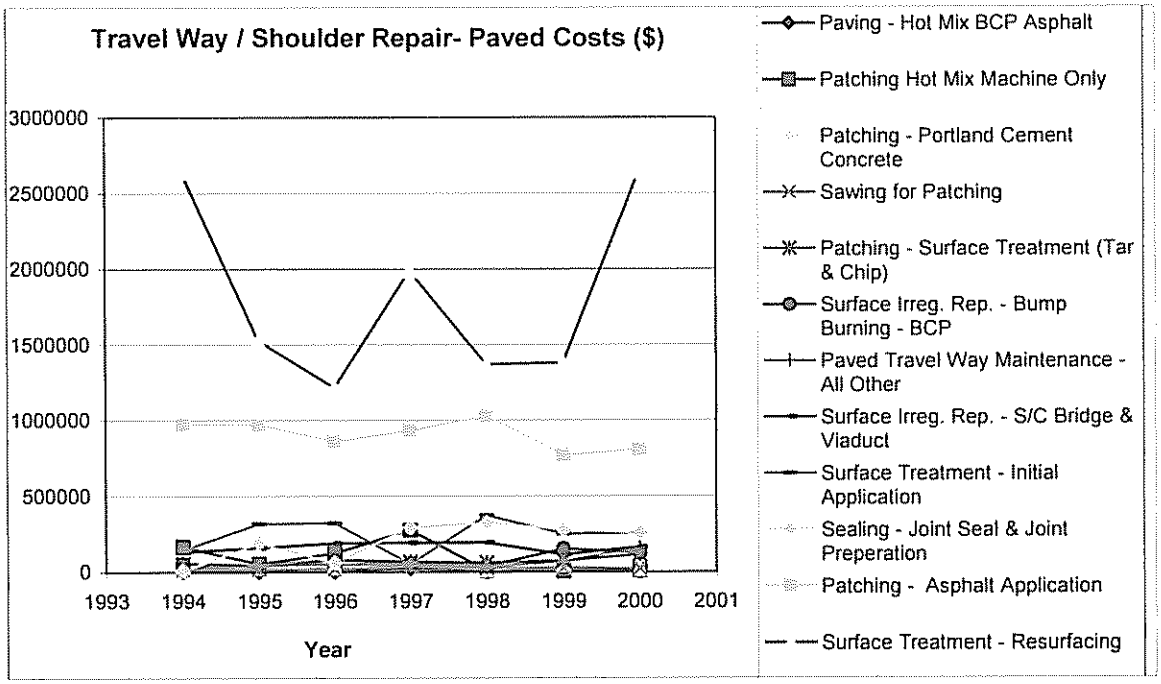
Figure 21
Labor Costs by Maintenance Category



Source: DelDOT Highway Maintenance Management System

Another interesting way of looking at the Highway Maintenance Management Information System is by functions or functional categories as in figure 22. Other views of specific maintenance categories are included in the appendix of this report.

Figure 22
Travel Way / Shoulder Repair by Year by Function



Source : DelDOT Highway Maintenance Management System

The largest Highway Maintenance category in any one year by far is on snow and ice incidents in the year 1996. The average spent on snow and ice Incidents over the last 7 years of data is just over $2.8 million making it on average the third most costly item.

Figure 23
Average costs for snow and ice incidents
Year 1994 to 2000

	Average Cost	Avg % of Total Cost	Min (FY95)	Max (FY96)
Materials	1,103,709	40.7	281,576	2,473,123
Labor	911,474	31.9	257,655	2,021,272
Equipment	809,729	27.3	251,988	2,141,412
Total Cost	2,2824,912	100	791,219	6,635,807

Source: DelDOT Highway Maintenance Management System

Figure 24
Snow and Ice Incident Average Percentage Costs by Function, Year 1994 to 2000, (DelDOT HMMS)

Ice and Snow Incident Function	Avg % of Total
Snow and ice control: Plowing , apply chemicals and abrasives (7565)	87%
Miscellanous effort related to snow and ice (7599)	9%
Maintaining and transporting sand storage (7553)	2%
Chemical & Abrasive Materials - Preparation & Stockpiling (7560)	2%

Source: DelDOT Highway Maintenance Management System

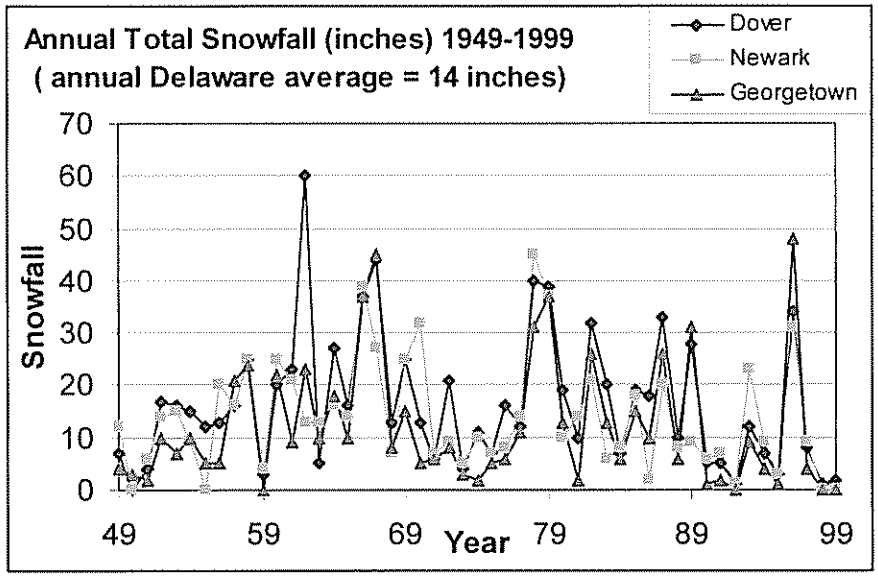
The figures above are for State Maintenance roads, not subdivision or municipality roads. DelDOT expenditures for suburban roads are out of the DelDOT Suburban Development Snow Removal Program started in 1997. Based on the lane miles and cul de sacs within a suburban development a reimbursement is calculated on the estimated 75% of snow removal costs for each development registered in the program and also the severity of the storm. During FY 1999 it was estimated that total program expenditures would be $135,000 for each 4 to 8 inch incident, $201,000 for a 8 to 12 inch, $277,200 for a 12 to 20 inch, and $412,000 for each over 20 inch storm. These total estimates are based on the lane miles, cul de sacs, and total number of development associations that were registered. About 13% more developments were registered in FY 2000 in the program than were in FY 1999. As a new program, this increase is not simply new developments, but includes existing development associations finding out and applying for the program. In 1999, about $271,320 was paid out for two, over 4 inch storms. This past year (FY2000) so far, New Castle County has had one 5 inch snow storm (Feb. 22) and the program estimates that reimbursements will be about $227,000 if all registered associations request reimbursement for snow removal. Snow removal for municipalities is covered in another section.

Figure 25
Number of snow incidents between 1949 and 1999

	Station			
	Newark	Dover	Georgetown	Expected number
Amount of snow in incident				of annual incidents
0 to under 3"	168	199	188	3.6
4" to under 8"	51	58	33	2.8
8" to under 12"	6	13	12	0.6 (once every 1.6 years)
12" to under 20"	4	1	2	0.05 (once every 20 years)
20" or greater	0	2	0	0.01 (once every 100 years)

Source: Tabulated from daily snow fall data from the Delaware State Climatologist

Figure 26
Annual total snowfall at 3 weather stations in Delaware



Source: Daily snow fall data from the Delaware State Climatologist

DelDOT's Traffic Engineering and Management (TEAM)

DelDOT's Traffic Engineering and Management Section (TEAM) within the Division of Highway Operations handles the maintenance of signals, signs, street lights, and pavement markings. TEAM provided cost estimates as shown in figure 27 below. TEAM total budgets have been virtually the same for past 7 years. There is great interest by TEAM in information system tools that would assist them in better understanding where resources are going, and where they are most needed. There is a growing backlog in maintenance of facilities that TEAM is responsible for, and this is discussed in the next subsection on projected costs. Personnel have been working on activities related to new Integrated Transportation Management Systems (ITMS) in addition to normal maintenance duties. The ITMS initiative is a six year project costing about $100,000,000 and is 80% funded by the federal government. The new ITMS equipment is expected to produce increased maintenance demands on TEAM within a few years after it's installation. In FY 2000, about 66% of reported signal problems were in North District, 15% in Central District, and 19% in Southern District. About 47% of the signing work was done in Southern District, 23% in Central, and 29% in Northern District.

Figure 27
Maintenance Cost Estimates From TEAM

FY 2001 TEAM OPERATING BUDGET

	Contractural services	Capital Outlay	Energy	Casual Seasonal & OEC	Regular Salaries & OEC	E & C Overtime Salaries	TOTALS:
Signals	703,000.00	6,700.00	973,300.00	13,500.00	1,145,000.00	91,500.00	**2,933,000.00**
Signing	362,300.00				892,400.00	58,100.00	**1,312,800.00**
Markings	1,280,300.00				167,500.00	1,300.00	**1,449,100.00**
Section Support	128,200.00	27,000.00		70,000.00	1,028,800.00	8,400.00	**1,262,400.00**
TMC	244,400.00				779,400.00	308,300.00	**1,332,100.00**
SR1 Tolls	2,000.00		75,600.00				**77,600.00**
Gen Admin.				2,200.00	7,200.00		**9,400.00**
Financial Mgmt.					77,800.00		**77,800.00**
E & C					100,000.00		**100,000.00**
Section Mgmt.					421,300.00		**421,300.00**
TOTALS:	**2,720,200.00**	**33,700.00**	**1,048,900.00**	**85,700.00**	**4,619,400.00**	**467,600.00**	**8,975,500.00**

Source: DelDOT Traffic Engineering and Management Section (TEAM)

DelDOT Expressways Maintenance

The Expressways Section is responsible for 258 lane miles for Interstates 95, 295, and 495, and 46 lane miles for U.S. Route 1. There are two toll plazas, one maintenance yard, an office, automotive repair shop, equipment storage, four salt storage facilities, and a new facility planned in the Smyrna area to serve U.S. Route 1. No detailed breakdown of costs and activities was available. Costs for FY98 were available as shown in figure 28.

Figure 28
DelDOT Expressways costs, FY1998

Maintenance Operations	1,759,000
Contracted Services and Materials	2,119,000
Energy Costs	242,700
Snow Removal	375,000
Total	**$4,495,700**

Source: DelDOT Expressways Group

DelDOT District Bridge Maintenance Groups

The DelDOT Bridge Section maintains an ongoing condition rating for bridges and each year there are efforts by the Bridge Maintenance Groups in each District to make improvements. These groups do not deal with major renovations or reconstructions of bridges that would be part of the Capitol budget. Activities are more focused on patching and drainage. Yearly costs for the North District Bridge Group were estimated to be in the $1.5 million range. Central and Southern Districts handle bridge maintenance from the district offices and figures for bridge maintenance are within the Highway Maintenance Management System presented earlier.

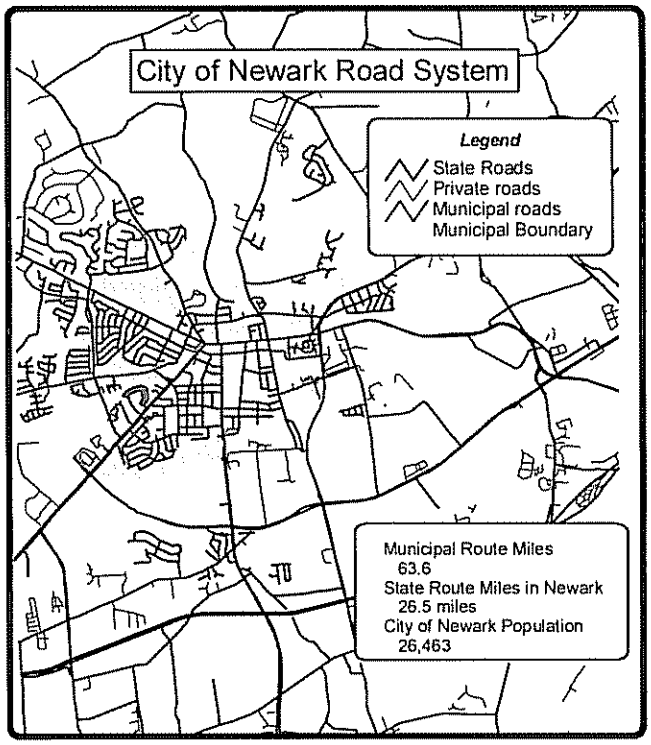
DelDOT Pavement Management Group

Each year the DelDOT Pavement Management Group selects roads across the State for resurfacing. The process of selecting what roads to resurface is extensive and takes into account results of yearly condition ratings, level of traffic, functional classification, safety, future predictions, cost/benefit strategies, and complaints. In FY 2000 almost $34 million was spent on the program. For FY2001, $36 million is budgeted. Funds were spent fairly evenly between the three maintenance districts. This yearly cost includes $50,000 for storm water management, $300,000 for patching, $2 million for surface treatment in Central and South Districts, and $2 million for conversion of surface treatment roads to hot mix surfaces in Central and South Districts.

Section 2.2, Transportation Facility Maintenance Costs in Municipalities

Each municipality was contacted by mail to collect information about the type and number of transportation facilities that they were responsible for and related maintenance costs. There was generally low response from inquiries. Data was collected from the larger towns by calling and talking to personnel who handled maintenance or finances. Most data from the municipalities was only available in very broad categories such as "Maintenance", "Snow Removal", "Resurfacing". In some cases a few years of data were available and sometimes only one year. In other cases, the data reported in a particular year coincided with atypical activities such as a period where federal grant money was available, or an off cycle year for pavement resurfacing or other activity.

Figure 29
City of Newark road system



Source: DelDOT Centerline File

Review of Available Municipal Maintenance Cost Data And Estimates

Population, area, density, total route miles, and total amount of DelDOT roadway were factors that were considered that would relate to maintenance cost totals. Population is the strongest indicator, though Dover was an exception. For Dover there are 25% more people than in Newark but Dover's total costs are less than half that of Newark. The density of Dover is less than half that of the much more urban Wilmington and Newark.

Figure 30
Municipal maintenance cost data that was collected

	Street Repair	Pavement Resurfacing	Signal Maintenance	Sign Maintenance	Snow Removal	Energy Costs (lights/signs)	Cleaning	All Others or Not Categorized	Total Maintenance	2000 Population		Total Municipal Route Miles	Total DelDOT Maintenance Road Route Miles	Municipal Street Aid Y2000	Acreage
Dewey				1,500	3,000	6,000		13,000	23,500	1,997	7	0.60	6.21	24,921	298
Clayton	7,000	20,000	0	2,000	3,000	12,000	1,500	13,400	58,900	1,227	8	5.00	3.22	39,886	690
Bridgeville	43,500	10,000			90	17,400		37,610	108,600	1,350	11	7.86	3.42	56,399	510
Laurel	29,672					44,960		57,607	132,259	3,814	18	11.76	6.42	103,913	1,030
Middletown	111,700	103,400		2000	10,600	8,600		33,600	270,100	5,116	19	15.02	4.33	135,382	5,797
Lewes								305,700	305,700	2,295	28	18.12	9.53	121,124	2,954
Seaford						104,000		225,000	329,000	5,689	44	32.52	11.37	234,472	2,411
Milford					4,300	69,000		469,250	542,550	6,666	47	30.81	16.19	236,023	4,235
Dover	20,000	403,000	73,000	46,600	14,000	361,200	61,200	346,000	1,325,000	34,546	140	88.44	59.45	845,285	14,267
Newark	460,000	530,000	8,100	92,000	75,000	336,470	50,000	1,312,635	2,864,205	26,463	90	63.57	26.52	625,344	5,830
Wilmington	971,750	550,000		86,250	152,250	1,370,500		3,975,600	7,106,350	72,848	177	146.68	30.54	1,572,277	10,699

Figure 31 on the next page shows the population to cost relationship for data available above, with Dover data being the data point most off what could be seen as a linear relationship. Figure 32 shows the relationship between total route miles and maintenance costs. From these figures, Dover seems more like other towns in Delaware rather than the urban areas of Newark and Wilmington, despite its higher population and municipal route miles. Again, Dover is the exception with much lower costs per route mile than the other municipalities.

Figure 31
Maintenance cost ($) per capita
Delaware municipalities

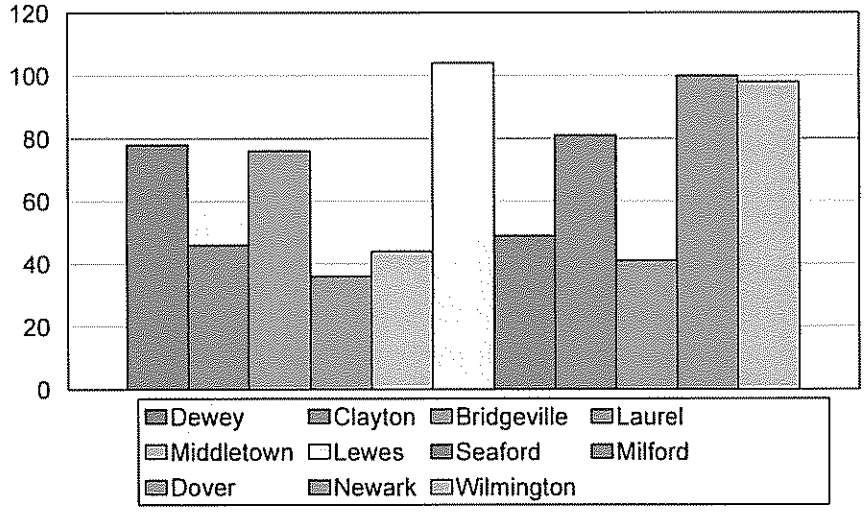
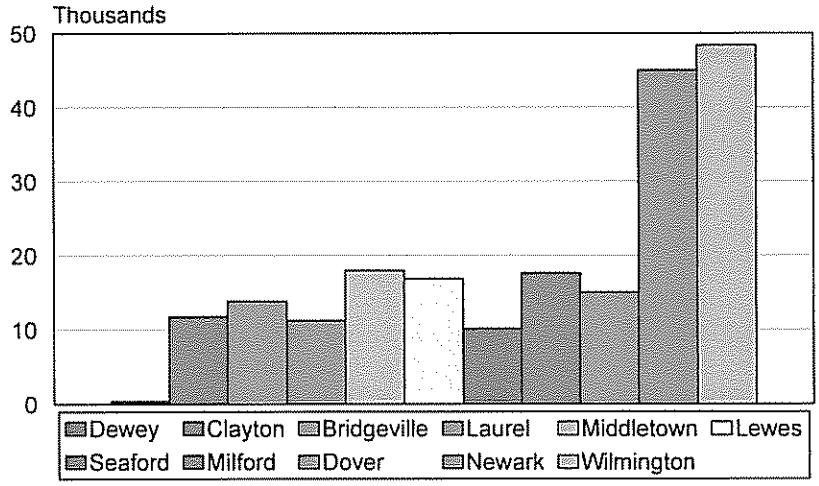


Figure 32
Maintenance cost($) per municipal route mile
Delaware municipalities



To estimate total costs that municipalities are spending on maintenance is difficult due to the lack of data. A rough estimate might be the total maintenance costs as a function of total population. If the data point for Dover were removed, a linear regression on current data would indicate about $100 per person. So, by year 2000 Census figures showing 214,718 total persons living in municipalities in Delaware, that would be an estimated total cost of transportation facility maintenance (including snow removal, pavement resurfacing, and light and signal energy costs) of about $21.5 million. A better way might be to treat Dover, Newark, and Wilmington separately as they have about 20,000 or more people than any other town and millions of dollars more needed each year. In particular, Wilmington and Newark are urban areas unlike any other town in Delaware and maintenance costs per person would be expected to be higher than for smaller towns because of all the signals, lights, signs, and other additional facilities that are in place. A better estimate for the smaller towns would then be about $70 maintenance cost per person. That would be $11,295,555 total for Wilmington, Dover, and Newark, and $5,696,040 for the 81,372 persons living in all other towns, and the total maintenance for all towns would be estimated at about $17 million.

Section 2.3 Are Current Maintenance Levels Sufficient?

In the 1999 DelDOT Household Survey, about 74% of respondents rated the condition of Delaware roads as good to excellent. About 62% rated DelDOT performance in managing transportation in Delaware as good to excellent. So in terms of public opinion, DelDOT is doing well. Past maintenance activities and investments in the pavement management program have resulted in transportation facilities that are in generally good condition. There has been progress in recent years accomplishing some preventive maintenance. Faced with several years of small changes in funding and staff, and ever increasing responsibilities, DelDOT maintenance staff have done very well in increasing productivity and getting things done. Backlogs in maintenance are beginning to show up, however, particularly in TEAM.

Another area of concern is in figures for the Maintenance District expenditures. For the Division of Highway Operations, costs were accounted for TEAM, Field Services, Administrative and Headquarters costs including toll operations, and for costs shown in the Highway Maintenance Management System (HMMS). There were other costs not accounted for in the $10 million to $12 million range that went toward Maintenance District costs that either were not tracked in the HMMS or were for contracted services. The change in these costs from the year 2000 to year 2001, and from the year 2001 to year 2002, were both around a 10% increase. This points to most likely an increase in contract services. At that level of increase the total budget for the Division of Highway Operations will exceed the typical yearly increase of about 2.5% and if funding is not increased in future years the question is "What work will not be done?".

Condition and Level Of Service of Transportation Facilities

Except for expenses that cannot be planned for in any given year, such as snow storms and other incidents, maintenance expenditures are limited by the amount budgeted each year, and activities not handled by outside contractors are limited to available DelDOT personnel. Maintenance is not just to fix what is broken but also includes those activities that maintain or extend the serviceable life of transportation facilities. Yearly costs then are only a portion of the picture. Agencies may be spending more or less each year but without knowing the resulting condition of transportation facilities through a maintenance management program there is no idea as to whether efforts are sufficient or if maintenance needs are under control or increasing. A lack of

maintenance may not even show up as a future maintenance cost but as a capital cost. If, for instance, a road crack is not sealed or if drainage areas around the road are not cleared, the period of time before the road needs to be resurfaced could be much shorter. Lack of maintenance can lead to large replacement costs. As activities move away from inspections and preventive maintenance, they would be expected to move toward handling increased complaints and to a very costly reactive mode, that can take large investments over years to catch up from.

Information systems at DelDOT that address maintenance costs have not been sophisticated enough to relate expenditures to condition. New information systems planned for Division of Highway Operations sections will provide capabilities to address benefits and facility condition for activities and provide decision support, rather than just having the ability to tally costs. New pavement management systems model the life cycle of roads and assist with the determination of yearly programs that will result in the least long-term costs within the available budget.

KPMG, in staffing and operations reviews in 1998 and 1999, indicated that DelDOT lacked a programmatic approach for performing roadway and bridge maintenance activities. KPMG recognized that annual maintenance budgets were based on a combination of available funding and minor adjustments to prior year funding rather than a process that examined priorities and objectives around maintaining an acceptable level of service, and recommended a budget that would reflect program objectives and priorities, and effort required to meet defined level-of-service standards. KPMG also recommended that the Division of Highway Operations should develop comprehensive performance measures and indicators of efficiency or effectiveness that are critical to the success of activities.*

Indications of backlogs in maintenance

There are a few indications that there are potential growing backlogs in maintenance. Staffing is at low levels. Maintenance staff per 1000 lane miles for Delaware is 55.3. For Pennsylvania the ratio is 70 and for Maryland it is 75.9. The Delaware State highway system has grown nearly 16 percent in total lane miles between 1982 and 1999 but state maintenance forces have declined in that period. KPMG recommended 24 additional maintenance positions in North District and 24 in Expressways, 50 in total. The KPMG 1999 Staffing Review said " ....there is a clear

* KPMG, Delaware Department of Transportation Operations Review, May 1998 and DelDOT Staffing Review May 1999.

indication that the roadway and bridge maintenance workload has increased during the past several years. Delaware has fewer maintenance staff per 1000 lane miles compared to many of its neighboring states. These circumstances have presented a great challenge to the Division of Highway Operations to maintain and preserve the existing roadway, bridge and other transportation infrastructure. ..Lack of adequate resources has hampered DelDOT's effort to perform core maintenance activities. There is a general consensus among DelDOT maintenance units regarding not having adequate resources to carry out necessary pavement patching, crack sealing, joint repair, deck repair, drainage maintenance-activities that could extend the life of roadway and bridge and reduce rehabilitation costs."

State and municipal traffic engineering departments typically employ one traffic technician for every 30-70 signalized intersections maintained. ITE's Traffic Signal Installation and Maintenance Manual recommends a ratio of signals to technicians of 31:1. In a 1999 DelDOT estimate for acquiring signal maintenance in Wilmington, it was shown that in New Castle there is a ratio of 138 signals per technician which is a ratio that has effectively eliminated their ability to do any preventive maintenance that should be done on a regular schedule such as fan operation filter replacement, signal head alignment, control cabinet cleaning, controller operation inspections, and signal maintenance safety inspections. There were 238 calls per month and a poor perceived level of service and a lack of preventive maintenance showing an average of 43 repairs calls per 100 signals. In Kent and Sussex there's a ratio of 74 signals per technician and about 26 repair calls per hundred in Kent/Sussex.

TEAM is experiencing a continued shortage in personnel. Overtime pay in FY2001 was close to half a million, about 10% of the total for regular salaries and 5% of the total TEAM budget. Their budget has been virtually the same for the last 7 years and the work load has certainly been increasing over this time . The ITMS project is now 2 years into a 6-year, $100 million project. Costs for ITMS future signal maintenance are expected to be about an additional $200,000 a year. A large portion of manpower that could otherwise be put toward inspection, preventive maintenance, or other such activities is being devoted to ITMS, and there is a growing backlog of work. In addition to the future needs for ITMS maintenance, TEAM has identified new areas that need to be funded over the next years, including a $400,000 per year program over three years to address a back log in the maintenance of signals, a program at $100,000 a year to address sign, light, and bridge structure maintenance, and a bulb replacement project to be funded at $60,000

per year. There are over 40,000 bulbs throughout the state and a systematic bulb replacement project is expected to realize significant savings over simply sending out crews when lights happen to burn out. Lamp and signal energy costs have gone beyond the approximately $850,000 budgeted for the past few years and costs are expected to gradually rise.

The current $36 million budgeted for the pavement rehabilitation program presently has maintained the current condition of roads in Delaware. Funding was increased to this level from about $16.5 million budgeted in 1997 when it was realized that if funding levels were not increased then the overall condition of the road network would decrease. An additional $10 million is estimated to be needed for the program in the year 2003 to keep pace with resurfacing projects that will need to be done.

Core Activities and Performance Measures

The Division of Highway Operations portion of the FY2002 Budget Program Strategic Plan references objectives, activities, and performance measures. Evaluating performance begins with identifying key objectives. The key objectives are shown in figure 33 below.

Figure 33
Division of Highway Operations - Primary Objectives

1) To manage, operate and maintain Delaware's road and bridge transportation infrastructure consistently across the North, Central, South, TEAM and Expressway districts
2) To manage, operate and maintain Delaware's transportation infrastructure for traffic movement by TEAM organization
3) To manage, operate and maintain Delaware's Toll Operations and toll collection
4) Inventory existing landscape installations requiring Departmental maintenance on an annual basis. Maintain the inventory of median and roadside landscape installations to the established standards.
5) To administer all of the Department's transportation related construction and rehabilitation.
6) Manage material quality through testing and to manage, implement and maintain NPDES compliance by the Field Services section.
7) To manage, operate and maintain the automotive fleet, heavy equipment and support equipment required to meet Objective 1.
8) To manage, operate and maintain the Business Management support function.

Source: DelDOT FY2002 Budget Program Strategic Plan

Numerous activities are associated with each of these. As an example, the related activity and performance measure of objective 1 above is to deliver in excess of 95% of the planned infrastructure stewardship, preventive and corrective maintenance programs based on established standards.

Figure 34
Some Objective 1 performance measures

	Goal
Travelway Maintenance	95%
Roadside Maintenance	95%
Drainage Maintenance	95%
Incident (Snow and Ice)	95%
ITMS Device Maintenance	95%
Traffic Control Device Maintenance	95%
Bridge Maintenance Response	95%
Bridge Maintenance Contract	95%
Historical Bridge Maintenance	95%

Source:DelDOT FY2002 Budget Program Strategic Plan

Another performance goal is to manage pavement improvement to maintain an 85% aggregate average of pavements in good to excellent condition. The network level pavement condition level is the performance measure. Other examples of performance measures are:

- Response to hazardous conditions within 2 hours for 95% of notifications of surface, line of sight, or drainage or flood conditions.
- Response to 100% of hazardous condition failure of traffic control devices within two hours of notification.
- Less than 5% absence rate
- 95% position fill rate

Such goals are defined for the large array of responsibilities of the Division. Examining to what extent these goals are being attained and what the future outlook may be requires a better measure of the condition of facilities and information systems for decision support and analysis.

Preventive Maintenance

The benefits of maintenance activities applied in the correct way at the correct time are significant though sometimes hard to accurately quantify. In particular, crack and joint sealing and other preventive maintenance treatments for roadways can save millions. One of the earliest studies on preventive maintenance strategies, conducted by the Utah Department of

Transportation in 1977, indicated that every $1 invested in a preventive maintenance treatment early in the life of a pavement, avoided the expenditure of approximately $3 later on in the cost of a major rehabilitation (Byrd 1979). In Kansas a strategy was implemented to treat the pavements in need of preventive maintenance before funding the reconstruction of poorer pavements (Byrd 1979). After the first 4 years, expenditures for both surface repairs and resurfacing of aggregate and asphalt pavements decreased progressively. DelDOT representatives referred to information they have seen that indicates a savings of $5 or more for each $1 of preventive maintenance.

The Wisconsin Transportation Information Center at the University of Wisconsin-Madison conducted several simulations of pavement management strategies. One of the studies was conducted for a small city with a 68-mile roadway network and demonstrates the benefits of a preventive maintenance strategy. The pavement condition rating is on a scale of 1 to 10, with 10 equal to new pavement and 1 equal to failed pavement. The network initially had $2.4 million of work backlogged and an average condition rating of 5.88. The simulation demonstrated that the most beneficial strategy, which also results in the highest pavement condition rating, is to perform preventive maintenance on those pavements when and where preventive maintenance treatments are appropriate, and then to resurface and reconstruct those pavements where the condition has deteriorated below the point where preventive maintenance is effective (Geoffroy 1996). The least beneficial strategy is to allow a pavement to deteriorate until it needs to be resurfaced or reconstructed.

Preventive maintenance however shows no immediate, glaring improvement or benefit. When budgets are tight a very strong argument has to be made to dedicate large amounts of resources to something that will only show benefits over several years. To experienced maintenance personnel the benefits of preserving facilities to prolong life are obvious, if not exactly quantifiable. DelDOT Highway Operations Staff have promoted preventive maintenance and have dedicated more resources to it in recent years. DelDOT continues to develop information systems to support such decisions, particularly in the area of pavement management where so much of the maintenance costs are dedicated and hopefully in a few years some benefits will be realized in terms of efficiency and prioritizing maintenance activities.

Section 2.4 Estimates of Future Maintenance Costs

A primary task in this project is to estimate maintenance costs over the next 10 years to the year 2010. The goal is to determine as best as possible what resources would be needed to sufficiently maintain transportation facilities at current levels of service/condition, or what would be needed to meet performance goals and measures. What is desired is a first best guess, and to at least identify and approximate costs that need to be considered to get a comprehensive picture. As information systems improve at DelDOT over the next years, future maintenance costs may be easier to determine.

As in the last chapter, a summary of costs will be presented followed by a more detailed look at the sources and methods behind the numbers.

Projecting Current Maintenance Costs

Estimates of future maintenance costs are presented in figures 35 and figure 36. Most of the projections and new cost items were provided by transportation agency representatives. An effort was made to identify any major future new costs. Data from the Highway Maintenance Management System for the years 1994 thru 2000 were examined. Budgets for FY2000, FY2001, and FY2002 were reviewed for any trends. In most cases current numbers were projected using the Producer Price Index of 2.5% to account for rising costs.

The total budget for the Division of Highway Operations budget saw a 7.2% increase between FY2000 and 2001 perhaps largely from the over $2million spent the first year addressing new NPDES regulations. There was a 2.4 increase between FY2001 and FY2002. The Division budget is not expected to increase significantly in the next years. The State Administration is calling for budget cuts as the expected surpluses did not materialize and the war on terrorism is producing great uncertainty in the economy. Material and other costs are still expected to rise however, so the Division budget was projected to grow at 2.5% in the next ten years, amounting to an increase of close to $2 million each year. This projected Division budget total was used as a control total for the program costs within the Division. As usual there is expected to be some shift of funds year to year within the Division to address priorities and make the most of available funding. Next is a discussion of how each category shown in figure 35 was projected.

Figure 35
Summary of current and projected maintenance costs between FY2000 and FY2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
District Costs											
Highway Maintenance Management System	14,810	14,958	15,108	15,259	15,411	15,565	15,721	15,878	16,037	16,197	16,359
Travel Way/Shoulder - Paved, Resurficing (incl. $2m from pave	2,640	2,706	2,774	2,843	2,914	2,987	3,062	3,138	3,217	3,297	3,379
Snow and Ice Incidents	3,907	4,346	4,455	4,566	4,680	4,797	4,917	5,040	5,166	5,295	5,428
Water and Wind Incidents	434	576	590	605	620	636	652	668	685	702	719
Other District Expenditures	9,447	10,552	12,421	12,321	12,629	12,945	13,269	13,600	13,940	14,289	14,646
Total budget for maintenance districts	31,238	33,138	35,347	35,594	36,255	36,931	37,620	38,325	39,045	39,781	40,532
Expressways	5,378	6,810	6,160	6,314	6,472	6,634	6,799	6,969	7,144	7,322	7,505
Construction and Expressway Construction	3,601	3,980	4,061	3,648	3,739	3,833	3,928	4,027	4,127	4,231	4,336
TEAM	8,121	8,871	9,216	9,394	9,629	9,870	10,116	10,369	10,628	10,894	11,167
Field Services											
NPDES Program	205	666	2,495	2,310	2,368	2,427	2,488	2,550	2,614	2,679	2,746
Other Field Services	1,975	2,024	2,075	2,127	2,180	2,235	2,290	2,348	2,406	2,467	2,528
Toll Operations	7,344	8,593	7,362	7,417	7,602	7,792	7,987	8,187	8,392	8,601	8,816
Director's Office	1,490	1,031	1,320	1,330	1,350	1,370	1,391	1,412	1,433	1,454	1,476
Division of Highway Operations Total	**59,354**	**64,313**	**68,037**	**68,136**	**69,595**	**71,091**	**72,621**	**74,186**	**75,789**	**77,429**	**79,106**
Pavement Management Yearly Program											
Road resurfacing	29,858	32,000	36,000	46,000	46,000	46,000	36,900	37,800	38,800	39,700	40,700
Surface Treatment in Kent and Sussex	2,000	2,050	2,101	2,154	2,208	2,263	2,319	2,377	2,437	2,498	2,560
Conversion of surface treatment to hot mix	2,000	2,050	2,101	2,154	2,208	2,263	2,319	2,377	2,437	2,498	2,560
Other State Programs											
Suburban Development Snow Removal	270	516	542	569	597	627	658	691	726	762	800
Suburban Street Aid (mostly capital projects)	20,000	20,000	20,000	20,000	?	?	?	?	?	?	?
Municipal Street Aid Program (mostly capital projects)	6,000	6,000	6,000	6,000	?	?	?	?	?	?	?
Municipalities											
Dover, Newark, Wilmington	11,296	11,578	11,868	12,165	12,469	12,780	13,100	13,427	13,763	14,107	14,460
All other Municipalities ($70 per person in year 2000)	5,696	5,838	5,984	6,134	6,287	6,445	6,606	6,771	6,940	7,114	7,291
New Castle County Light District Costs	2,450	2,573	2,701	2,836	2,978	3,127	3,283	3,447	3,620	3,801	3,991

Projecting District and Expressways Costs

District Maintenance Costs in the Highway Maintenance Management System

About half of the district maintenance costs are tracked in the Highway Maintenance Management System (HMMS) and include those for all district offices, maintenance areas, specialty crews, and float crew costs. As pointed out earlier, the source of the greatest variation is found in weather incident costs and in travel way paving and resurfacing. Within travel way/shoulder repair costs, surface treatment and resurfacing are the largest and most variable cost items and will be projected separately. Future weather incidents and resurfacing costs will also be estimated separately. Removing surface treatment and resurfacing, and weather incidents results in the following totals from the HMMS.

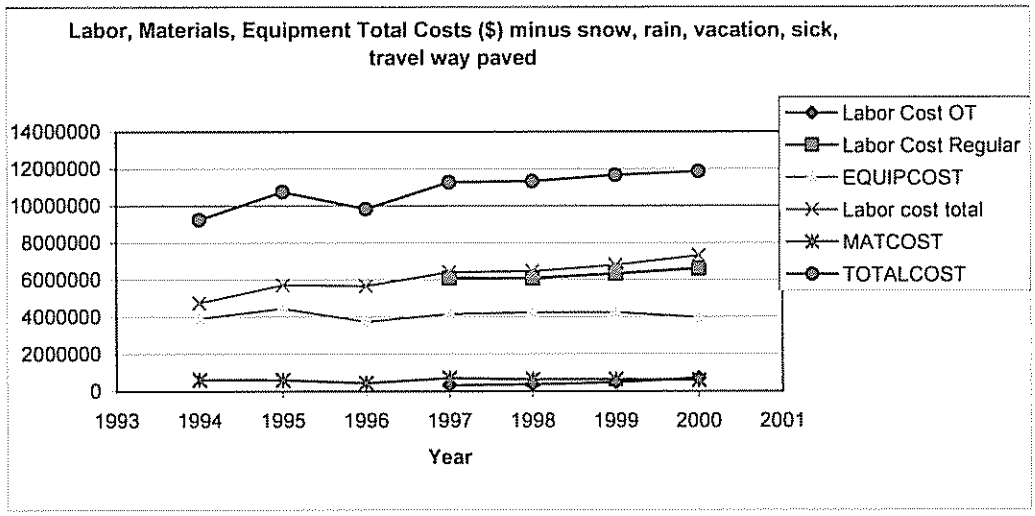
Figure 36
HMMS costs without resurfacing and weather incidents

Year	1997	1998	1999	2000
Cost ($ x 1000)	14,211	14,397	14,434	14,810

Source: DelDOT HMMS

As shown in figure 37 below there is a fairly steady rise each year when some of the more variable costs are removed. The linear trend of these numbers would be about an $180,000 increase each year, which is about a one percent each year, and this portion of the HMMS costs will be projected for future years at one percent a year.

Figure 37



Source: DelDOT HMMS

Paved Travel Way/Shoulder Resurfacing

A large and variable cost tracked in the Highway Maintenance Management System is in the surface treatment/resurfacing category, that would include primarily, resurfacing for tar and chip roads as found predominantly in Kent and Sussex counties. Patching of any type or joint sealing, as well as hard surface (hot mix) resurfacing as included in the yearly pavement management budget, are not included in this category and were part of the costs previously addressed in HHMS data.. Figure 39 below shows this as the most variable and costly item in a chart of paved travel way/shoulder repair costs from the HMMS. Costs for resurfacing are as follows.

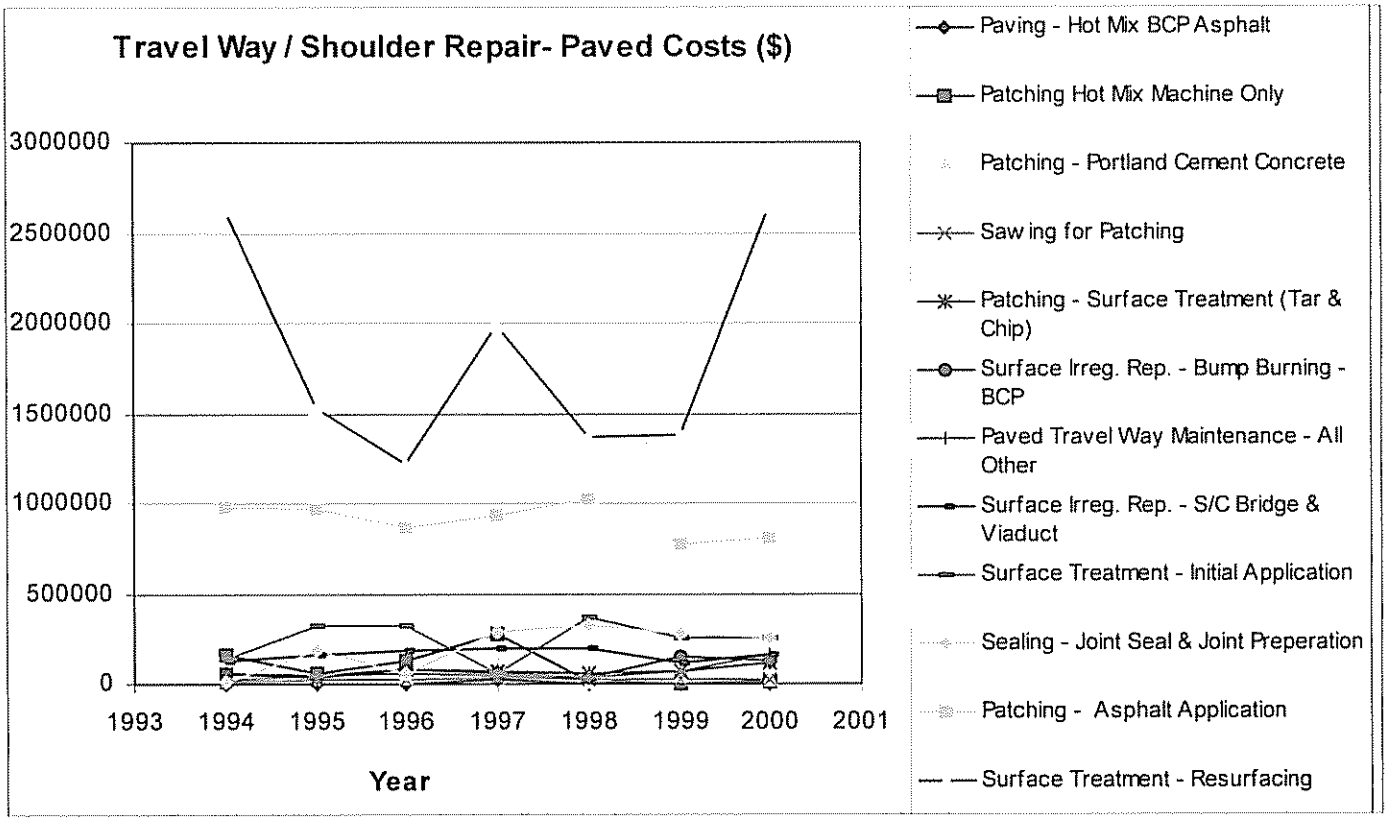
Figure 38
Paved Travel Way/Shoulder Repair Costs

Year	1994	1995	1996	1997	1998	1999	2000
Cost $ (x 1000)	2,637	1,525	1,216	1,989	1,369	1,379	2,640

Source: DelDOT HMMS

In the year 2000, $2 million of resurfacing costs came from the yearly pavement management program, mostly as materials. This $2 million is included in the pavement management budget for the next years. To project this portion of maintenance cost, 2.5% (PPI) will be added each year starting with the $2,640 figure in year 2000

Figure 39



Source: DelDOT HMMS

Snow and Ice Incidents

Costs for Snow and Ice incidents can be large and very variable from year to year. The Highway Maintenance Management System presents the following costs.

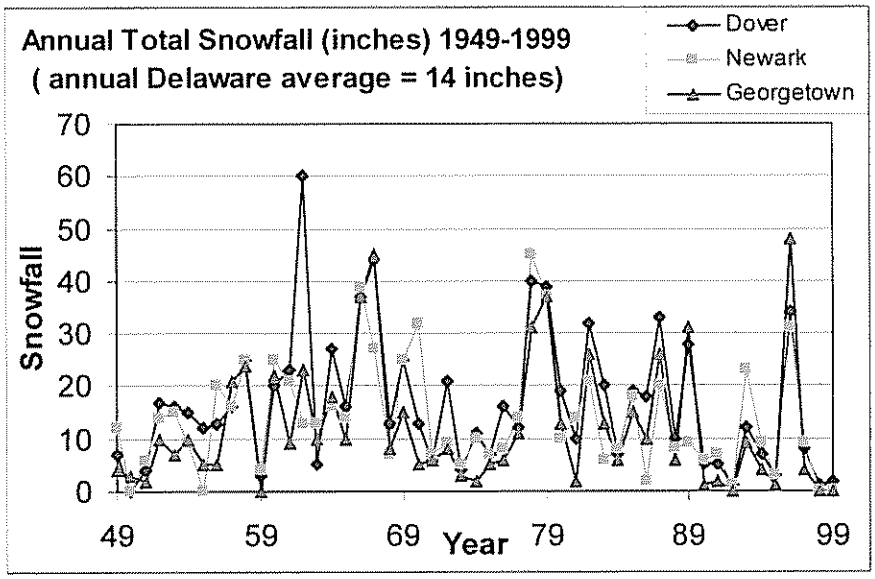
Figure 40
Snow and Ice Incident Costs

Year	1994	1995	1996	1997	1998	1999	2000
Cost $ (x 1000)	3,843	791	6,636	1,785	991	1,821	3,907

The average over the 7 years is about $2,825,000 per year . The last 50 years of snowfall data available from the Delaware State Climatologist were studied. Total annual snowfall during that period is graphed in figure 41. Average annual total snow fall was calculated as 14 inches. In the period between 1994 and 1999 the average annual total snowfall was about 9.2 inches each year, about 66% of the 50 year average The average number of snow incidents of 1 inch or greater is 4.9 incidents per year. The average number of snow incidents of 1 inch or greater from

1994 to 1999 was 3.2 incidents each year, about 65% of the 50 year average. The average cost between 1994 and 2000 was about $2,825,000 and this was considered to be about 65% of the average cost based on the 50 year annual total average and number of incident average. Using the 65% proportion as $2,825,000 the estimated average annual cost for snow and ice incidents was estimated at $4,346,000. This figure will be used for the year 2001 in projections and then grown at 2.5% each year after that.

Figure 41



Source: DelDOT HMMS

DelDOT expenditures for snow removal on suburban roads are out of the DelDOT Suburban Development Snow Removal Program started in 1997. Based on the lane miles and cul de sacs within a suburban development a reimbursement is calculated on the estimated 75% of snow removal costs for each development registered in the program and also the severity of the storm. During FY 1999 it was estimated that total program expenditures would be $135,000 for each 4 to 8 inch incident, $201,000 for a 8 to 12 inch, $277,200 for a 12 to 20 inch, and $412,000 for each over 20 inch storm. These total estimates are based on the lane miles, cul de sacs, and total number of development associations that were registered. About 13% more developments were registered in the FY 2000 program than in FY 1999. As a new program this increase in not just from new development but also due to existing development associations finding out and applying for the program. In 1999, about $271,320 was paid out for two, over 4 inch storms.

This past year (FY2000) so far New Castle County has had one 5 inch snow storm (Feb. 22) and the program estimates that reimbursements will be about $227,000 if all registered associations request reimbursement for snow removal.

Figure 42
Number of snow incidents between year s 1949 and 1999

	Station				
	Newark	Dover	Georgetown	Expected number of annual incidents	
Amount of snow in incident					
0 to under 3"	168	199	188	3.6	
4" to under 8"	51	58	33	2.8	
8" to under 12"	6	13	12	0.6	(once every 1.6 years)
12" to under 20"	4	1	2	0.05	(once every 20 years)
20" or greater	0	2	0	0.01	(once every 100 years)

Source: Delaware State Climatologist

Using current expenditures for storms of each level of severity and the probability of those storms, the program would be expected to cost on average $516,000 each year at current levels. As a new program there are still a number of developments in the counties that have not registered for the program. North District is expected to have a 25% increase in applicants. Currently 443 developments are registered for North District, 15 for Central, and 18 for South District. To project costs out 10 years a 5% growth factor was used, 2.5% for new developments and 2.5% for the year to year cost growth factor.

Water and Rain Incidents

Water and rain incidents can be large and very variable from year to year also. The Highway Maintenance Management System presents costs as follow.

Figure 43
Water and Rain Incident Costs

Year	1994	1995	1996	1997	1998	1999	2000
Cost $ (x 1000)	1,289	114	220	66	1,179	730	434

Source: DelDOT HMMS

The yearly average cost for these seven years is about $576,000. Based on records that record events of 1 inch or more the average total rainfall in the last 50 years is 36 inches per year. Hurricane Floyd was in 1999, recording a 9 inch rainfall. Costs in each year are not strongly correlated with tropical storm occurrence or rainfall. Average rainfall in the years between 1994 and 1999 were 35.5 inches so this is considered to be a typical period and this 6 year average will

be used for the projection with a growth factor of 2.5 for future years.

Expressways

The budget for the Expressways Section was increased 2.5% a year to establish projections of current costs. As discussed below in addressing new costs, an approximately 10% increase in interstate/expressways lane miles is expected between years 2000 and 2010, primarily with the openings of additional sections of Route 1 in 2003.

Other District Expenditures

By looking at the total Division of Highway Operations budget and subtracting budgeted figures for Field Services, TEAM, Administrative, Expressways, and costs included in the Highway Maintenance Management System, there is about 10 to 12 million dollars remaining that primarily includes contracted maintenance that is listed in the budget summary as Other District Expenditures. Understanding these costs would take a substantial effort examining financial records that are referenced by vender rather than activity. These other unaccounted for costs have shown an approximately 10% increase each year for FY2000 to FY2002. The method to project these costs is to continue this trend adding 10% each year.

TEAM Costs

There was a 4.3% increase in the TEAM budget between FY2000 and FY2001, and a 2.2% increase between FY2001 and FY2002. The decision was made to project this portion of the Division of Highway Operations by adding 2.5% each year.. There are a number of new cost items addressed for TEAM discussed later in this chapter.

Pavement Management Program

Projected figures for the Pavement Management were provided by DelDOT representatives. The resurfacing cycle reflects a large increase expected to be needed between FY2003 and FY2005.

Other Categories

Other costs listed in the cost summary in figure 35 generally were projected by adding 2.5% per year. The Suburban Street Aid and Municipal Street Aid programs primarily address capital improvements but fund some maintenance work.

PROJECTING NEW MAINTENANCE COSTS

The previous portion of this section discussed projection of current maintenance costs. The largest new costs are expected to be from growth, new NPDES regulations, and in various projects that will be the responsibility of the DelDOT Traffic Engineering and Management Section (TEAM). Costs associated with population growth and growth in vehicle miles traveled (VMT) were considered. There are a number of concerns relating to upgrades, backlogs in maintenance, and preventive maintenance for signal systems, signs, lights, pavement markings, and structures for which TEAM is responsible. The projections for these new maintenance costs are presented in Figure 44 and this section discusses the various categories and how they were projected.

Population Increase

Significant new development is not expected in municipalities. Urban and high density areas are expected to lose population. Most growth is expected in the lower density suburban or rural areas and the facilities in these areas will be the responsibility of DelDOT. There is a gradual "suburbanization" taking place where no local jurisdiction is responsible for the transportation facilities. Examples of fast growing areas of concern are those next to Delaware Beach towns where traffic volumes, commercial activity, and residential development are increasing and causing more travel problems. As rural areas are steadily transformed into suburban developments, intersections that were once managed with simple yield and stop signs, have increasingly been replaced by signal systems with higher maintenance needs. Costs incurred by increases in population over the next 10 years are difficult to gauge. Effects from the new populations are discussed below.

Population projections by district, maintenance area, County, and State are presented in figure 45. The only difference between district and county groupings are that Area 9, the area in New Castle County below the C&D Canal, is part of the Central District. Area 9 and Area 10 in New Castle County, and Area 3 in Sussex County are expected to see the most growth. Figure 45 includes part-time populations (seasonal) for Sussex County maintenance areas, and for Area 4 and Area 5 that include the beach areas, the seasonal population is over twice as much as the year round population.

Figure 44
Projected New Maintenance Costs

	2003	2004	2005	2006	2007	2008	2009	2010
Costs From new facilities and increased travel (2% of district budget) (Estimated at 2% of Maintenance District costs)	712	725	739	752	766	781	796	811
Costs from new suburban roads (0.5% of District maintenance costs)	178	181	185	188	192	195	199	203
Opening of new sections of Route 1		631	647	663	680	697	714	732
NPDES regulation - Remedies for problems found	1,235	1,266	1,298	1,330	1,363	400	410	420
Increased Staffing in Districts/Equipment Shops	175	175	350	350	525	525	700	700
Backlog in TEAM, maintenance of signals	400	400	400	400				
TEAM Signals								
Aging Traffic Signal Upgrades	200	200	200	200	200			
Signal Device Upgrades			50				50	
Preventive Maintenance	150	150	150					
10% Material Increase		71			77			85
TEAM Signing								
Overdue Budget Increase Needed	200	205	210.1	215.4	220.8	226.3	231.9	237.7
Aging Signs in Sussex Co.	50	50						
Statewide Upgrades for Reflexivity Standards			50	50	50	50		
Highway Overhead Signing Upgrade	12	12.3	12.6	12.9	13.2	13.6	13.9	14.3
10% Material Increase		57			62			
TEAM Markings								
New Product Testing	50		50		50		50	
Permenant Upgrade Line Widths 4" to 6"	130							
10% Material Increase	130			173			189	
TEAM Bulb Replacement Project	60	60	60	60	61	63	65	66
TEAM Structure Maintenance	100	100	100	100	100	102	105	108
ITMS Total Deltrac	207	228	250	276	303	325	350	376
Total of expected new costs	**3,989**	**4,512**	**4,750**	**4,771**	**4,663**	**3,377**	**3,873**	**3,752**

Figure 45

Population Projections for Maintenance Areas

	YEAR					%Change	Pop. change
Maintenance Areas	**2000**	**2005**	**2010**	**2015**	**2020**	**2000to2010**	**2000-2010**
Laurel	25828	27357	29034	30058	31189	12	3206
Seaford	25804	27397	29013	30138	31310	12	3209
Ellendale	31845	34994	38103	40108	42064	20	6258
Gravel Hill	43115	44758	46589	47640	48758	8	3474
Dagsboro	30329	32856	34980	36267	37346	15	4651
Harrington	19928	20737	21605	22571	23611	8	1677
Magnolia	55926	57296	58743	60296	61962	5	2817
Cheswold	50568	52062	53823	55757	57932	6	3255
Middletown	29674	32574	35843	39701	44569	21	6169
Bear	230329	239345	246627	252313	257263	7	16298
Kiamensi	121660	124349	125442	124899	122952	3	3782
Talley	118594	120097	120316	119406	117925	1	1722
North District	470583	483791	492385	496618	498140	5	21802
Central District	156096	162669	170014	176325	188074	9	13918
South District	156921	167362	177719	184211	190667	13	20798
New Castle County	500257	516365	528228	536319	542709	6	27971
Kent County	126422	130095	134171	138624	143505	6	7749
Sussex County	156921	167362	177719	184211	190667	13	20798
Delaware Population	783600	813822	840118	859154	876881	7	56518

Source: Year 2000 figures taken from Year 2000 Census, projections estimated from a 1998 projection produced by CADSR for DelDOT.

Mostly all of new growth is expected in unincorporated areas of rural to low density suburban densities. Transportation facilities in these areas will be DelDOT's responsibility. Most municipalities and areas of high density residential development are not growing or are losing population. Costs incurred from new population growth will be estimated in terms of the additional facilities expected and increased vehicle miles traveled

Vehicle Miles Traveled

The effect of population growth and increased travel demand can be seen as additional volumes on roads. Vehicle miles traveled (VMT) though has been increasing well above population increases. Figure 46 shows historical data on VMT. In the last decade, VMT between the years 1991 and 2000, increased on average by about 2.4% per year . This includes a minus 3% decrease in the year 2000, the first time VMT showed a decrease in the last 20 years. DelDOT Division of Planning representatives suggested a 2.5% increase in VMT per year as a suitable estimate for the next decade. Some estimates of VMT that have been used in the past for VMT projections indicate accelerated increase in the neighborhood of 4.5% per year and above. This

would seem high based on the past decade and it would imply over a 50% increase in miles traveled over ten years.

Figure 46
State of Delaware, Annual Vehicle Miles of Travel (in Millions)
Calendar Years 1970-2000, Source: HPMS 2000

Year	AVMT	% Change
1970	2958	
1971	3202	8.25
1972	3425	6.96
1973	3541	3.39
1974	3475	-1.86
1975	3625	4.32
1976	3850	6.21
1977	4038	4.88
1978	4232	4.80
1979	4093	-3.28
1980	4221	3.13
1981	4459	5.64
1982	4591	2.96
1983	4886	6.43
1984	5123	4/85
1985	5365	4.72
1986	5761	7.38
1987	6087	5.66
1988	6386	4.91
1989	6446	0.94
1990	6549	1.60
1991	6666	1.79
1992	6817	2.27
1993	6894	1.13
1994	7026	1.91
1995	7516	6.98
1996	7645	1.71
1997	7962	4.15
1998	8165	2.55
1999	8543	4.63

With more VMT it would be expected that some costs would increase. More cleaning and repair of the road surface would be necessary. There would be additional vehicular incidents. Adjustment of traffic control devices would be necessary. As traffic increases, additional safety measures may need to be taken while conducting maintenance, and maintenance may need to be scheduled in evening hours so as not to disrupt traffic flow during the day. Increased VMT leads to more surface repair and crack sealing being needed. Pavement life would be decreased with more use, but by how much is difficult to estimate. The life of a pavement can be influenced by

other factors, such as the composition of the pavement, the loads that it is subjected to, and weather conditions. New development for instance produces more VMT in an area, but the greatest damage to roadways could be from the heavy construction equipment. Maintenance costs incurred from additional VMT is difficult to estimate. For future cost projections the effect of additional VMT was accounted for by adding a 1% per year increase of the Division of Highway Operations district costs.

Additional Roads

Growth can also be seen with additional facilities added. Data was available for years 1996 thru 1999 for total lane miles by functional class as shown below in figure 47. By these figures in those 4 years about 107 lane miles of major roadway were added.

Figure 47
State of Delaware Total Lane Miles by Functional Class

	1996	1997	1998	1999	Change 1996 to 1999
Interstate	253	253	253	254	<1
Other Freeways	47	47	47	47	0
Principal Arterial	1250	1261	1271	1318	68
Minor Arterial	685	685	685	705	20
Major Collector	1586	1587	1584	1595	9
Minor Collector	340	340	340	350	10

Source: DelDOT Road Inventory as prepared for HPMS

The DelDOT Travel Demand Forecast Model includes all new major roads that are planned in the future, and the dates roads are expected to go into or out of service. Future estimates from the model shown in figure 48 thru 50 by functional class, show the calculation of the difference in route miles and lane miles over the next 10 years. Loss of roadway indicated by negative figures are due to a reclassification . Completion of Route 1 is the largest new addition. There are actually two separate travel demand forecasting networks comprising the State, one for New Castle and one for Kent and Sussex Counties together as the breakdown indicates. The largest addition is in the functional classification of expressways and other freeways that are handled by the Expressways section of DelDOT Division of Highway Operations and from the figures above this would mean approximately 10% more lane miles that are the responsibility of the Expressways section. About 1% additional lane miles will be added to the major road network. To account for these costs an additional 10% of the Expressways budget will be added to the

budget for a new future cost starting in the year new portions of Route 1 will be in service (2003), and 1% will be added to district costs to address the 1% increase in other major roads and additional facilities that may be added.

Figure 48
DelDOT Travel Demand Forecasting Model Changes in Lane Miles Between Years 2000 and 2010, State of Delaware

	2000	2010	Change	
Interstate/Expressway	435.6	479.7	44.2	10%
Divided Highway	1265.6	1281.0	15.4	
Multi-Lane Undivided	165.7	197.2	31.5	
Major Arterial	246.4	292.7	46.2	
Minor Arterial	2113.7	2064.4	-49.3	
Collector	289.6	287.7	-1.9	
Ramp	39.9	46.2	6.3	
Totals	**4556.4**	**4648.9**	**92.5**	**2%** (1% not including expressways)

Figure 49
DelDOT Travel Demand Forecasting Model Changes in Lane Miles Between Years 2010 and 2000, New Castle County

2000	2010	Change	
Interstate/Expressway	364.8	400.3	35.5
Divided Highway	573.6	586.5	12.8
Multi-Lane Undivided	152.1	152.1	0
Major Arterial	150.6	155.7	5.0
Minor Arterial	621.9	617.7	-4.2
Collector	192.1	191.1	1.0
Ramp	33.6	38.5	4.8
Totals	**2088.9**	**2141.8**	**52.9**

Figure 50
DelDOT Travel Demand Forecasting Model Changes in Lane Miles Between 2010 and 2000, Kent County and Sussex County

	2000	2010	Change
Interstate/Expressway	70.7	79.46	8.76
Divided Highway	691.8	694.5	2.7
Multi-Lane Undivided	13.7	45.2	31.5
Major Arterial	95.78	137.0	41.2
Minor Arterial	1491.8	1446.7	-45.1
Collector	97.4	96.5	-0.9
Ramp	6.25	7.7	1.48
Totals	**2467.5**	**2507.1**	**39.6**

A calculation of additional subdivision roads that might be added was performed based on calculations of households per lane miles for each Planning District in New Castle County and DelDOT Household Projections by Planning District. The goal was to capture the typical density or housing pattern in each planning district and use the resulting average lane mile per household as a figure that could be used together with the projected new households per planning district to calculate an estimate of new lane miles added. In New Castle County, it was estimated that an additional 216 lane miles of suburban road would be added by the year 2010 (a 7% increase from year 2000) in New Castle County. Data for the estimate was insufficient for Kent and Sussex counties. Based on expected population gains, Kent would be expected to be about a quarter (54 lane miles) of New Castle's and Sussex about three quarters (162 lane miles). So additional suburban lane miles statewide over the next 10 years by this estimate would be about 432 miles, about a 5.5% gain statewide over the next ten years.

With new development and roads there are other transportation facilities such as new signs, signals, drainage, and landscaping. Data concerning the costs and growth of other facilities each year are currently not available. An estimate is needed for what costs may be incurred from the additional lane miles added over the next 10 years. To account for increases in maintenance costs from new facilities associated with suburban development for the next ten years, 0.5 percent of district maintenance costs will be added to the maintenance cost estimate each year.

Increased Workloads in TEAM

Cost estimates for new work in TEAM are only rough estimates provided by TEAM staff at the time of this report and new projects and costs are under continual review and consideration.

There are growing signal maintenance backlogs in TEAM for a few reasons, one of which is that staffing is low relative to the amount of facilities to be maintained, and also staff have been used for implementation of new Integrated Transportation Management Systems (ITMS). Estimated future costs for TEAM have been estimated by DelDOT staff to address backlogs, ITMS maintenance, structure maintenance initiative, and the bulb replacement initiative.

Integrated Transportation Management Systems (ITMS)

DelDOT will soon be responsible for maintaining an extensive assortment of ITMS devices, including fiber optic communications and electronic detection equipment, cameras, controllers, etc. This will require extensive outsourcing in addition to internally provided support. The costs of the ITMS effort (DelTRAC) in particular are hard to estimate as the system is all new and still being put in place. There are many types of costs associated with ITMS and there is no established history for maintenance of such a system. DelDOT's traffic technicians must perform signal system repairs and timing changes instantaneously in response to incidents detected through the Department's new ITMS. Heightened level of service expectations and increasing workload demands are likely. Additional training will be needed also in ITMS.

NPDES Regulatory Compliance

Regulations will require increased inspection for NPDES regulated storm water controls and outfalls that are the responsibility of DelDOT. The regulations will also require additional sweeping, vacuuming, and cleaning of debris, and there will be additional restrictions on how debris materials can be disposed of. This program is estimated to cost about an additional $3.9 million per year . This figure is expected to cover new costs and is an estimate that includes inventory and inspection, monitoring, and remediation of any problems found during the process. How much remediation will actually cost is especially hard to predict at this time. The inventory of facilities is a five year program, and is estimated to cost about $1 million each year, so after the five years when all facilities are inventoried and mapped, costs are expected to decrease by about this amount. The projection of NPDES new costs will use a 2.5% growth factor and decrease the total cost after 5 years by $1 million. Sweeping costs will increase with this program some of which is attributable to more restrictions on what can be done with the collected wastes.

Potential New Costs

There are several sources of new costs to consider as discussed below. Cost estimates were not computed for these.

Tar and Chip to Hot Mix Pavement Conversions

Currently DelDOT conducts a yearly program to convert some tar and chip roads and in the year 2000 this was funded at about $2 million and converted about 10 miles of road in Central and South District each. About 70% of roads in Central and Southern Districts are tar and chip which are dramatically less costly to install and maintain even with the surface treatment necessary every 5 years. A tar and chip overlay costs about $10,000 per mile and a 2 inch hot mix overlay costs between $120,000 to $200,000 per mile. One rule of thumb indicates that as traffic volumes become greater (more than 1000 to 2000 AADT), roads warrant conversion from tar and chip to hard road surfaces. By looking at the DelDOT Travel Demand Forecasting Network it was estimated that roughly about 50 miles of roadway could be considered for conversion by 2010. Over the years as more tar and chip roads are converted, there could be increased maintenance funding needed.

Demand for New Services

Another effect of new populations moving to less density areas that has been suggested by DelDOT representatives is an increase in expectations for services. As populations move into an area from higher density areas, there is a tendency for some to request additional service such as increased lighting, grass cutting, drainage, lane striping and other improvements which may or may not be warranted by guidelines that would address the increase of population or traffic volume, or even from a safety perspective. .

Drainage

Drainage work is primarily done in a reactive mode to complaints with no routine or regularly scheduled maintenance for drainage facilities. Problems and complaints at this time do not seem to be increasing and maintenance groups seem to be holding the line for now without new costs.

The NPDES will address the majority of closed drainage issues and the condition and costs will be better know as the program progresses. Recently, code is requiring that closed drainage systems be video inspected as part of the inspection process for new facilities Open drainage as exists more in the Central and Southern districts are expected to require more resources as time goes on. As rural areas become more populated, a higher level of service is desired and open pools of standing water become an issue for residential communities.

Other new transportation facilities

A number of new facilities have been added besides roads including transit facilities, bike routes, sidewalks, and greenways over the last several years as multi-modal travel is encouraged. With each addition comes new maintenance responsibilities.

New Programs and Initiatives

DelDOT has introduced several new maintenance programs and initiatives such as incident management , sediment control, wildflower planting , and improved public safety measures without increase in maintenance resources.

Assuming Responsibilities in Municipalities

DelDOT has considered taking over some of the responsibilities that are now handled by the municipalities. An estimate to take over sign, signal, streetlighting, and pavement marking in the City of Wilmington involved annual costs over $800,000 with initial start up costs of about $700,000. If DelDOT begins to take over maintenance in municipalities, costs could be greatly increased. Presumably other funding methods would be part of new arrangements between DelDOT and the municipalities, and residents of municipalities would probably still fund maintenance in some way.

Increased Off Peak Maintenance and Safety

VMT has tripled since 1970. To insure safety of maintenance staff and commuters many maintenance activities are being performed off rush hour. This could lead to additional overtime costs. There is an increasing need for additional personnel for work zone safety and traffic control support.

Equipment Maintenance

Thirty seven percent of current equipment fleet has exceeded its useful service life. Most of DelDOT's current equipment inventory was purchased between 1979 and 1981and is in need of replacement. An estimate of replacing over age equipment is $19 million. About $7 mill in annual funding is required for equipment replacement, and only 4.5 has been allocated. Maintenance hours per year per piece of equipment have increased 60% between 1993 and 1998.

Assuming maintenance responsibility for private roads

In the past DelDOT has assumed responsibility for private roads in Delaware and in some cases this required costs to bring the roads not initially built to standard specifications up to a higher level of service. There are a number of private roads in Sussex that may be considered.

SECTION 3 – FUNDING

Overview

This section discusses the funding of transportation activities. The section is divided into four parts. First, the sources of maintenance funding in Delaware are presented. Second, for the purpose of comparison, maintenance funding mechanisms in selected other states are discussed. Third, the history of Delaware Transportation Trust Fund revenue is presented. And finally, revenue forecasts are made for Delaware.

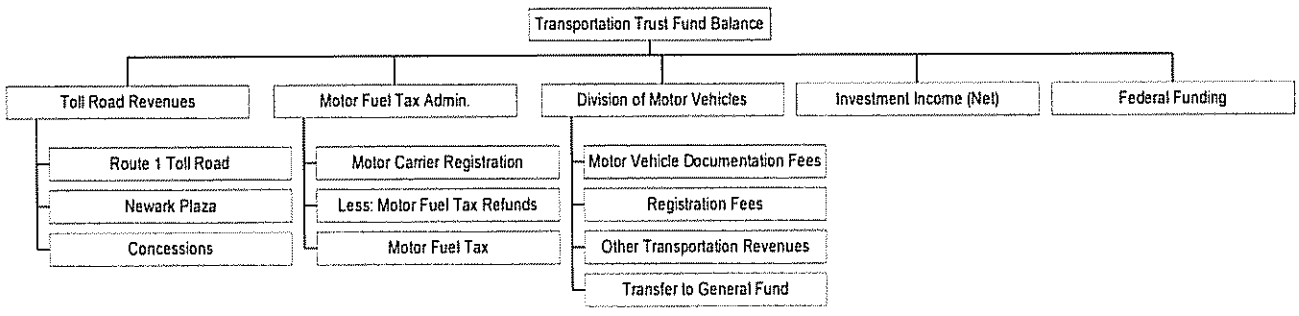
3.1 Sources of Maintenance Funding in Delaware

In 1988, Delaware established the Transportation Trust Fund (TTF) as a dedicated fund to finance the operations of DelDOT. Prior to 1988, DelDOT competed in the budget for annual transfers from the General Fund. The TTF garners funds from transportation related activities in the state, which are then made available to finance the transportation infrastructure of the state.

TTFs are a commonly used mechanism to fund transportation operations. Besides Delaware, Maryland, Missouri, Louisiana, North Carolina, New Jersey, New York, and Virginia all operate some form of trust fund to finance their transportation needs.

While TTFs are operated by a number of states, the sources of revenue that flow into the fund do vary. DelDOT's revenue sources are presented below. Though the operation of a trust fund is intended to preclude support from the state coffers, transfers from the general fund due occur.

Figure 51:
Transportation Trust Fund Revenue Sources

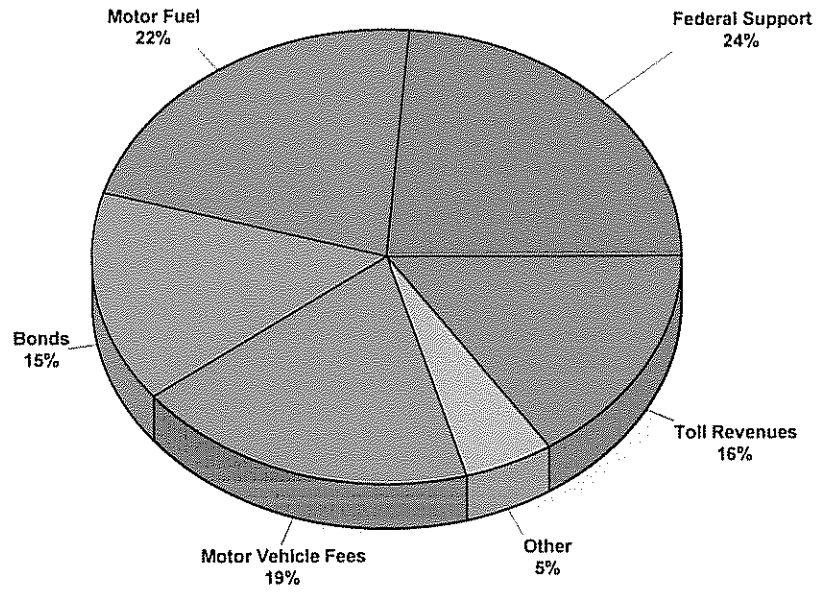


Source: Center for Applied Demography and Survey Research, University of Delaware

Delaware's TTF is primarily funded by four in-state sources: toll road revenues, motor fuel taxes, motor vehicles fees, and bonds.

The relative importance of these sources is presented below.

Figure 52:
Average Contribution to Revenue by Source, 2001-2006



Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT projections years 2001 to 2006

3.2 Maintenance Funding In Neighboring States

State departments of transportation (DOTs) vary in organization, funding mechanisms, scope, and allocation methods. Nevertheless, there exist some common traits between them: all are responsible for the development and maintenance of state highways, all distinguish between state maintained roads and municipality roads, and all are wrestling with rising costs, the growth of which is outstripping the revenue growth. The following pages present an overview of DelDOT in comparison to other states.

Organization

Delaware operates a Department of Transportation, headed by a Governor-appointed Transportation Secretary. While Departments of Transportation are commonplace across the nation (only three states operate Departments of Highway), many states appoint Directors or Commissioners of transportation, and an overwhelming number of states operate a governing board or commission. The membership of these governing boards or commissions are typically organized to ensure that the interests of the different regions of a state are represented, and have explicit guidelines regarding candidacy.

Responsibility

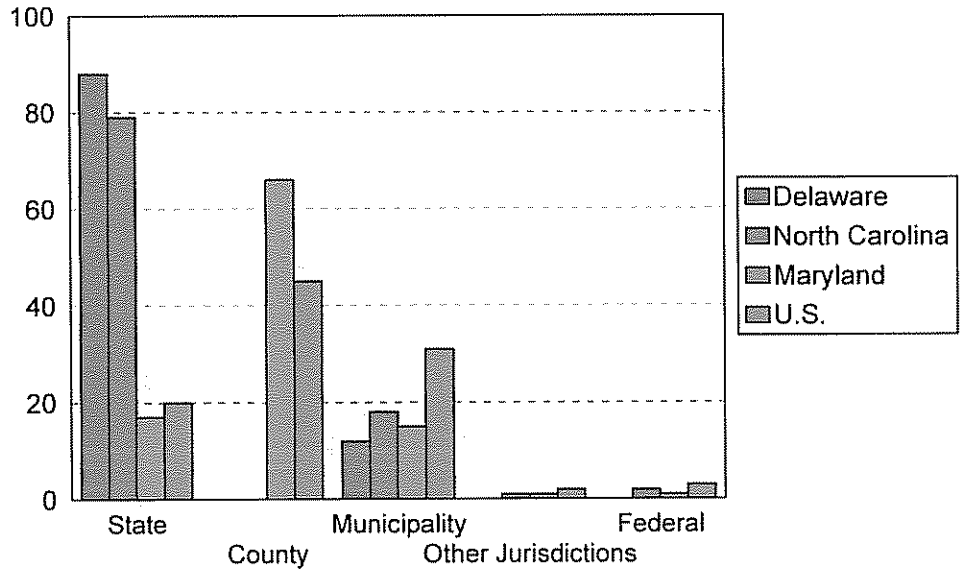
State transportation departments fall into one of two categories: those that operate a county road system, and those that do not. This distinction is an important one as it has direct bearing on the amount of responsibility shouldered by the state departments of transportation.

An overwhelming number of states operate county road systems. Delaware is one of the few states that do not operate such a system. The other states that do not include Connecticut, Maine, New Hampshire, North Carolina, Vermont, and West Virginia. However, this group is in the minority.

To illustrate this, the chart below presents the ownership of roads in Delaware and North Carolina (two states that do not operate a county road system), it also presents Maryland (which does not have a county road system) and the U.S. average.

Nationally, 40% of lane miles are owned by counties, with states owning 20% on average, municipalities 31%, and the Federal Government 3%. Delaware (like other non-county road system states) owns a high proportion of the state's roads. Eighty-eight percent of Delaware's roads are state owned, and while this number can vary among non-county road system states, the proportion is typically close to 80%.

Figure 53:
Ownership of Roads



Note: Maryland and the majority of U.S. states operate county road systems; Delaware and North Carolina do not.
Source: Center for Applied Demography and Survey Research, University of Delaware.

Maryland is a state that operates both a TTF and a county road system. It therefore provides a useful model of how a TTF can operate in conjunction with an alternative road ownership structure.

Maryland

As mentioned earlier, several states operate a transportation trust fund. During the 1970s, Maryland established the first TTF as a dedicated fund to pay for the activities of the Maryland Department of Transportation (MDOT). Legislation related to the TTF states "all department expenditures are made through the TTF and may be used for any lawful purpose related to the exercise of the department's rights, powers, duties, and obligations subject to the appropriation limits approved within the State budget." All activities of the department are supported by the TTF including debt service, maintenance, operations, administration, and capital improvements (new or existing). A portion of the revenues credited to the TTF is shared with local governments and other State agencies. The department's funds are allocated by the Secretary of Transportation and approved by the Governor and the General Assembly. Unspent funds at the close of each fiscal year remain in the TTF and do not revert to Maryland's general fund.

All or part of the following revenues are used to fund the TTF:

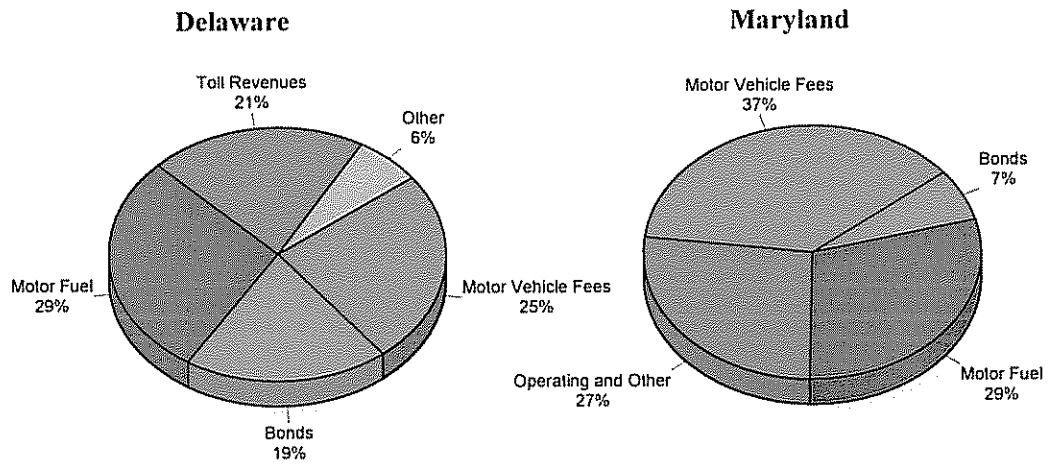
- motor fuel tax revenues
- motor vehicle excise (titling) tax revenues
- motor vehicle registration, license and other fees
- corporate income tax revenues
- bus and rail fares
- fees from the Port Administration and Aviation Administration
- federal funds
- bond proceeds
- other miscellaneous sources

Maryland operates a county road system. As a consequence, Maryland's twenty-three counties plus Baltimore City receive a share of the TTF revenues. Of the revenues, 70% is managed by MDOT, and 30% is distributed amount the counties. Until recently, half of this 30% was directed to Baltimore City, with the remainder being allocated among other cities based on vehicle registrations and lane miles. With growth becoming more dispersed across the state, the allocation now favors the other counties more.

Maryland derives its TTF revenue from four user sources: motor fuel tax, titling tax, registration fees, and corporate income tax. Corporation tax in Maryland is 7%, of this 1.75% flows into the trust fund and the balance remains in the general fund.

The TTF sources for Delaware and Maryland provide a basis for comparing the relative importance of each state's revenue streams. See figure 54 below.

Figure 54:
Transportation Trust Fund Source of Revenue
Comparison of Delaware and Maryland, 1999

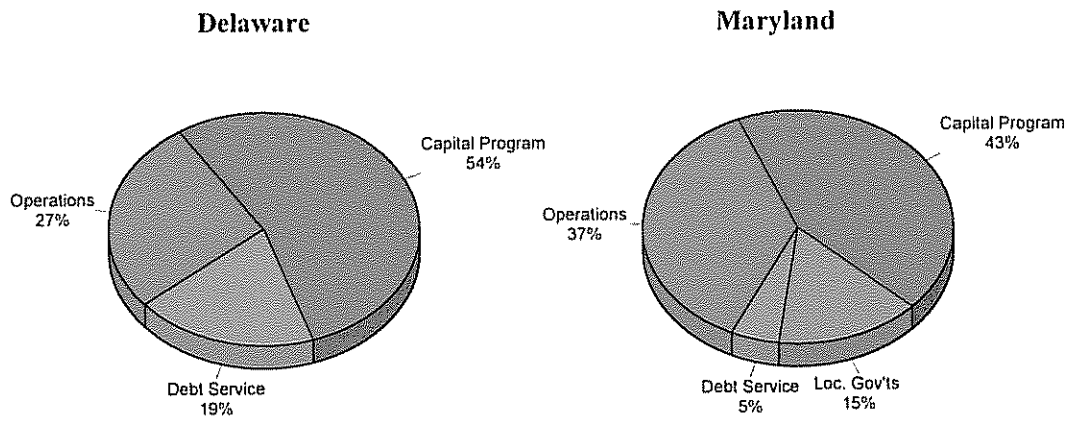


Source: Center for Applied Demography and Survey Research, University of Delaware.

While the composition of revenue sources for the two states is comparable, there are differences in the level of bond issuance and the motor vehicle fees. Delaware is more reliant on bond issuance to support its TTF than Maryland. Delaware garners a lower proportion of its revenue from motor vehicle fees than Maryland.

Greater reliance on bond issuances has consequences for Delaware's expenditures. A larger proportion of expenditures are allocated to interest payments than in Maryland's case. See figure 55 below.

Figure 55:
Average Transportation Trust Fund Uses of Funds
Comparison of Delaware and Maryland



Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT, MDOT. Delaware data relates to 2001-2006. Maryland data relates to 2000-2005.

To summarize, Maryland's operation of a county road system requires that MDOT be responsible for 17% of the state's roads. Sixty-six percent of Maryland's roads fall to the constituent counties to maintain. To permit this, the counties receive 30% of the TTF revenues, which are allocated on a formula basis.

The sources of funding of MDOT and DelDOT are comparable except for the level of debt that DelDOT issues. This greater reliance on debt impacts the use of the TTF revenues. MDOT allocates on 5% of its TTF to debt servicing, allowing for a greater proportion of funds to flow to Operations, its Capital Program, and Local Governments, in comparison with DelDOT.

North Carolina

North Carolina, like Delaware, has no county road system. North Carolina roads can be broken into the following categories:

- Federal Highways
- State Highways
- Municipality Roads
- Secondary Roads.

Originally, secondary roads were old farm roads that would carry approximately 200 cars per day. However, the rate of population growth and sprawl in North Carolina requires upgrading and expansion of these roads to handle volumes of up to 15,000 cars per day.

NCDOT is responsible for all roads except municipality roads and the Federal Highways. The secondary road infrastructure is ineligible for Federal Funds or Trust Funds monies. Therefore, it falls to NCDOT preserve and expand these roads.

The key components of NCDOT's taxes and fees are presented below:

- State gasoline tax: 23.35 cents per gallon
    - 17.5 cents per gallon + 7% average wholesale price + 0.25 cents inspection fee
    - inspection fee is for gasoline quality control functions, tax accounting, and other non-NCDOT functions
    - state gas tax adjusted every six months; above is second half of FY 2000
    - state gas tax includes gasoline, diesel, and all liquid alcohol blends

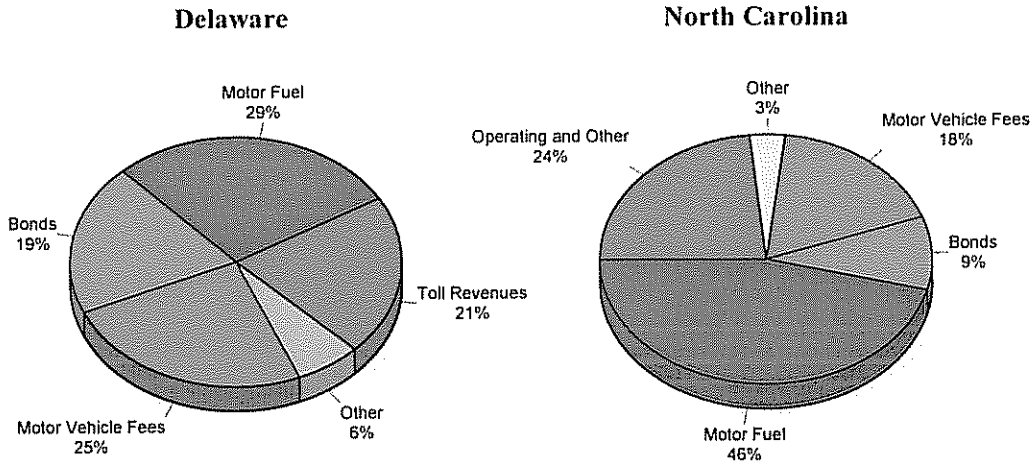
- Highway Use Tax
    - 3% of retail value of a motor vehicle (up to $1,000 for trucks and $1,500 for cars)
    - 3-8% of gross receipts for lease or rental of motor vehicles
    - $1,000-1,500 maximums for same person continuous leases/rentals

- Fees/Other
    - Licenses, Registrations, Inspections, Permits
    - Penalties, Interest

NCDOT operates a Highway Fund and a Highway Trust Fund. Both receive revenue from fees and gas taxes, but only the Highway Trust Fund enjoys revenue from the Highway Use Tax.

The relative importance of NCDOT's revenue sources are presented in figure 56 below.

Figure 56:
Average Transportation Trust Fund Source of Funds
Comparison of Delaware and North Carolina



Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT, MDOT. Delaware data relates to 2001-2006. Maryland data relates to 2000-2001.

In summary, North Carolina generates a greater portion of its revenue from motor fuel taxes. By virtue of its price-linked tax, fuel tax receipts rise with energy prices. NCDOT is also wrestling with growth in the unincorporated areas of the state (termed secondary roads).

3.3 History of Delaware TTF Revenue

Fuel Taxes

One principle source of revenue for Delaware and other states is the fuel tax. Typically, fuel is taxed on a cents-per-gallon basis, in which the revenue generated varies directly with the tax rate and the volume of fuel purchased[1].

Each state sets its own fuel tax, and a summary table of tax rates is included in the appendix. However, fuel taxes alone do not represent the full cost burden on consumers. Some states may have lower rates on fuel, only to impose a heavier burden on their motorists through another means (e.g. documentation fees, or use fees). Nevertheless, it is useful to see how Delaware's fuel tax rate compares to other states. Delaware's fuel tax is 23 cents per gallon sold, the fourteenth highest in the nation. It is the single-largest source of TTF revenue (37% of non-Federal sources).

Nineteen-ninety five was the last year Delaware's fuel tax rate was increased (see figure 57 below). Presently, Delaware's fuel tax approximates that of Pennsylvania and Maryland. However, departments of transportation in the region will seek fuel tax increases in the near future. In the case of Maryland, there has been no rate increase since 1992, and a rate increase may soon be proposed. New Jersey attempted to pass a fuel tax increase recently, but it lacked political backing in an election year, and the proposal was defeated. Another attempt may be made in the near term.

Figure 57:
History of Delaware Fuel Tax Rates

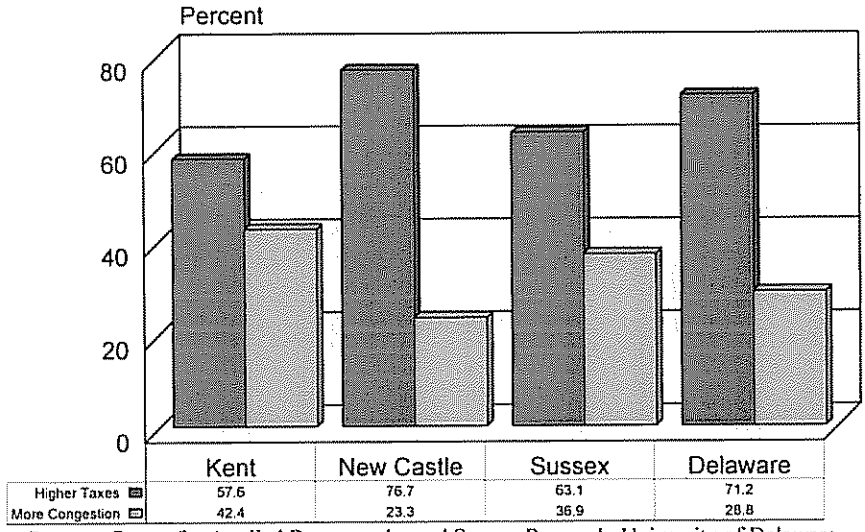
Date	Previous Rate (cents)	New Rate (cents)	Change (cents)
Aug. 1, 1981	9	11	2
Oct. 1, 1986	11	13	2
Sept. 1, 1987	13	16	3
Jan. 1, 1991	16	19	3
Sept. 1, 1993	19	22	3
Jan. 1, 1995	22	23	1

Note: Jan. 1, 1995 also included a 19 to 22 cent increase on special fuels.
Source: Center for Applied Demography and Survey Research, University of Delaware. DelDOT.

[1] Additionally, some states tie the fuel tax to the wholesale price of gas.

Prior research by the Center for Applied Demography and Survey Research (CADSR) at the University of Delaware reveals that given the choice between higher gas taxes or more congestion, higher gas taxes were chosen as the better alternative (see figure 58 below). This result suggests that the public may be more amenable to gas taxes hikes than expected.

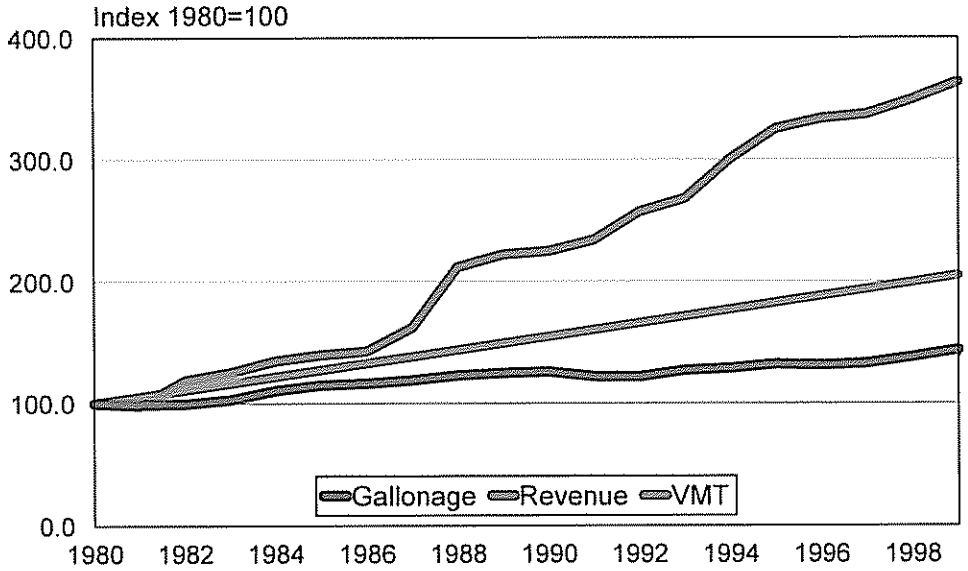
Figure 58
Choose Higher Gas Tax Or More Congestion
By County



Source: Center for Applied Demography and Survey Research, University of Delaware.

Delaware's five fuel tax increases since 1980 have taken the fuel tax in the state from 9 cents per gallon to 23 cents per gallon. Without the tax increases, fuel tax revenue growth would be constrained to the rate of growth of gallonage purchase, which trail VMT growth. See figure 59 below.

Figure 59:
History of Gallonage/Revenue from Motor Fuel Taxes.



Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT.

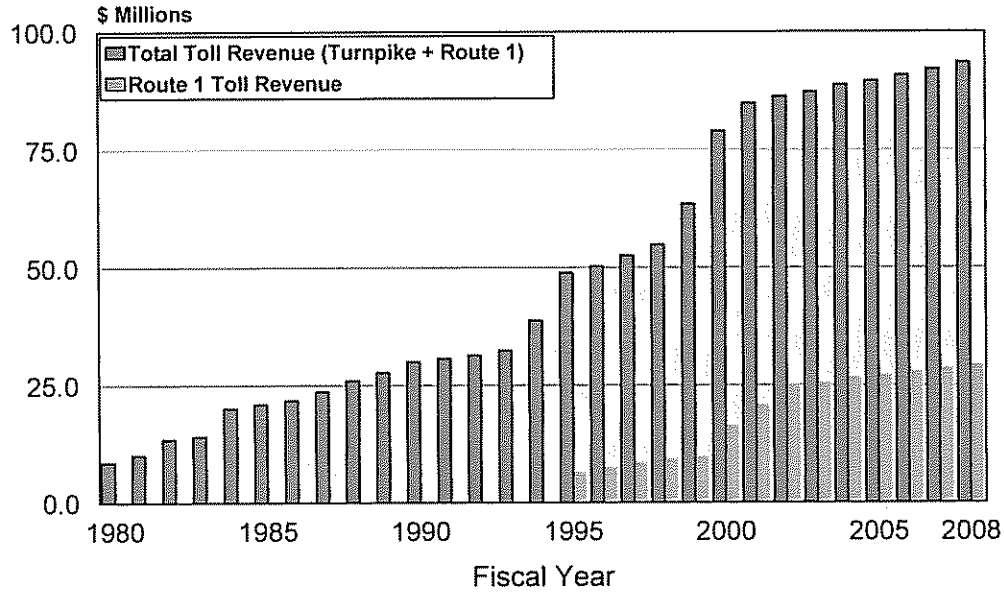
VMT has doubled in over the past twenty years, but gallonage has grown only 50% as automobile fuel efficiency has increased. The five fuel tax increases, which have raised the rates by 14 cents per gallon, have helped keep the TTF afloat. Without such increases, revenue will always grow insufficiently while VMT growth outstrips gallonage growth.

Toll Revenue

The history and forecast of toll revenues is shown in figure 60 below. Tolls are collected at the Delaware Turnpike and, since 1995, along Route 1.

Toll revenue is the fastest growing component of Trust Fund Revenue. During the period 1980-2001, toll revenues have grown at 10.5% annual average. Growth was bolstered during the nineties as the Route 1 tolls came online.

Figure 60:
Toll Revenues
History and Forecast

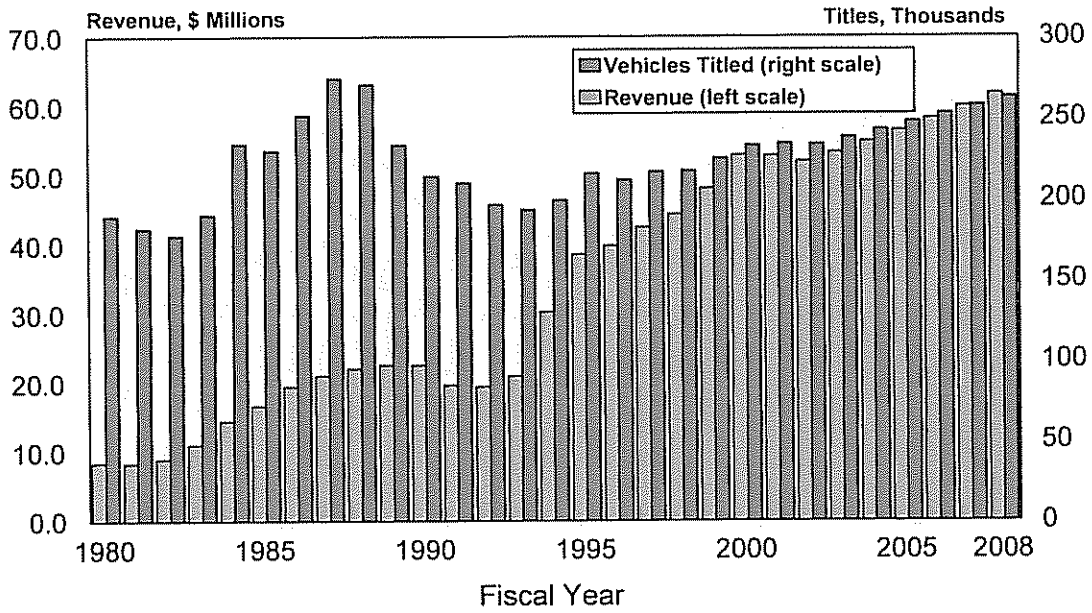


Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT.
Note: 2002-2008 is forecast revenue: DelDOT Bond Review, November 15, 2001.

Documentation Fees

Documentation fee revenue is a function of the number of cars to be titled and their value. The history and forecast of documentation fees is shown in figure 61 below. Documentation fee revenue averaged 7.1% growth per annum between 1980 and 1993, despite no change in the document fee. Revenue fell during the years 1990 to 1992, the recessionary period. The upturn in revenue thereafter reflects the upward trend in titling, but more significantly the 1993 document fee increase.

Figure 61:
Documentation Fees
History and Forecast

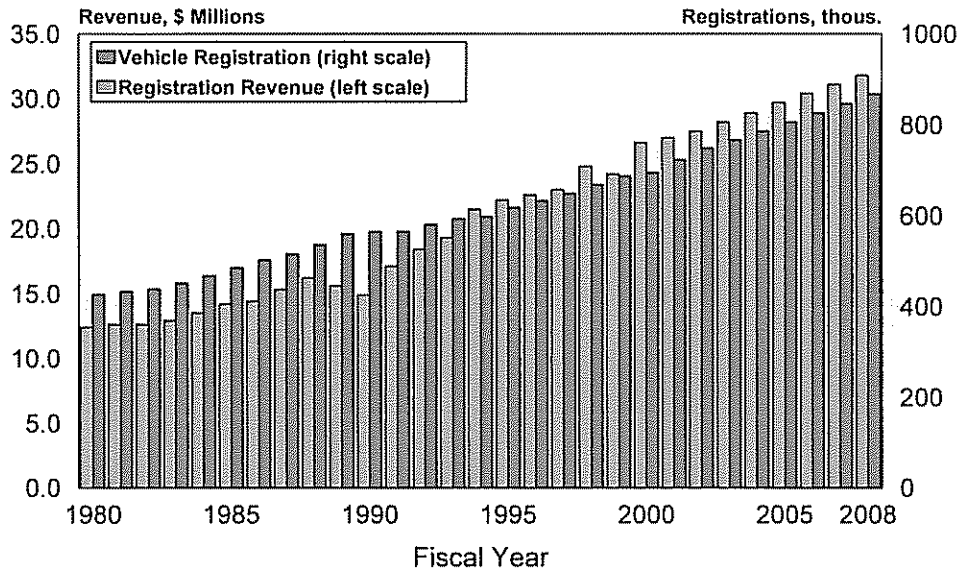


Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT.
Note: 2002-2008 is forecast revenue: DelDOT Bond Review, November 15, 2001.

Vehicle Registration Fees

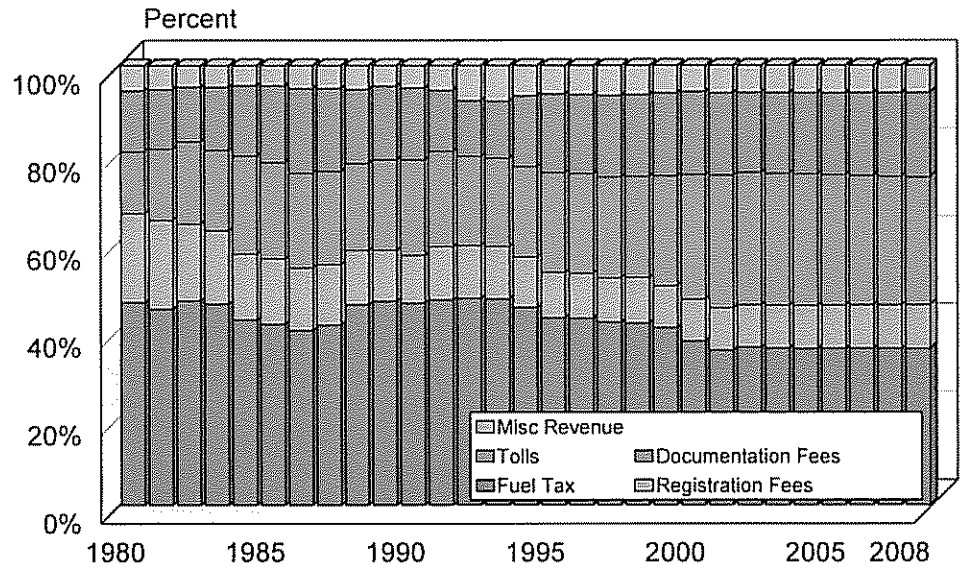
Vehicle registration fees are one of the slower growing components of the Trust Fund revenue. During the eighties, registration fee revenue grew at an average annual rate of only 2% (see figure 62 below). This rate of growth increased during the nineties as registration fees for commercial vehicles increased. The annual percentage change in registration fee revenue during that period is 6%. In 2001, growth slowed to 1.5%, but is expected to average 2.5% between 2003 and 2008.

Figure 62:
Vehicle Registration Fees
History and Forecast



Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT.
Note: 2002-2008 is forecast revenue: DelDOT Bond Review, November 15, 2001.

Figure 63:
Contribution to Transportation Trust Fund Revenue
History and Forecast



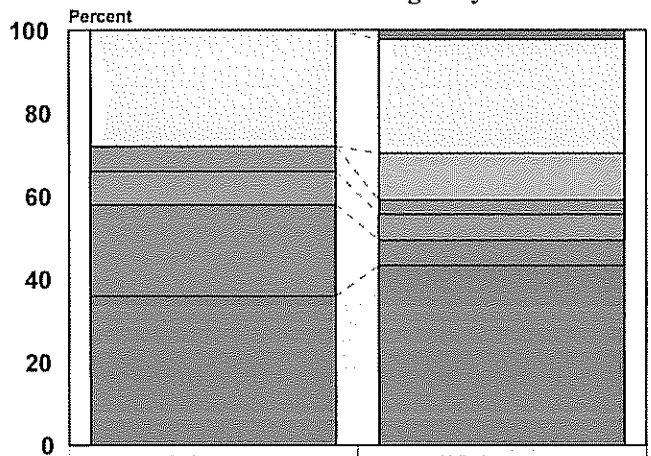
Source: Center for Applied Demography and Survey Research, University of Delaware, DelDOT.
Note: 2002-2008 is forecast revenue: DelDOT Bond Review, November 15, 2001.

As a consequence of the disparate growth rates among the Trust Fund revenue components, their relative contributions are shifting (see figure 63 above). In 1980, fuel tax revenues accounted for almost fifty percent of to revenue. By 2001, this contribution had waned to thirty-five percent. Registration fees' share of total revenues halved from twenty percent to ten percent over the same period. Simultaneously, toll revenue's importance doubled to twenty-nine percent, and documentation fees' share grew to nineteen percent from fourteen percent.

Revenue Sources and Disbursements for State Administered Highways

DelDOT's sources and uses of funds are compared to the national average in figures 64 and 65. The data is derived from the Federal Highway Authority's (FHWA) annual highway statistics publication. DelDOT's Federal funding approximates the national average. Road and crossing tolls constitute a far greater share of revenue for Delaware than nationally. This is reflective of the high volume at the I-95 toll and SR-1 toll road operations. User taxes for DelDOT trail the national average in their contribution to revenues.

Figure 64:
Revenue Sources for State-Administered Highways – 1999.



	Delaware	U.S. Average
Local Governments	0	2.2
Federal Government	28	27.5
Bond Proceeds	0	11.2
Misc	6	3.4
Other Imposts and General Funds	8	6.2
Road and Crossing Tolls	22	6.1
User Tax Revenues	36	43.4

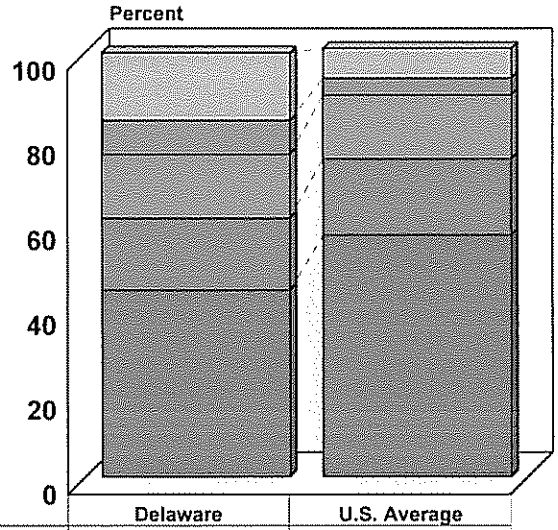
Source: Center for Applied Demography and Survey Research, University of Delaware, FHWA.

DelDOT closely follows the national average in its disbursement of funds. Despite the fact DelDOT owns and is responsible for a far greater proportion state road system than that national average, it does not allocate a greater proportion of funding to the maintenance of these roads. Debt related expenses (bond retirement and interest) are higher than the national average,

reflecting DelDOT's greater reliance on debt. Spending on maintenance and highway services in Delaware matches the U.S. average at 18%.

This result is corroborated by FHWA statistics on disbursements for state administered highways by road mile. During the period 1997-1999, DelDOT spent an average of $18,000 per year per road mile for maintenance and highway services. Delaware ranks twentieth among states for per road mile maintenance and highway expenditure on state administered highways.

Figure 65:
Disbursements for State-Administered Highways– 1997-1999.



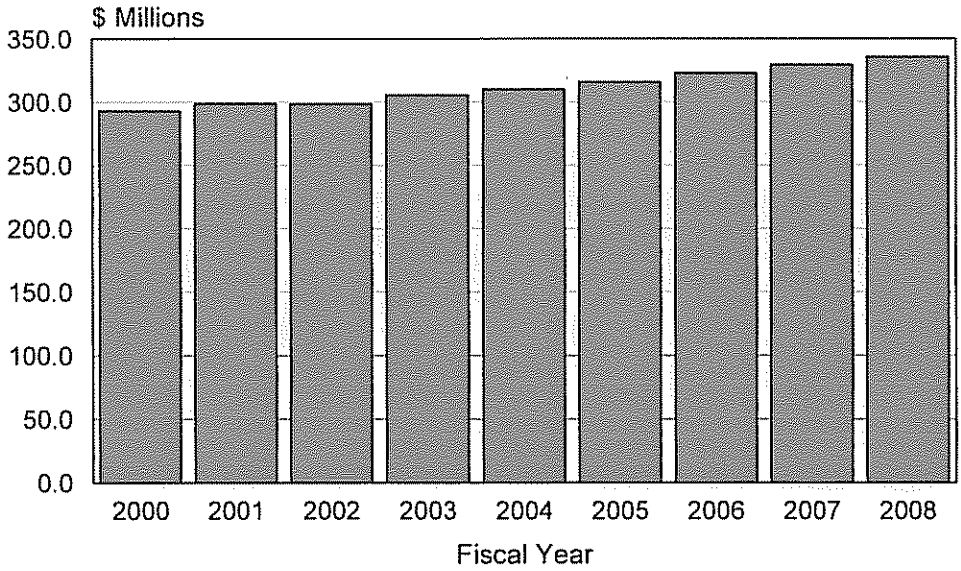
	Delaware	U.S. Average
Bond Retirement	16	7
Interest	8	4
Admin and Hway Policy and Safety	15	15
Maintenance and HWay Services	17	18
Capital Outlay	44	57

Source: Center for Applied Demography and Survey Research, University of Delaware, FHWA.

3.4 Delaware Revenue Forecasts

The Delaware Economic and Financial Advisory Council (DEFAC) produce the official State estimates of TTF revenues. The current projections are presented below.

Figure 66:
Transportation Trust Fund Revenue Projections (excluding Federal Funds)

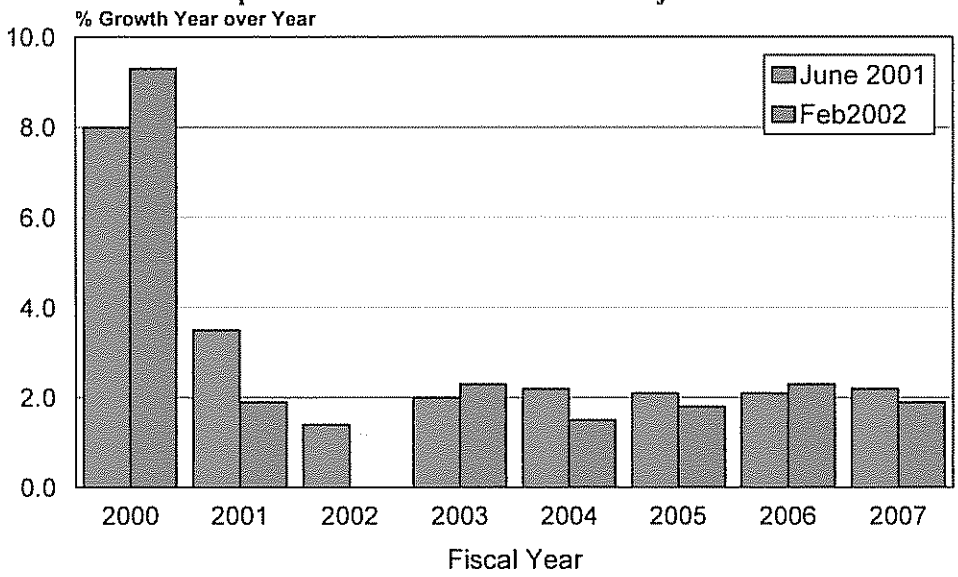


Source: Center for Applied Demography and Survey Research, University of Delaware, DEFAC 2002.

TTF revenue had been growing strongly in recent years due to a robust economy. Robust job and income growth coupled with low unemployment has buoyed the economy, which in turn has yielded strong TTF revenue growth as more motor vehicles are purchased and registered and more trips are taken. However, the economy is cooling from its previous breakneck speed, due to a slowdown in the economy and the war on terrorism, and as it does, the revenue from the gas tax, and documentation fees, and toll revenue are expected to slow.

Figure 67 below highlights the projected growth of the TTF revenue. Expected TTF revenues have been revised downward between the June 2001 and February 2002 estimates, reflecting the slowdown in the economy, which has direct bearing on the revenue generation of the TTF.

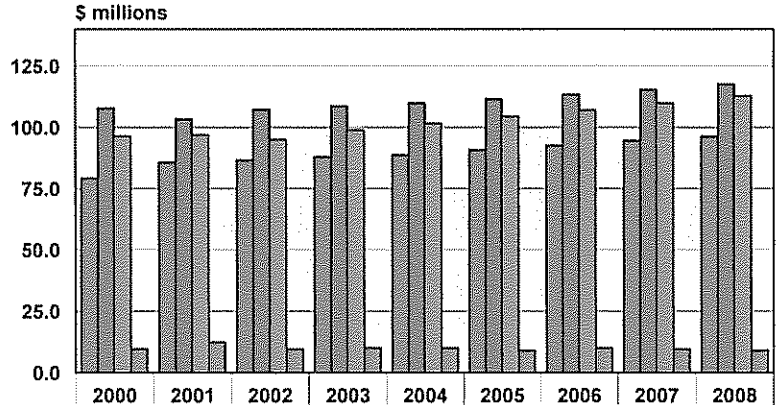
Figure 67:
Transportation Trust Fund Revenue Projections



Source: Center for Applied Demography and Survey Research, University of Delaware, DEFAC.

The revenue projections by major category are presented below.

Figure 68:
Transportation Trust Fund Revenue Projections by Major Category



	2000	2001	2002	2003	2004	2005	2006	2007	2008
Toll Road Revenues	79.2	85.8	86.6	87.9	88.6	90.8	92.6	94.5	96.3
Motor Fuel Tax Admin.	107.8	103.4	107.3	108.6	109.9	111.6	113.4	115.4	117.6
DMV	96.3	96.9	95.0	98.9	101.6	104.4	107.0	109.9	112.8
Investment Income	9.7	12.4	9.5	10.0	10.0	9.0	10.0	9.5	9.0

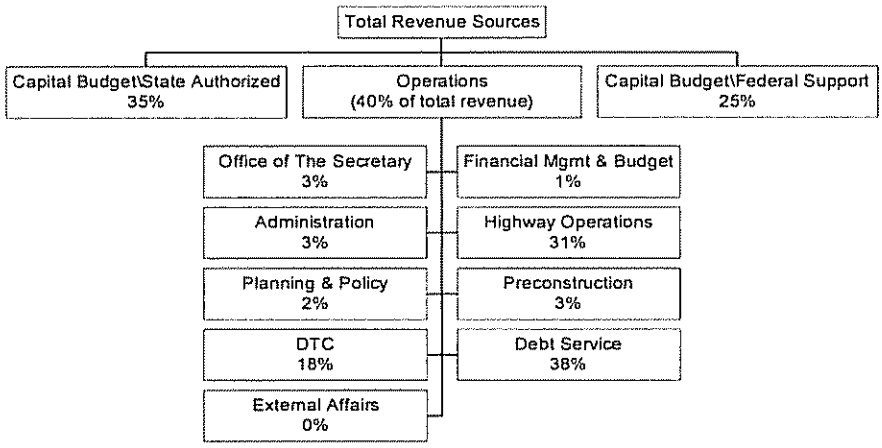
Fiscal Year

Source: Center for Applied Demography and Survey Research, University of Delaware, DEFAC 2002.

The TTF is the primary source of funding for the Operations Division. Operations receives approximately 99% of its funds from the TTF; the balance being Federal funds for the Delaware Transit Corporation (DTC). Therefore, the TTF revenue forecast is central to quantifying predicted Operations revenue. By applying the funds to Operations based on their historic shares, one may form a picture of expected funding based upon observed allocations.

The chart below shows the allocations of total revenue sources. Operations' share of the revenue sources has ranged from 38% to 50% over the past ten years. The most recent proposed budget would see Operations take an increased share of the budget. This is due in part to a large amount of investment in the DTC. Prior budgets have allocated $33m to the DTC, the FY2001 budget is allocating $43m. Of this, debt service accounts for 38%, the largest share, with highway operations taking 31%. An illustration of the 2000 budget uses is presented in Figure 66 below.

Figure 69:
Total Uses of Revenue, 2000



Source: Center for Applied Demography and Survey Research, University of Delaware.

The following tables present a forecast for the TTF, and the expected funding that Operations and its component departments might expect to receive.

Figure 70
Transportation Trust Fund Historical and Forecast Summary by Major Function (In Millions)

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
Trust Fund Sources														
T.T.F. Revenues (Fees and Taxes)	227.8	233	235.4	250.9	271.2	293	298.5	298.4	305.4	310.1	315.8	323	329.3	335.8
General Fund Support	0	0	0	32.5	8.2	11.2								
Federal Support	72.9	92.9	96.9	108.5	122.4	118.9								
Total Sources	**300.7**	**325.9**	**332.3**	**391.9**	**401.8**	**423.1**								
Trust Fund Uses														
Operating Divisions	86.6	90.7	97.8	101.2	105.9	116.9	144.5	153.6	152.7	155.1	157.9	161.5	164.7	167.9
Debt Service	67.1	67.4	67.1	68.7	69.3	69.1	76	81	79	81	82	84	86	87
Capital Budget\State Authorized	75.3	109.3	112	121.9	131.3	158.9								
Capital Budget\Federal Support	58.3	77.4	81.2	94	107.9	115.1								
Total Uses	**287.3**	**344.8**	**358.1**	**385.8**	**414.4**	**460**								
Bonding Required (Uses-Sources)	**13.4**	**18.9**	**25.8**	**-6.1**	**12.6**	**36.9**								
Debt Issued	**70**	**0**	**0**	**70**	**0**	**84**								

Note: Gray cells indicate forecasted values, DEFAC 2002.
Source: Delaware Fiscal Notebook, 2000 Edition, Department of Finance; DelDOT Bond Bill Presentation, May 2001.

Figure 71
Transportation Trust Fund Historical and Forecast Summary Operations (In Millions)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
Trust Fund Sources									
T.T.F. Revenues (Fees and Taxes)	293	298.5	298.4	305.2	309.5	315.6	323.2	329.8	336.3
Trust Fund Uses									
Operations (exc. Debt Service)	116.9	144.5	153.6	152.6	154.8	157.8	161.6	164.9	168.2
Debt Service	69.1	76	81	79	80	82	84	86	87
Total To Operations	**186.0**	**220.5**	**234.6**	**232.0**	**235.2**	**239.9**	**245.6**	**250.6**	**255.6**
Highway Operations (29% of Dept)	59.3	63.6	66.1	67.3	68.2	69.6	71.2	72.7	74.1
Annual Growth Rate		7%	4%	2%	1%	2%	2%	2%	2%

Note: Gray cells indicate forecasted values, DEFAC 2002.
Source: Delaware Fiscal Notebook, 2000 Edition, Department of Finance.

SECTION 4 – FUTURE MAINTENANCE FUNDING

Overview

This section is organized in the following manner: First, the transportation funding squeeze is discussed, second, future costs versus revenues are presented, and third, observations regarding the consequences of the TTF position are made.

4.1 The Transportation Funding Squeeze

The funding squeeze is nationwide: across the country, states are confronted with the rising cost of transportation infrastructure in the face of slow revenue growth.

> "The inability of federal and state governments to spend more on transportation infrastructure is due largely to the inability of the main funding mechanism, the gas tax, to keep up with inflation" (Brown et al. 1998[2]).

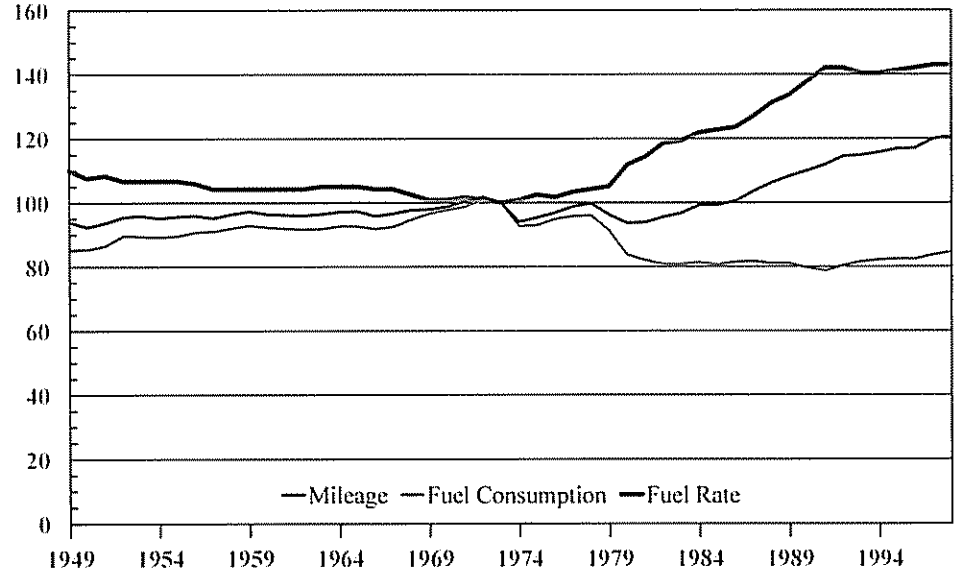
The gas tax has a built-in "sunset clause" associated with inflation and increasing fuel efficiency. That is, without yearly increases, the purchasing power of the monies derived from the gas tax decrease as inflation and vehicular fuel efficiency increase. As Figure 72 below illustrates, the fuel economy (miles per gallon) has risen 43% since 1973. Simultaneously, miles per vehicle rose by only 20% and fuel consumption (gallons per vehicle) fell 16%. Collectively, these three forces caused per-gallon gas tax revenues to grow at an anemic pace.

Additionally, transportation infrastructure costs have risen. This rise is due to the significant increase in the cost of rights-of-way in urban areas and larger numbers of federal and state mandates for transportation planning, such as the requirement for environmental impact review. These costs have occurred without corresponding increases in funding to pay for them; they have greatly expanded costs for providing transportation infrastructure. In sum, the inability of federal and state governments to exact yearly gas tax increases in the construction costs for transportation infrastructure, has resulted in a revenue shortfall (Taylor 1995[3]). It has been increasingly difficult to finance needed transportation improvements with revenue from these funding mechanisms. As

[2] Brown, J. et al. "The Future of California Highway Finance." MA thesis: funded by the California Policy Seminar and the University of California Energy Institute, Berkeley, 1998.
[3] Taylor, Brian. "Public Perceptions, Fiscal Realities, and Freeway Planning: The California Case." *Journal of American Planning Association* 61, no. 1 (1995): 43-56.

a result, voter dissatisfaction with the state and federal governments' ability to find solutions to transportation problems has also increased (Brown et al. 1998).

Figure 72
National Motor Vehicle Mileage, Fuel Consumption, and Fuel Rates
All Motor Vehicles, 1949-1998, Index 1973=100



Note: Mileage is miles per vehicle. Fuel rate is miles per gallon. Fuel consumption is gallons per vehicle. All vehicles is passenger cars, motorcycles, vans, pickup trucks, sport utility vehicles, trucks, and buses.
Source: Center for Applied Demography and Survey Research, University of Delaware

The Devolution of Transportation Funding

As funding from state and national sources has dwindled and demand for relief from traffic and congestion have grown, local governments and transportation agencies are increasingly left to develop their own sources of enhanced revenues. Frequently, the bid to increase available revenues comprises a local ballot measure, enabling the citizens serviced by these governments and agencies to express their preferences for or against increased taxation that would support of an improved transportation system. What determines the success of campaigns in support of such ballot measures?

Statistical and case study research point to the following observations.

- Efforts to fund transportation with taxes are more likely to succeed in areas where the proportion of elderly is greater than 9 percent.

  In communities where the percentage of elderly is greater than 9 percent, analysis indicates that voters may be more willing to accept local transportation taxes. However, in communities where the percentage of elderly is less than 9 percent, transportation measures may require significantly more determined marketing to enhance the probability of passage.

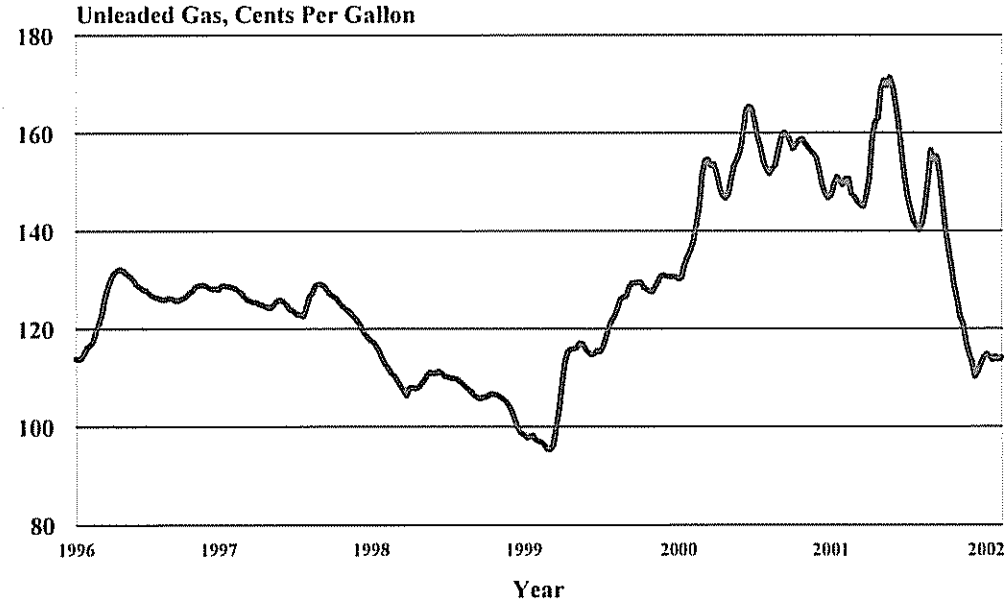
- Efforts to increase sales taxes for transportation programs will be less successful in communities with higher sales taxes.

  A relatively strong and negative relationship between sales tax and support for transportation tax initiatives was identified in the national election data. This suggests that communities with relatively higher sales taxes will be hard pressed to convince citizens to support additional increases. (Haas et al. 2000[4])

Voter resistance to fuel tax increases can be influenced by the current price of gasoline. The nominal (not adjusted for inflation) price of gas has seesawed since reaching its nadir in 1999, see figure 73 below. The movement in energy prices has hinged on the production quotas by OPEC and energy demand on the world markets. Recovering energy demand worldwide and the imposition of production quotas by OPEC drove the price of crude, and subsequently gasoline, upward. The rapid fall in gasoline prices since 2000 can be explained by weakening global demand, which has allowed inventories to recover from their relative lows in 2000. The U.S. economic slowdown, as well as seasonal factors, has also reduced demand for gasoline. Fuel prices are expected to remain relatively steady in the coming months, and the decade-low prices enjoyed in 1999 are not expected to return in the near future.

[4] Haas, Peter J., Massey, Kristen Sullivan, Valenty, Linda O., Werbel, Richard, "Why Campaigns for Local Transportation Funding Initiatives Succeed or Fail: An Analysis of Four Communities and National Data." Norman Y. Mineta International Institute for Surface Transportation Policy Studies.

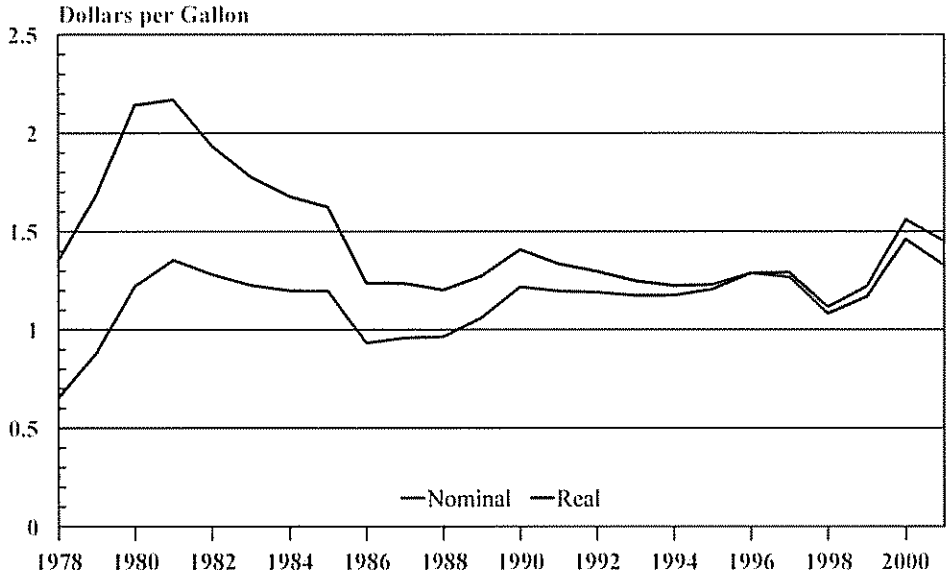
Figure 73
The Price At The Pump



Source: Center for Applied Demography and Survey Research, University of Delaware, Oil Price Information Service

However, the price at the pump masks the reality that fuel prices--adjusted for inflation--have been relatively stable in recent years. Figure 74 below shows that inflation-adjusted prices have fallen significantly from their levels in the early eighties, and have been stable during the nineties. Meanwhile, nominal prices have been largely unchanged over the entire period. The inflation-adjusted price indicates that gasoline relatively cheaper now than twenty years ago. However, public perception tends to overlook this fact, concentrating only on the nominal, price at the pump cost. If it is believed that gasoline prices are too high, the passage of an additional fuel taxes will be more difficult than during a low-gas price environment.

Figure 74
National Retail Motor Gasoline Prices
1978-2001



Note: Real prices in chained 1996 dollars.
Source: Center for Applied Demography and Survey Research, University of Delaware; U.S. Department of Energy.

4.2 Future Costs Versus Estimated Revenues, and Solutions to Funding Needs

Figure 75 below compares maintenance costs estimates for the next years that were estimated in this study with estimates of revenues for the Division of Highway Operations.

Figure 75, Division of Highway Operations Budget Projections, Trust Fund Compared With Estimated Needs For Years 2003 to 2010, In Millions of Dollars

Year	'03	04	05	06	07	08	09	10
Estimated Need								
Present Costs	68.1	69.6	71.1	72.6	74.2	75.8	77.4	79.1
Estimated New Costs	4.1	4.8	4.9	4.7	3.9	3.8	4.2	4.1
Trust Fund Estimate	67.3	68.2	69.6	71.2	72.7	74.1	75.7	77.3
Expected Shortfall	**4.9**	**6.2**	**6.4**	**7.9**	**5.4**	**5.5**	**5.9**	**5.9**

These figures do not take into account potential new costs that have been discussed but not estimated such as from taking over maintenance in the municipalities, or any potential new programs. They also assume that the $2 million from the Pavement Management Program will be available for the Division's tar and chip resurfacing project. A shortfall is estimated to average approximately $6 million each year. Another concern is that cost estimates from the Pavement Management Program include the need for an increase of $10 million that will be needed for resurfacing starting in 2003. The need for additional funding and possible solutions are discussed in the following remainder of this chapter.

Additional Funding and Possible Solutions

Based on the analysis in previous sections of this report, the Transportation Trust Fund will not have sufficient revenues to support required maintenance functions unless other expenditures are curtailed. These estimates suggest a near-term shortfall of nearly $5m rising to almost $8m over the next few years. In addition, the impact of financing the increases in the paving projects beginning next year could add another $1m annually in debt service. If current programs are maintained then the state will have to choose between increasing revenues, shifting costs, or perhaps financing some expenditures over a longer period of time with the attendant increases in cost. There are a number of issues that need to be considered in making this decision.

Funding transportation in Delaware and elsewhere in the United States is a complex business.

That complexity arises from several sources. First, multiple levels of government provide transportation services and infrastructure. In some cases, governments are partners in providing the service. Second, unlike many other governmental services, transportation services involve both capital and operating expenses. In fact, governments often have a choice as to how to classify and finance their expenditures. Obviously there are expenditures that are purely operating in nature and others that are purely capital, but many are in the gray area. Decisions related to funding transportation must consider both factors.

Generally, three guidelines are addressed when considering potential funding sources: (1) revenue adequacy, (2) ease of administration, and (3) tax equity. In other words, the basket of revenue sources in the Transportation Trust Fund should provide sufficient resources to cover existing needs and should grow at a rate commensurate with the growth in the systems. Failing that, additional sources or higher rates of taxation will be required. Second, most of the current sources are not overly costly to the state to collect. Third, the taxpayers are paying relative to their use of the system (fuel taxes and tolls) or are paying based on ability to pay (document fees).

The TTF approach has been adopted by many states. The strategy was intended to meet four needs. First, provide a stable revenue source to cover transportation expenses that did not compete with the rest of the general fund of the state. Second, since the revenues shifted to the TTF were all transportation-related, it restricted those funds to uses from which they were generated. Third, some of the revenue sources, most notably the motor fuel tax, were directly related to utilization of the network. Fourth, the document fee, which is based on the value of the vehicle being purchased, has some relationship to ability to pay since people with higher incomes tend to purchase more expensive vehicles.

In spite of all these positive aspects, the TTF has reached the point where it is no longer providing adequate revenues to meet all of the state's maintenance expenditures. The annual growth rate of just over 2% is barely greater than current inflation and costs for transportation infrastructure are increasing even faster. The problem lies in the composition of the TTF's revenue base. Currently, about 22% of total revenue comes from motor fuel taxes. As was shown earlier, this source has been severely impacted by the increase in fuel efficiency. During the past 20 years miles traveled increased by 200% while gallons used increased by 130%. Only an increase in the tax of $0.14 per gallon has permitted the revenue base to remain stable. During recent years, motor fuel usage has been positively affected by the fact that about 50% of all new vehicles are SUV's or light

trucks, both of which fall outside of the fuel efficiency standards. During this recession, there has been an increased interest in smaller fuel-efficient cars as people become more conservative. It remains to be seen whether this is a trend or an anomaly, which will be reversed as economic conditions improve. In all likelihood, motor fuel tax rates will have to increase if the TTF is to have adequate growth. Currently, the long-term growth rate is 2% annually.[5]

Motor vehicle document fees unlike motor fuel taxes are an ad valorem tax i.e. they are levied on the value of the vehicle. For this reason, the tax has provided an element of growth to the TTF revenue base. Like any sales tax, it is likely to be somewhat volatile since people are able to delay purchases of new vehicles in an economic downturn. Obviously, this has not been a problem during the economic expansion of the last decade. It may exacerbate the current condition of the TTF if the recession is prolonged or there is a somewhat anemic recovery. To the extent that the past trend of purchasing more expensive SUV's abates, the tax may not grow as rapidly as well. The long-term growth rate is currently estimated to be 3% annually.

Motor vehicle registration fees are a smaller but still important source of funding for the TTF. This source of revenue depends on growth in the number of vehicles owned by Delaware residents and upon the vehicles registered here for business reasons such as rental car fleets. The former component will largely be determined by the growth of driving-age persons and the average number of vehicles per household. Both of these factors will probably provide growth of approximately 2% over the next decade. The real problem is the static nature of the registration fee. There is a great deal of reluctance to increase this fee since it affects so many people. However, the value of that fee diminishes each year as costs rise. There needs to be periodic increases in this fee in order to support its share of total revenues if the growth in vehicles falls short. The fee for passenger vehicles has been $20 since 1965. Commercial vehicles fees have increased during the past decade.

The last major source of revenue (excluding bond receipts) in the TTF is tolls. The recent addition of SR1 has boosted this source of revenue considerably, but it brings with it additional debt service, operations, and maintenance costs. The challenge is to make sure that tolls are properly calculated to offset these costs. Currently, toll revenues essentially cover the cost of toll road operations plus annual debt service for all capital improvement projects i.e. toll non-toll

[5] Based on 2001 gallonage of 438.8 million, a 1 cent increase in the fuel tax would yield approximately $4m in additional revenue.

roads. This source is expected to increase at 2% annually based on projected utilization rates. However, the current trend shows debt service rising at nearly 4% annually. As SR1 is completed, additional debt and debt service will impact the TTF. At this point there are no planned increases in tolls, so that debt service will further degrade the funding for operations.

Because of the shortfall in the TTF revenue base to fund priority transportation projects, more than $50m has been transferred from the general fund of the state in FY98 thru FY00. The need for transfers of this type will in all likelihood increase unless there are increases in the motor fuel tax, registration fees, and tolls. The growth rates in these sources are simply insufficient to properly fund the TTF. In fact, based on the analysis of expenditure patterns, maintenance activities are already being constrained to a nearly fixed annual budget. This has the perverse affect of understating the actual need for maintenance funds and understating the revenue needed in the TTF.

The options available for increasing funding in the TTF are available but are not necessarily palatable. Increases in the motor fuel tax and registration fees have the broadest impact on Delaware residents. In addition, the impact is largely regressive since the increases would impact lower income residents disproportionately. On the other hand both have at least some relationship to use of the transportation system. The fact that these sources have fixed rates means they should periodically be adjusted to reflect inflation and to avoid large increases when the need for revenue becomes more acute.

After making inflationary adjustments in the motor fuel tax and registration fees, increases in the document fee are probably more acceptable since the tax is probably proportional to income and has some inherent growth built in as vehicle prices increase.

Toll revenues will need to be increased to ensure that debt service does not encroach on revenues required for highway operations. To the extent that tolls are paid by non-Delaware residents, the impact is exported.

Developing additional revenue sources, such as claiming a piece of the corporation tax (as Maryland does), would ease funding pressure. However, acquiring a share of other tax revenues would probably face considerable challenge in the political arena.

Planned and programmed transfers from the general fund may be an acceptable solution to the

funding shortfall. Transfers have three appealing features: first, the negative impact of increases in the motor fuel tax and registration fees can be avoided. Second, the revenue structure of the general fund is probably proportional in its impact. Third, nearly 46% of the revenues are paid by non-residents or by the federal government through the deductibility of the state personal income tax. The proportion of TTF revenues paid by non-residents is substantially less.

Transfer of responsibilities or costs to municipalities to reduce the pressure on the TTF should be avoided. First, the revenue structures found in most municipalities tends to be one of slow growth and regressivity since revenues are dominated by the property tax. Second, municipal revenues can rarely be exported and are also not related to the transportation system per se. Third, the cost of delivering services at the municipal level may increase costs, reduce productivity, and eliminate any economies of scale.

Finally, the practice of simply not increasing maintenance activity to meet the growing need and/or decreasing the number of capital projects undertaken to a level supportable by current TTF revenue ultimately will increase costs and either degrade safety or reduce the quality of life in Delaware.

Comparison of State Fuel Taxes

	Gasoline			Diesel		
	Excise	Fee/Tax	Total	Excise	Fee/Tax	Total
Alabama	16	2	18	17	2	19
Alaska	8		8	8		8
Arizona	18		18	18		18
Arkansas	19.5	0.2	19.7	20.5	0.2	20.7
California	18		18	18		18
Colorado	22		20.5	20.5		22
Connecticut	32		18	18		31
Delaware	23		23	22		22
Florida	4	9.3	13.3	16.1	9.3	25.4
Georgia	7.5		7.5	7.5		7.5
Hawaii	16		16	16		16
Idaho	25	1	26	25	1	26
Illinois	19	0.3	19.3	21.5		21.5
Indiana	15		15	16		16
Iowa	20		20	22.5		22.5
Kansas	20		20	22		22
Kentucky	15	1.4	16.4	12	1.4	13.4
Louisiana	20		20	20		20
Maine	22		22	23		23
Maryland	23.5		23.5	24.25		24.25
Massachusetts	21		21	21		21
Michigan	19		19	15		15
Minnesota	20		20	20		20
Mississippi	18	0.4	18.4	18	0.4	18.4
Missouri	17	0.05	17.05	17	0.05	17.05
Montana	27		27	27.75		27.75
Nebraska	23.9	0.9	24.8	23.9	0.9	24.8
Nevada	24		24	27		27
New Hampshire	18	0.7	18.7	18	0.7	18.7
New Jersey	10.5		10.5	13.5		13.5
New Mexico	17	1	18	18	1	19
New York	8		8	8		8
North Carolina	22	0.25	22.25	22	0.25	22.25
North Dakota	21		21	21		21
Ohio	22		22	22		22
Oklahoma	16	1	17	13	1	14
Oregon	24		24	24		24
Pennsylvania	12	18.77	30.77	12	18.77	30.77
Rhode Island	28	1	29	28	1	29
South Carolina	16		16	16		16
South Dakota	22		22	22		20
Tennessee	20	1.4	21.4	17	1.4	18.4
Texas	20		20	20		20
Utah	24.5	0.25	24.75	24.5	0.25	24.75
Vermont	19	1	20	16	1	17
Virginia	17.5		16	16		17.5
Washington	23		23	23		23
West Virginia	20.5	4.85	25.35	20.5	4.85	25.35
Wisconsin	25.8		25.8	25.8		25.8
Wyoming	13	1	14	13	1	14
Federal	18.3	0.1	18.4	24.3	0.1	24.4

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