Vermont Agency of Transportation

Final Report

VERMONT'S HIGHWAY SYSTEM POLICY PLAN

June 2004

VERMONT TRANSPORTATION PLANNING

final report

Vermont Highway System Policy Plan

prepared for

Vermont Agency of Transportation

prepared by

Cambridge Systematics, Inc.
100 CambridgePark Drive, Suite 400
Cambridge, Massachusetts 02140

with

Fitzgerald & Halliday, Inc.

June 2004

Table of Contents

List of Tables

List of Tables
(continued)

List of Figures

List of Figures
(continued)

Executive Summary

Highway System Policy Plan Context and Objectives

Vermont's highway system constitutes the most important component of the State's transportation network. Private vehicle travel is the predominant mode of transportation for the vast majority of Vermonters (approximately 98 percent).[1] In addition, trucking is the primary mode of freight transportation in Vermont, accounting for the vast majority of freight moving into, out of, within and through the State.

The Highway System Policy Plan (HSPP) takes a broad look at current and likely future highway system conditions and needs. It provides a high-level, strategic view to guide the Vermont Agency of Transportation (VTrans) in preserving, maintaining and enhancing the highway network over the next 20 years. This strategic view complements the existing processes already in place for identifying and developing specific highway projects.

The HSPP responds to a number of key transportation concerns, including:

- **Aging Infrastructure –** Vermont roads and bridges are at an age where maintenance and rehabilitation requirements are substantial and increasing. Careful planning is required to ensure that appropriate levels of resources are targeted towards infrastructure maintenance and that these resources are used in the most effective manner.

- **Limited Resources for Transportation –** Even in the best economic times, there is never enough funding to address all of the legitimate needs for infrastructure maintenance and improvement. Major projects currently in progress such as the Bennington Bypass, the Mississquoi Bay Bridge, and the Circumferential Highway account for a large share of the highway program. The need to complete these projects must be balanced against other, more dispersed but nevertheless real needs across the State.

- **Increased Emphasis on Highway Operations and Management –** Given the limited resources and the myriad complexities and impacts of adding new highway capacity, transportation agencies across the country have recognized the need to put greater emphasis on improving highway operations and management strategies.

- **Recognition of Transportation/Land Use Relationships –** A coordinated approach to land use and transportation decisions at the corridor level must be pursued and

[1] Vermont Long-Range Transportation Plan, January 2002.

combined with careful highway access management in order to maintain mobility and safety on existing highways while allowing for economic development.

- **Balancing Quality of Life, Mobility, Environmental, and Economic Development Concerns –** The need to achieve a balance between promoting economic well-being, providing convenient travel options for both freight and passengers, and preserving the character and scenic beauty of Vermont has been a central theme of previous planning efforts, and is recognized in the HSPP.

Development of this policy plan was guided by an Advisory Committee with representation from VTrans, the Department of Motor Vehicles, the Chittenden County Metropolitan Planning Organization, the Vermont Association for Planning and Development Agencies (VAPDA), and the Federal Highway Administration (FHWA). It also reflects comments received from members of the Transportation Planning Initiative (TPI), a partnership between VTrans and Vermont's regional planning organizations.

Contents of the Highway System Policy Plan

The HSPP includes the following sections:

- A **Current Profile** of the highway system and the activities it supports.
- **Performance and Investment Framework** identifies highway system subnetworks and land uses for which goals, measures and targets are established covering preservation, safety, mobility, and environment/quality of life.
- **Investment Tradeoff Analysis** to understand likely future highway and bridge preservation needs and estimate system performance based on different investment levels.
- **Policy Guidance** for future highway investments.
- **Implementation Plan** with actions for VTrans to take in order to carry out the policy guidance in the HSPP.

Highway System Profile

System Overview

There are over 14,000 miles of public roads in the State of Vermont. The state highway system (SHS) accounts for less than one-fifth of these miles (2,704 miles), but provides the backbone network serving interregional and interstate passenger and freight travel. Vermont has 703 miles on the designated National Highway System (NHS), including 320

Interstate system miles. There are a total of 2,659 publicly owned long[2] highway bridges in the State, 40 percent of which are on the SHS. However, SHS bridges account for over 70 percent of all of the State's bridge deck area. The SHS also includes another 1,306 short structures (six to 20 feet in length), over 40,000 culverts (six feet or less in diameter), nearly 65,000 signs, 235 traffic signals, roughly 1,000 roadway lights, and over 1,000 miles of guardrails.

System Performance

Pavement Condition – Pavement condition (rutting, cracking and roughness) is surveyed regularly and this information is used to assign a condition rating from 0 (worst) to 100 (best) to each section of pavement. Data collected in 2003 indicates that roughly one-third of the SHS pavement is in "very poor" (0 to 39) or "poor" (40 to 64) condition. The Interstate system is in better shape than the remainder of the system, with only eight percent in poor or very poor condition. Pavement condition ratings are an indicator of road surface smoothness, but do not provide a complete picture of how long pavements will last. There is some uncertainty about the "remaining life" of the pavement network, particularly given the fact that 57 percent of SHS pavement length is classified as "non-engineered" which means that the type and placement of fill underneath the surface is unknown and may not meet engineering specifications or criteria.

Bridge Age and Condition – Almost half (46 percent) of the SHS bridges are between 31 and 50 years old, which is the stage of a bridge's life span when substantial maintenance or rehabilitation is required to preserve its structural integrity. Eight percent of the SHS bridges are over 70 years old, which indicates that they are nearing (or exceeding) the typical bridge life of 75 to 80 years old[3]. About one tenth of the SHS bridges have a bridge sufficiency rating below 50, which means they are eligible for Federal bridge replacement funds. Seventeen percent of Vermont's SHS bridges (188 of 1,075) are classified as structurally deficient, a Federally defined indicator which is based on a poor condition rating for one of their major structural components (deck, superstructure, substructure, culvert). This is slightly higher than the national average of 14 percent.

Traffic – Vermont is a predominantly rural state with low-population density and only one designated urbanized area – Chittenden County. Additional small urban areas and clusters are scattered around the State. While the Interstate system and sections of the NHS carry the heaviest traffic (passenger cars and trucks) in the State, heavy traffic and congestion conditions are also experienced by motorists on urban arterials and connectors primarily during peak hours. Based on responses to surveys conducted for the 1995 and 2002 Long-Range Transportation Plans, the majority of Vermonters surveyed indicated that congestion is not considered to be a major problem and it does not adversely affect their quality of life. Traffic projections for 2020 indicate that congestion will be spreading beyond the Burlington area to other portions of the State including Hartford, Rutland, Bennington, St. Johnsbury and the I-89 corridor north of Burlington.

---

[2] Long structures are defined as those over 20 feet in length.

[3] NCHRP Report 483, "Bridge Life-Cycle Cost Analysis," 2003.

Safety – The Vermont Agency of Transportation is committed to roadway safety and diligently works to monitor crashes to ensure that there are no roadway design flaws that could contribute to hazardous roadway conditions. According to the agency's extensive – but not comprehensive – crash database, there were 3,461 crashes and 76 fatalities in 2000. Analysis conducted on historical crash data indicates that the crash rate has been declining steadily over the past decade, and is significantly lower than the national average (52.8 crashes per 100 million VMT in Vermont versus 232 for the United States as a whole).[4]

Performance and Investment Framework

Vermont's highway network requires continuing investments to maintain its function and continue to serve the transportation needs of residents, employees, industries and visitors. The list of maintenance, operation and improvement needs is large and inevitably, the dollars fall short of the level that is desirable. Investment decisions should be made based on a thorough understanding of the needs and opportunities at different highway system locations, but also with an understanding of the implications of various investment levels on different portions of the system.

This section presents a performance and investment framework for Vermont's highway system under which desired outcomes are defined for the system (such as preservation, safety, mobility and environment/quality of life); performance measures and targets are established for different highway sections and land uses; and an analysis is presented of future highway system conditions (pavements and bridges) under different investment scenarios.

The performance and investment framework includes three key elements:

- Definition of different highway system subnetworks and land uses for which different performance targets or approaches to improving performance may be appropriate.
- Establishment of performance categories and goals, defining the major considerations driving the identification and evaluation of highway investments.
- Development of specific performance measures and targets pertaining to the different subnetworks that address the performance goals.

[4] Vermont Department of Public Safety, Vermont Crash Data Resource Book 2000.

Highway Subnetworks

For system preservation purposes, especially under fiscally constrained conditions, it is desirable to define different sections of the highway system based on functionality and overall level of importance for which different performance standards and investment policies are developed. The HSPP establishes a *Primary* state highway network which includes the National Highway System (NHS) and NHS Intermodal Connectors as well as additional routes included in Vermont's designated Commercial Vehicle Network (see Figure ES.1). This network serves the vast majority of freight and passenger travel in the State, and is of critical importance to the State's economy. Conditions will be tracked for all highway subnetworks to look at future investment options, and to develop policy guidelines for highway management and improvements:

Primary Network

- ***The Interstate Network***– is the most critical portion of the network, constructed to the highest standards. It constitutes one-fifth of the state highway two-lane[5] miles but nearly one-third of the SHS's vehicle miles of travel, and nearly one-half of all of the truck miles of travel. There are 314 Interstate bridges.

- ***The Non-Interstate Primary Network* –** includes the rest of the NHS along with additional routes included in the designated Commercial Vehicle Network. The Non-Interstate Primary network accounts for another third of the vehicle miles of travel, and another 28 percent of the truck travel on state highways. There are 190 bridges on the Non-Interstate Primary network.

Off-Primary Network – includes the remaining portion of the SHS, accounting for 58 percent of the miles, 40 percent of the vehicle miles of travel, and 25 percent of the truck traffic. There are 530 bridges on the Non-Primary network.

Intercity Corridors and Land Uses

Assessing the performance of the highway system with respect to mobility is best done at a corridor level taking into consideration different land use requirements. The HSPP identifies nine North-South and seven East-West corridors and four land use area types (large cities and towns, smaller towns and villages, suburban corridors and rural corridors) for which performance targets and highway policies are established. The selected corridors connect population and employment centers served by the Primary Network (see HSPP report for more details). These corridors will be used as the basis for future detailed corridor planning efforts that examine transportation and land-use issues and strategies.

---

[5] The Pavement Management System analyzes two-lane sections of roadway. Two sides of a divided highway are treated as separate sections. Therefore, the Interstate Pavement Management System mileage is roughly double the number of Interstate centerline miles.

Figure ES.1 Primary Network

Performance Categories and Goals

Based on the Vermont Long-Range Transportation Plan (LRTP), a set of performance goals to guide future highway investment and management were established. These are presented in Table ES.1.

Table ES.1 Performance Categories and Goals

Performance Category	Goals
Preservation	• Protect the existing investment in the highway network by keeping it in serviceable condition. • Provide acceptably smooth and safe driving surfaces. • Minimize the need to restrict or close bridges by maintaining their structural integrity in accordance with current and anticipated loadings. • Negate the risks of structure failure. • Minimize the life-cycle cost of maintaining acceptable condition levels.
Safety	• Minimize the occurrence and severity of crashes on the highway network through application of appropriate, context sensitive design standards and cost-effective improvements to address high-accident or high-risk locations. • Minimize conflicts between vehicles, pedestrians and bicycles.
Mobility	• Maintain safe and efficient flow of traffic at acceptable speeds. • Provide convenient interstate and intercity connections for passengers and freight. • Support economic development consistent with established regional and local growth plans. • Provide convenient connections to intermodal facilities.
Environment/ Quality of Life	• Support and reinforce state policies for compact growth patterns. • Manage undesirable impacts of truck traffic in downtown areas. • Minimize negative environmental impacts of highways. • Maintain existing air quality attainment status.

Performance Measures and Targets

Quantitative performance measures for these goal areas were established, as shown in Table ES.2. These measures are described in detail in the body of the HSPP.

Table ES.2 Vermont Performance Measures and Targets

Performance Category	Performance Measure	Level of Application	Baseline (2002)	Target
Preservation				
Pavements	Average Condition Index of Vehicle Miles Traveled	Interstate Non-Interstate Primary Off-Primary	79 68 62	Maintain existing conditions[1]
	Percent lane miles with "very poor" condition rating	Interstate Non-Interstate Primary Off-Primary	1% 7% 23%	Maintain existing conditions[1]
Structures	Number of restricted bridges (weight limits, height restrictions, one-lane bridges)	Interstate Non-Interstate Primary State-owned Off-Primary	0 2 6	0 Maintain adequate connectivity; keep bridges open or provide detour route
	Number of structurally deficient bridges (>20 feet)	Interstate Non-Interstate Primary State-owned Off-Primary	36 27 116	Maintain existing conditions[1]
	Number of structurally deficient short structures (six to 20 feet)	Interstate Non-Interstate Primary State-owned Off-Primary	48 50 129	Maintain existing conditions[1]
	Average health index (> 20 feet)	Interstate Non-Interstate Primary State-owned Off-Primary	90 88 84	Maintain existing conditions[1]
Safety				
	Number of major crashes per year (fatal, "serious injury," and "moderate injury")	All	1,244 (in 1998)	Five percent reduction from 1998 to 2008 (per Safety Management System)
	Percent of high-priority safety needs addressed (high accident location and high benefit/cost improvement)	All		100 percent within five years of identification
Mobility				
	Average travel time between major cities	Corridors on Primary Network	Varies (see report)	No decline in average travel time from current levels
	Maximum V/C ratio on state highways	Urban area downtowns Rural corridors Other (small towns/ villages, suburban corridors, growth areas)		0.9 0.7 0.8
	Percent of employment within 10 minutes of the Primary Network	All	86% (2000)	Maintain current level
	Percent of Employees Living within 10 minutes of the Primary Network	All	76% (2000)	Maintain current level
Environment/Quality of Life				
	Air quality attainment status	All	No non-attainment areas	Maintain current attainment status

[1] Pavement and bridge preservation targets to "maintain existing conditions" refer to the overall system condition and not to individual projects. These targets should be viewed as "pragmatic" given current fiscal realities.

Investment Analysis

The agency's pavement and bridge management systems were used to obtain an understanding of future investment needs to address the preservation objectives of the HSPP. The analysis looked at how bridge and pavement conditions would vary based on a range of investment levels over a 10-year period. Separate analyses were conducted for the three subnetworks (Interstate, Non-Interstate Primary and Off-Primary). Graphs such as the ones shown in Figures ES.2 and ES.3 were developed for both pavement and bridges on each subnetwork, to provide VTrans information about the effects of different investment levels on the system performance. Based on these graphs, four investment scenarios were assembled, representing a range of possible budget levels.

Figure ES.2 Annual Pavement Investment versus Performance (2002-2011)
Non-Interstate Primary Network

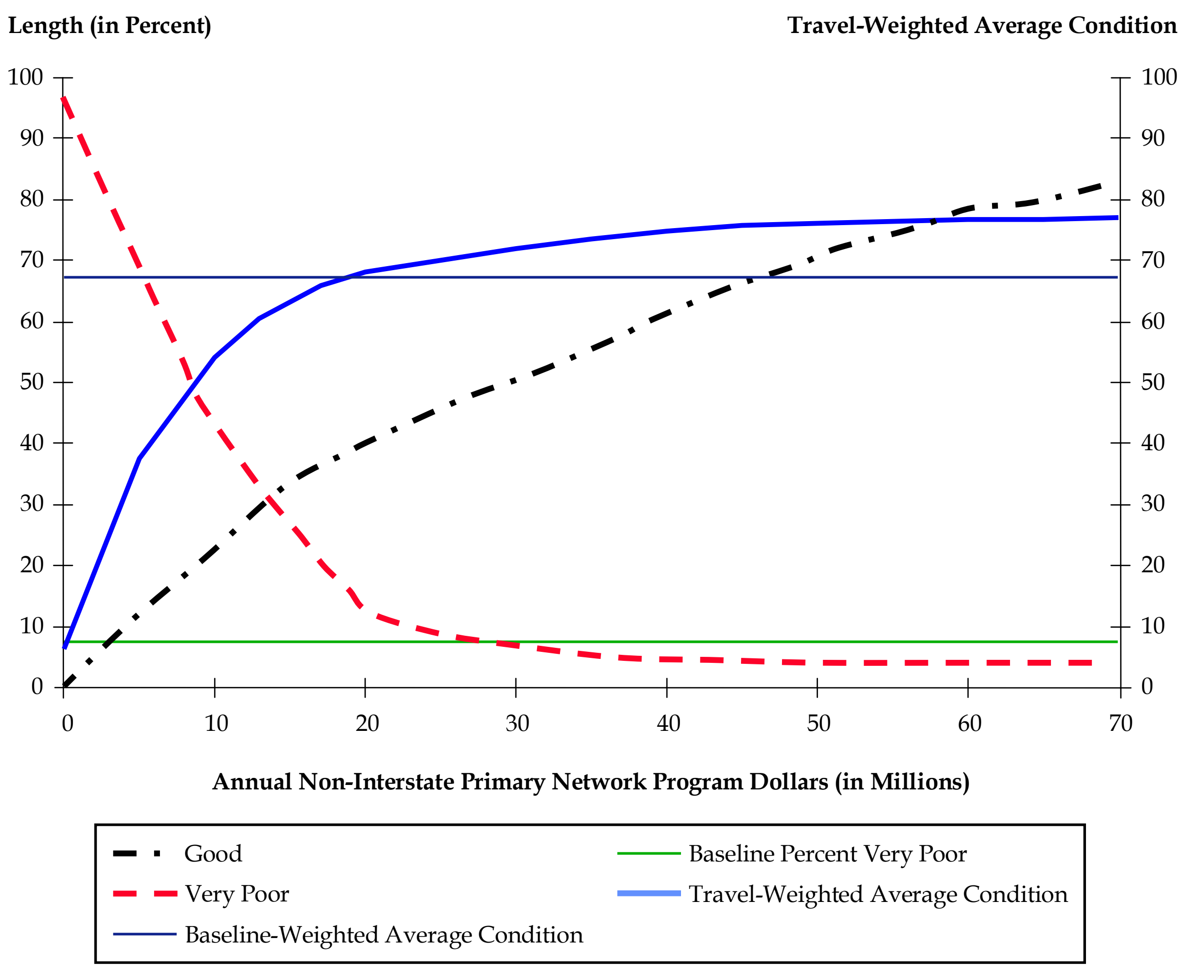
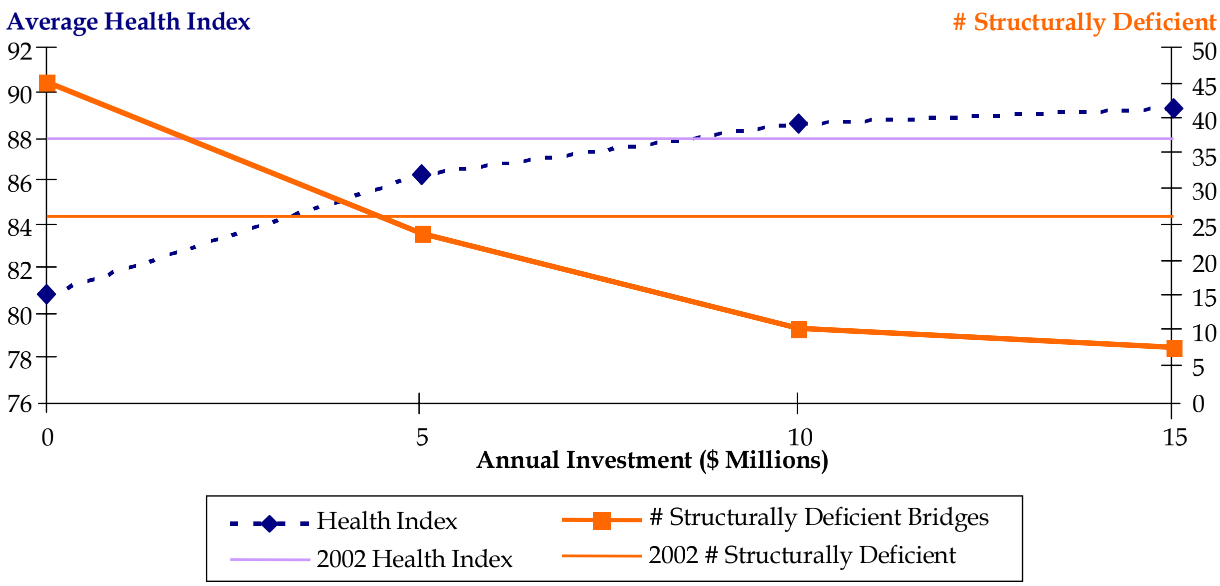


Figure ES.3 Annual Bridge Investment versus Average 10-Year Performance
Non-Interstate Primary Network Bridges



Pavement Investment Scenarios

Four pavement investment scenarios were developed involving different annual investment levels and allocations across the three subnetworks. The first three scenarios ($63 million to $109 million) represent increased funding levels over the historical average; the fourth scenario represents maintaining roughly the same average funding for pavement as over the past five years ($40 million).

- **Scenario 1: High Investment Level –** This scenario would improve pavement condition on all systems. The share of very poor miles would be negligible on the Interstate, five percent on the non Interstate Primary, and 21 percent on the Off-Primary Network. Average travel-weighted conditions would be 81 on the Interstate, and in the 73 to 74 range on the other two systems. This scenario would cost an average of $109 million per year.

- **Scenario 2: Medium Investment Level –** This scenario would allow very slight deterioration of the Intestate system, but still keep this system in very good condition (three percent of the system in very poor condition; average travel weighted condition of 80). It would hold the share of Non-Interstate Primary miles in very poor condition to its current level (seven percent), but would improve the travel-weighted average condition on this network from 68 to 72. It would allow a moderate decline in the condition of Off-Primary system, both with respect to the share of very poor miles (from 23 percent to 30 percent) and with respect to the average travel-weighted condition (from 62 to 69). This scenario would cost an average of $93 million annually.

- **Scenario 3: Low Investment Level –** This scenario is the same for Interstates as the previous scenario. It holds the travel-weighted average condition for the Non-Interstate

Primary network to the existing level of 68, but does allow the share of very poor miles on this network to increase from seven percent to 12 percent. The Off-Primary network experiences significant declines in condition – 55 percent of its length would be in very poor condition, and the average travel weighted condition would decrease from 62 to 56. This scenario would cost an average of $63 million per year.

- **Scenario 4: Current Funding Level –** This scenario is for an investment level roughly equal to the historical level ($40 million annually). It allows significant deterioration on all three systems. The Interstate system would be maintained at the highest condition level; the Off-Primary would be in the worst shape, with 76 percent in very poor condition.

Table ES.3 compares the required annual funding for these scenarios by network level, and their performance outcomes in the year 2011.

Table ES.3 Alternative Pavement Investment Scenarios

Investment Scenario	Network Level	Funding (per year)	Percent Length in "Very Poor" Condition		Travel-Weighted Average Condition	
			Baseline	Projected	Baseline	Projected
1. High Investment Level *$109 million/year*	Interstate	$14 million	1%	0%	79	81
	Non-Interstate Primary	$35 million	7%	5%	68	74
	Off-Primary	$60 million	23%	21%	62	73
2. Medium Investment Level *$93 million/year*	Interstate	$13 million	1%	3%	79	80
	Non-Interstate Primary	$30 million	7%	7%	68	72
	Off-Primary	$50 million	23%	30%	62	69
3. Low Investment Level *$63 million/year*	Interstate	$13 million	1%	3%	79	80
	Non-Interstate Primary	$20 million	7%	12%	68	68
	Off-Primary	$30 million	23%	55%	62	56
4. Current Funding *$40 million/year*	Interstate	$10 million	1%	10%	79	77
	Non-Interstate Primary	$15 million	7%	25%	68	63
	Off-Primary	$15 million	23%	76%	62	40

Bridge Investment Scenarios

Analogous to the pavement scenarios, four bridge investment scenarios were developed involving different annual investment levels and allocations across the three subnetworks. Rather than looking at performance at the end of the 10-year period as was done for the pavement analysis, the bridge analysis results are presented in terms of the average performance over the entire 10-year period. This is because the number of structurally deficient bridges exhibits considerable variation from year to year in the bridge management system so looking at the result for the end of the 10-year period could be misleading.

- **Scenario 1: High Investment Level –** This scenario includes sufficient funds to maintain the 10-year average health index for Interstate bridges at the current level (while reducing the 10-year average number of structurally deficient Interstate bridges down to three percent), and to make moderate improvements in the condition of Primary Network and Off-Primary Network bridges. This scenario would cost an average of $70 million annually.

- **Scenario 2: Medium Investment Level –** Maintaining the 10-year average performance at the current level on all of the three subnetworks. This scenario would cost an average of $59 million annually.

- **Scenario 3: Low Investment Level –** Allow the 10-year average Interstate bridge health index to drop below the current average of 90 to 88 but reduce the 10-year average number of structurally deficient Interstate bridges to 16 (currently 38). Allow the remainder of the bridges on the Primary Network to deteriorate slightly with respect to average health index (decline of one point), while slightly reducing the 10-year average number of structurally deficient bridges. Maintain the current performance level off of the Primary Network, given that the number of structurally deficient bridges on that network is already quite high, and would increase considerably at lower investment levels. This scenario would cost an average of $37 million per year.

- **Scenario 4: Current Funding Level –** This scenario assumes an investment level of $18 million per year, split evenly across the three networks.

Table ES.4 compares the required annual funding for these three scenarios by network level, and their average performance outcomes over the 10-year analysis period.

Table ES.4 Alternative Bridge Investment Scenarios

Investment Scenario	Network Level	Funding (per Year)	Ten-Year Average Health Index	Ten-Year Average Number Structurally Deficient
1. High-Level Investment *$70 million/year*	Interstate	$40 million	90	8 (3%)
	Non-Interstate Primary	$10 million	89	11 (6%)
	Off-Primary	$20 million	89	77 (14%)
2. Medium-Level Investment *$59 million/year*	Interstate	$40 million	90	8 (3%)
	Non-Interstate Primary	$7 million	88	27 (14%)
	Off-Primary	$12 million	84	116 (22%)
3. Low-Level Investment *$37 million/year*	Interstate	$20 million	88	16 (5%)
	Non-Interstate Primary	$5 million	87	24 (13%)
	Off-Primary	$12 million	84	116 (22%)
4. Current Funding Level *$18 million/year*	Interstate	$6 million	85	27 (9%)
	Non-Interstate Primary	$6 million	87	22 (12%)
	Off-Primary	$6 million	83	150 (28%)

Policy Guidance

The HSPP establishes policy guidance for preserving and improving the Vermont SHS. Its intent is to clearly identify the types of strategies to be pursued in order to meet established performance objectives in the most cost-effective manner.

General Policies

Based on the goals and performance targets established in the previous section, six key policy areas have been established for the highway system:

A. Investment Priorities;

B. Keeping Highways Safe;

C. Maintaining Primary Network Continuity;

D. Preserving the Existing System;

E. Improving the System; and

F. Managing Access to Maintain Mobility and Safety.

Policies within each of these areas are presented below.

A. Investment Priorities

Highest priority shall be placed on investments in the highway system that improve safety, preserve its physical integrity, enhance existing operations, and foster economic development.

Under limited funding conditions, investments shall be focused on high-priority safety improvements and on preserving highways and bridges on the Interstate and Non-Interstate Primary Networks.

B. Keeping Highways Safe

The established Safety Management System (SMS) process will be used to identify and implement cost-effective actions for reducing the number of serious crashes and fatalities on the SHS. A wide spectrum of actions shall be considered to address highway and driver-related causes of crashes.

VTrans shall strive to implement all spot safety improvements that address high-accident and high-risk locations in a cost-effective manner, as identified through the State's Highway Safety Improvement Program (HSIP), within a five-year period from their time of identification.

Safety considerations should be an integral part of the project identification processes for pavement, bridge and roadway projects through a well-defined work flow process and shared safety information across the Agency.

C. Maintaining Primary Network Continuity

VTrans will keep all Interstate bridges open and free of load restrictions.

VTrans will keep all other Primary Network bridges either free of load restrictions or provide a convenient detour.

D. Preserving the Existing System

Cost-effective investments in preservation projects will be made to keep the SHS infrastructure in safe, structurally sound condition, with a minimum of cost and discomfort to road users.

Available analysis tools will be used to determine least life-cycle cost preservation strategies to maintain established target conditions. In particular, for non-engineered pavements on the Primary Network, analysis will be conducted to assess whether replacement of the pavement (full-depth reconstruction) would be more cost-effective over the long term than periodic resurfacing treatments.

E. Improving the System

Corridor management plans for primary network highways should be developed in order to build consensus on transportation solutions that reflect different stakeholder interests and involve coordinated actions on the part of multiple agencies and jurisdictions.

The following priorities for improvements are established: 1) Prevent safety and capacity problems from developing through the use of access management and coordinated land use planning; 2) improved traffic operations and/or demand management strategies; 3) minor improvements to improve efficiency and capacity, such as widening shoulders, adding climbing lanes or truck pullouts; 4) major improvements such as new general purpose lanes or re-alignments; and finally 5) new facilities, including new interchanges and new bypasses.

General policy considerations for new facilities and major improvement projects may include the following: 1) the project's scope is appropriate given long-range projections of need; 2) the project is consistent with state, regional and corridor-level transportation and land use plans; 3) strategies are in place for protecting the improved facility's function in the future including intergovernmental agreements that require local jurisdictions to adopt actions supportive of access management in their local plans; 4) funding for the project (and any associated work to be undertaken by local governments) can reasonably be expected to be in place; and 5) the project was developed using established public involvement procedures.

F. Managing Access to Maintain Mobility and Safety

Access to the SHS will be managed according to the principles and approaches identified in the existing VTrans Access Management Guidelines. Ensure that the guidelines are effectively serving their intended purpose, through education and outreach, and if needed, through formal rulemaking.

Action Plan

Implementation of the HSPP will involve a coordinated set of actions across different units of the Vermont Agency of Transportation. Procedures and programs are already in place that are supportive of the majority of policies in the HSPP. However, a number of additional actions are needed to reinforce and strengthen the effectiveness of these policies. These actions are all supportive of the major LRTP objectives, and represent logical next steps for VTrans as it moves towards a more integrated, performance-based approach to managing its transportation assets.

HSPP recommended actions are shown in Table ES.5.

Table ES.5 Highway System Policy Plan Actions

Action (Lead Responsibility)	Description
1. Increase highway preservation funding (Executives/Program Development)	• Seek increases in funding for preservation to allow for both reconstruction of facilities at the end of their life and cost-effective preventive maintenance and rehabilitation actions to prolong the life of facilities throughout their life cycle.
2. Increase Emphasis on Preventive Maintenance (Program Development)	• Prepare a "preventive maintenance" emphasis option for consideration in the budgeting process which allocates an increased share of resources to work to extend the life of facilities that are still in fair to good condition. • Consider establishment of a preventive maintenance funding category within the pavement and bridge areas.
3. Performance-based Planning and Programming Process (Policy and Planning)	• Set performance targets in conjunction with the annual budgeting process based on current actual performance levels and analysis of what can be achieved with available resources. • Periodically conduct customer surveys or focus groups to obtain feedback on highway user sensitivity to different condition levels, and use this information in the target-setting process. • Investigate development of a new performance measure reflecting the remaining life or value of the highway network.
4. Corridor Planning (Policy and Planning)	• Develop corridor management planning guidelines. • Develop corridor management plans to address transportation and land use issues in a coordinated fashion involving key stakeholders. • Select corridors based on current safety, operational and congestion issues; and/or emerging transportation needs associated with likely future growth.

Table ES.5 Highway System Policy Plan Actions (continued)

Action (Lead Responsibility)	Description
5. *Coordinated Approach to Highway Needs and Project Scheduling (Policy and Planning and Program Development)*	• Develop tools and processes to look comprehensively at highway needs within a corridor, including pavement, bridge, safety, pedestrian/bicycle and traffic flow/mobility. • Ensure that project programming and scheduling takes into account coordination of different types of work.
6. *Strengthen and Reinforce Access Management Program (Program Development)*	• Continue current access management practice based on the established Access Management Guidelines. • Continue to monitor compliance with the current access management guidelines, and consider additional formal rulemaking if the guidelines do not appear to be effective. • Educate local officials, the development community, and the public at large about the benefits and importance of access management. • As part of corridor planning activities, develop a list of locations in major rural and suburban corridors, and near Interstate highway interchanges where proactive purchase of access rights would be desirable.
7. *Update Design Standards and Project Development Process Description (Program Development and Policy and Planning)*	• The 1997 Vermont State Design Standards, including the Level of Improvement (LOI) policy, and the Project Development Process Description should be updated over the next two years, and then every five years to ensure that they reflect current practice and continue to serve their intended function.
8. *Periodically Review Functional Classification and Facility Ownership (Program Development)*	• Periodically review the functionality of State Highway System (SHS) roadways, and modify the classifications when changes occur in the nature of use or function of a highway segment. • Pursue intergovernmental transfers as appropriate when a road segment transitions from one of statewide significance to one serving exclusively local traffic (e.g., as in the case of a bypass replacing an old state route) or when local road segment begins to take on statewide significance (e.g., to serve as a detour route for a bridge that is load posted).
9. *Integrate Asset Management Systems (Program Development and Policy and Planning)*	• Continue to improve and integrate individual asset management systems and make use of these systems as an integral part of highway investment decision-making processes.
10. *Enhance Pavement and Bridge Performance Models (Pavement Management, Bridge Management, Policy and Planning)*	• Utilize historical inspection data and bid tab information to improve deterioration and cost models in the pavement and bridge management systems. • Investigate use of HERS/ST.

1.0 Introduction

1.1 Highway System Policy Plan Context and Objectives

The 1995 Vermont Long-Range Transportation Plan (LRTP) and its 2002 update provide a framework for transportation planning, design, construction, operation and maintenance in Vermont, including all modes of travel. The LRTP was developed through an extensive public process that included community visits, outreach forums, a transportation summit, and a public opinion survey. The three major objectives defined in the LRTP and subsequently modified by the agency's Secretary and Executive Staff in early 2003 are to:

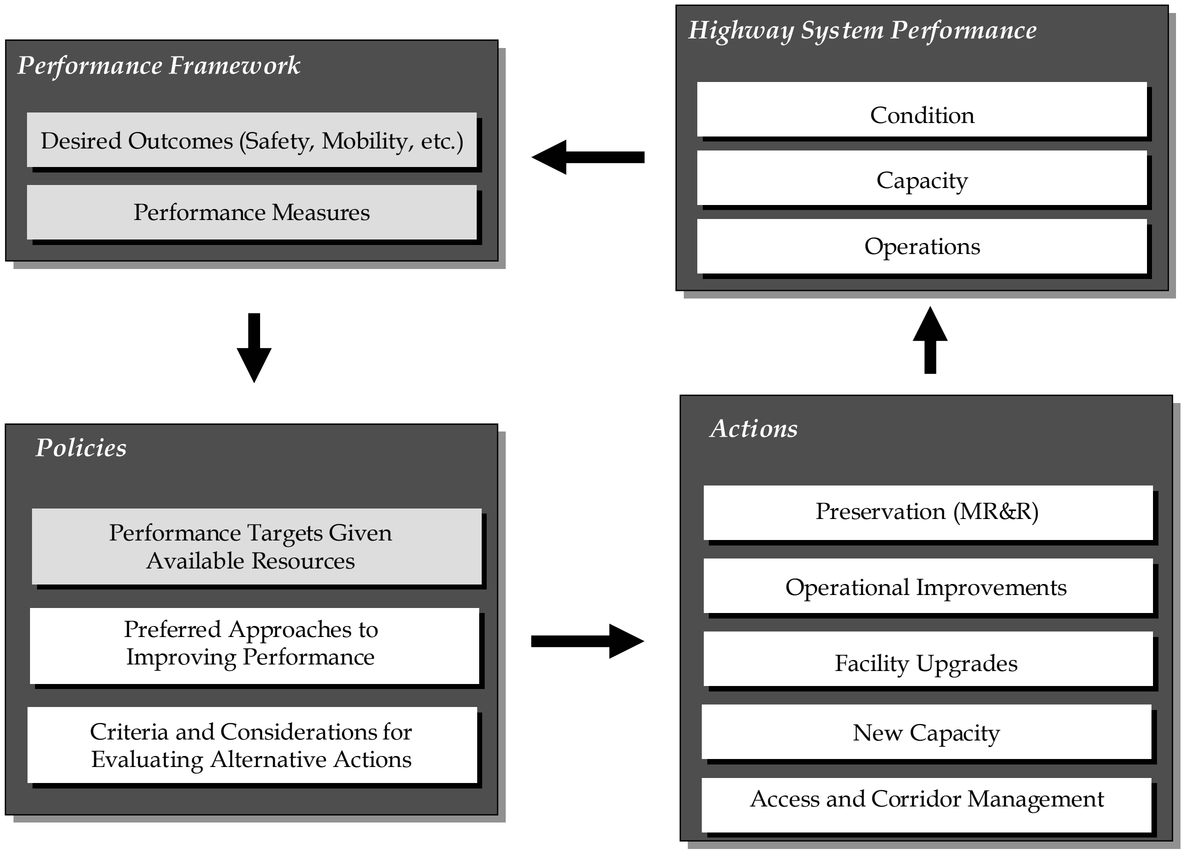
- Manage and improve the State's existing transportation infrastructure to provide capacity, safety, and flexibility in the most effective and efficient manner;
- Develop a seamless, integrated transportation system that incorporates all transportation modes and provides Vermonters with choices; and
- Strengthen the economy, protect and enhance the quality of the natural environment, and improve Vermonters' quality of life.

The LRTP called for the development of modal policy plans to set more specific policies for each mode of travel. All of the modal policy plans are guided by the broad set of transportation system goals, objectives, and strategies that were established in the LRTP.

The Highway System Policy Plan (HSPP) is the last in this series of modal policy plans to be completed. Its purpose is to develop policies and action strategies to guide the Vermont Agency of Transportation (VTrans) in preserving, maintaining, and enhancing Vermont's highway network over the next 20 years.

The HSPP does not recommend specific projects; rather it provides a performance-based framework for highway investment decisions. Figure 1.1 provides an overview of this framework. The plan defines desired outcomes (such as safety, mobility, system preservation, and environmental protection); and performance measures that can be used to track progress towards achieving those outcomes. It presents an analysis of the likely future trends in performance given different investment levels. This analysis provides a model for future resource allocation tradeoffs across different elements of the system.

Figure 1.1 Highway System Policy Plan Overview



The HSPP defines options to be considered to improve highway performance on different system elements, and provides criteria for choosing among alternative actions. These criteria are necessarily at a fairly general level. VTrans recognizes that there are numerous criteria that must be weighed in any specific transportation decision; and that a general policy plan cannot be a substitute for more detailed planning efforts and public involvement activities that take place for specific corridors and projects.

Development of this policy plan was guided by an Advisory Committee with representation from VTrans, the Department of Motor Vehicles, the Chittenden County Metropolitan Planning Organization (CCMPO), the Vermont Association of Planning and Development Agencies (VAPDA), and the Federal Highway Administration (FHWA). It also reflects comments received from members of the Transportation Planning Initiative (TPI), a partnership between VTrans and Vermont's Regional Planning Commissions (RPCs).

1.2 Key Highway Policy Issues

The Vermont Highway System Policy Plan responds to a number of key issues that affect transportation conditions and future needs in Vermont:

- **Aging Infrastructure –** Vermont roads and bridges are at an age where maintenance and rehabilitation requirements are substantial and increasing. Careful planning is required to ensure that appropriate levels of resources are targeted towards infrastructure maintenance and that these resources are used in the most effective manner.

- **Limited Resources for Transportation –** Even in the best economic times, there is never enough funding to address all of the legitimate needs for infrastructure maintenance and improvement. In the current economic climate, transportation resources are increasingly uncertain at all levels of government. In Vermont, there currently are more projects that are ready for construction than can be funded with available resources. In this environment, in which critical transportation projects must compete for increasingly scarce improvement funds, it is important to have a clear framework for assessing proposed projects within the context of established system performance objectives.

- **Project Mix –** Major projects currently in progress – the Bennington Bypass, the Mississquoi Bay Bridge, and the Circumferential Highway in Chittenden County – account for a large share of the highway program. A number of other significant projects are in the pipeline. The need to move forward with these more visible projects must be balanced against other, more dispersed but nevertheless real needs across the State.

- **Increased Emphasis on Highway Operations and Management –** Given the limited resources and the myriad complexities and impacts of adding new highway capacity, transportation agencies across the country have recognized the need to put greater emphasis on highway operations and management strategies. These include a wide variety of traditional and emerging traffic management techniques from roundabouts to incident management programs. In addition to managing existing traffic, a growing number of agencies have implemented strong access management programs to prevent future traffic and safety problems from developing.

- **Recognition of Transportation/Land Use Relationships –** The linkage between transportation investment and land use development has long been recognized in Vermont. A coordinated approach to land use and transportation decisions at the corridor level must be combined with careful highway access management in order to maintain mobility and safety on existing highways while allowing for economic development.

- **Recognizing the Effect of Freight Movements on Vermont's Transportation System –** Like most northern New England states, Vermont is heavily dependent on trucks for its freight shipments, and the transportation network must be designed and managed to accommodate truck traffic. However, trucks operating in Vermont can have significant impacts on pavement and bridge condition, highway congestion, air quality, and overall quality of life. These impacts must be mitigated to the greatest possible extent without impeding the flow of goods that is so vital to Vermont's economy.

- **Balancing Quality of Life, Mobility, Environmental, and Economic Development Concerns –** The need to achieve a balance between promoting economic well-being, providing convenient travel options for both freight and passengers, and preserving the character and scenic beauty of Vermont has been a central theme of previous planning efforts. The 1997 Vermont highway design standards developed by VTrans are an important example of Vermont's commitment to incorporate a diverse set of considerations into highway policy. This policy plan continues the emphasis on achieving a balance among competing objectives.
- **Multimodal, Interconnected Transportation System –** The LRTP policies clearly emphasize a strong multimodal transportation system with solid intermodal connections. Highway investment decisions need to be made with consideration of modal alternatives (existing or potential future) and also with consideration of the role of highway segments in an interconnected multimodal transportation system.

1.3 Policy Plan Overview

The remainder of this plan is divided into four sections, plus three appendices:

- **Section 2.0** provides a current profile of the highway system in Vermont, including its physical characteristics, operational characteristics, and connectivity with other modes.
- **Section 3.0** describes a framework for making future investment decisions. This framework includes a set of system elements (networks, corridors, and land use types), a set of goals and objectives, and a set of performance measures and performance targets for different portions of the system. It also describes the impacts of alternative investment scenarios on bridge and pavement conditions across the state highway network.
- **Section 4.0** provides policy guidance on the selection of different types of highway investments, based on the performance goals established.
- **Section 5.0** includes implementation steps for the recommended policies, including specific actions, responsibilities, and a timeframe for implementation.
- **Appendix A** reviews current highway policies and programs in Vermont. This material provided important baseline information for the development of this policy plan.
- **Appendix B** provides results of different investment scenarios analyzed using the Highway Economic Requirements System (HERS) model. This model supplements the information in Section 3.0, providing insight into the relative impacts of different investment levels on a variety of performance measures, including highway user costs.
- **Appendix C** contains background information on relevant topics, including corridor planning, access management, and acquisition of access rights.
- **Appendix D** contains a glossary of terms used throughout the plan.

2.0 Vermont's Highway System – Current Profile

This section presents information about the Vermont highway system and the activities it serves. Information is organized into three sections. Section 2.1 provides a profile of extent, characteristics, and condition of the system. Section 2.2 presents operational and usage characteristics. Finally, Section 2.3 focuses on activities served by the highway system as well as its connections with other modes.

The information presented here provided a solid baseline for understanding of existing conditions and development of a performance-based policy framework to guide future investment in the highway system.

2.1 Highway System Inventory and Condition

Extent and Classification of the Road Network

The State of Vermont has over 14,000 miles of public roads. Roughly 19 percent or 2,704 miles are on the state-owned highway system; the remainder is owned by cities and towns. Vermont has 703 miles on the designated National Highway System (NHS). The Vermont NHS system includes 320 Interstate system miles.

Vermont's highway system is predominantly rural – only 22 percent of Interstate and 15 percent of NHS miles are classified as urban. Table 2.1 shows a detailed breakdown of the road network by functional classification and roadway type. State and town highways in Vermont are classified by roadway type as follows:

- **State Highways –** These are highways maintained exclusively by the Agency of Transportation.
- **Class 1 Town Highways –** These are town-maintained highways which form the extension of a state highway route and which carry a state highway route number.
- **Class 2 Town Highways –** These are town-maintained highways selected as the most important highways in each town (in addition to Class 1 highways).
- **Class 3 Town Highways –** These are other town-maintained highways negotiable under normal conditions all seasons of the year by a standard manufactured passenger car.

Table 2.1 Vermont's Total Public Road Mileage

Functional Classification	State	Class 1 Town	Class 2 Town	Class 3 Town	Other Roads	Total	Percent
Interstate	320	–	–	–		320	2.2%
Principal Arterial	382	43	10	–		435	3.0%
Minor Arterial	770	54	60	–		884	6.2%
Major Collector	1,145	38	827	–		2,010	14.1%
Urban Collector	5	–	116	90		211	1.5%
Minor Collector/Local	10	–	1,697	8,402		10,109	70.7%
Military Reservation	-	-	-	-	24	24	0.2%
State Forest Highway	-	-	-	-	212	212	1.5%
National Forest Dev.	-	-	-	-	86	86	0.6%
Totals	**2,632**	**135**	**2,710**	**8,492**	**322**	**14,291**	**100%**
Percent	18.4%	0.9%	19.0%	59.4%	2.3%	100%	

Source: VTrans Program Development Division, January 1, 2002.

Pavement Characteristics and Condition

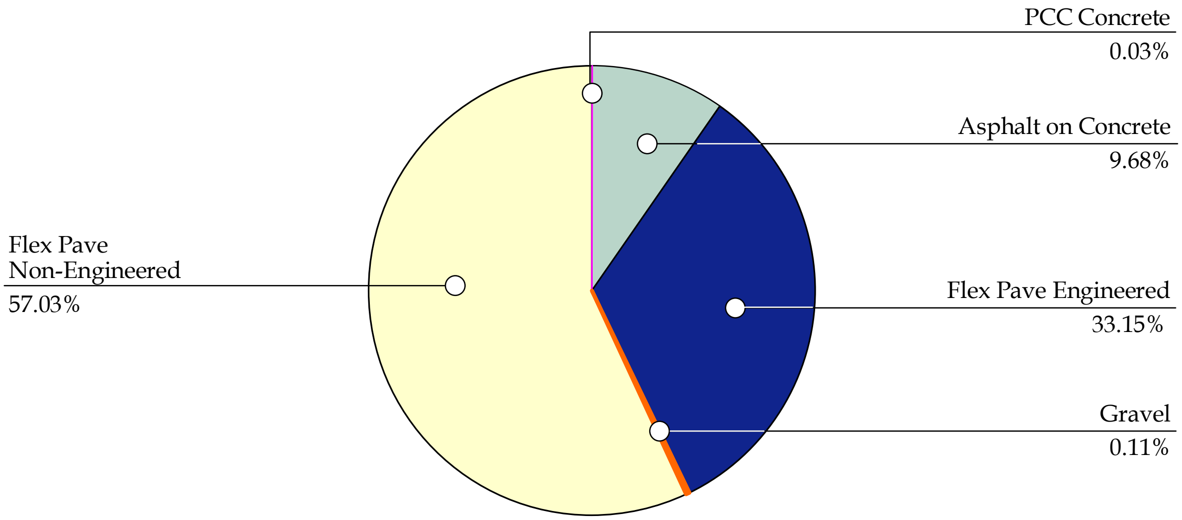
Pavement Type

Figure 2.1 shows the types of pavements on state and Class 1 town highways. Flexible (asphalt) pavement is the predominant type, accounting for 90 percent of the lane-miles. However, only 33 percent of the lane-miles have "engineered" flexible pavements, which means that the type and placement of fill underneath the surface is known and was designed to meet engineering specifications or criteria. Little is known about the subsurface characteristics for the 57 percent of lane-miles with "non-engineered" flexible pavements, which makes their future performance more uncertain. Ten percent of the lane-miles are composite – with an asphalt overlay on top of Portland cement concrete (PCC).

Pavement Condition

Pavement condition on State and Class 1 town highways are surveyed regularly with a specially equipped vehicle that measures rutting, cracking and roughness. This information is summarized into a condition index that ranges from zero to 100; where 100 represents perfect pavement conditions. As shown in Table 2.2 and Figure 2.2, the Interstate system is in relatively good shape, with 93 percent of the lane-miles in good or fair condition (condition index 65 or over). In contrast, 60 percent of the lane-miles in the non-Interstate portion of the State Highway System (SHS) are in good or fair condition.

Figure 2.1 Pavement Type – Lane-Miles Distribution
State and Class 1 Town Highways



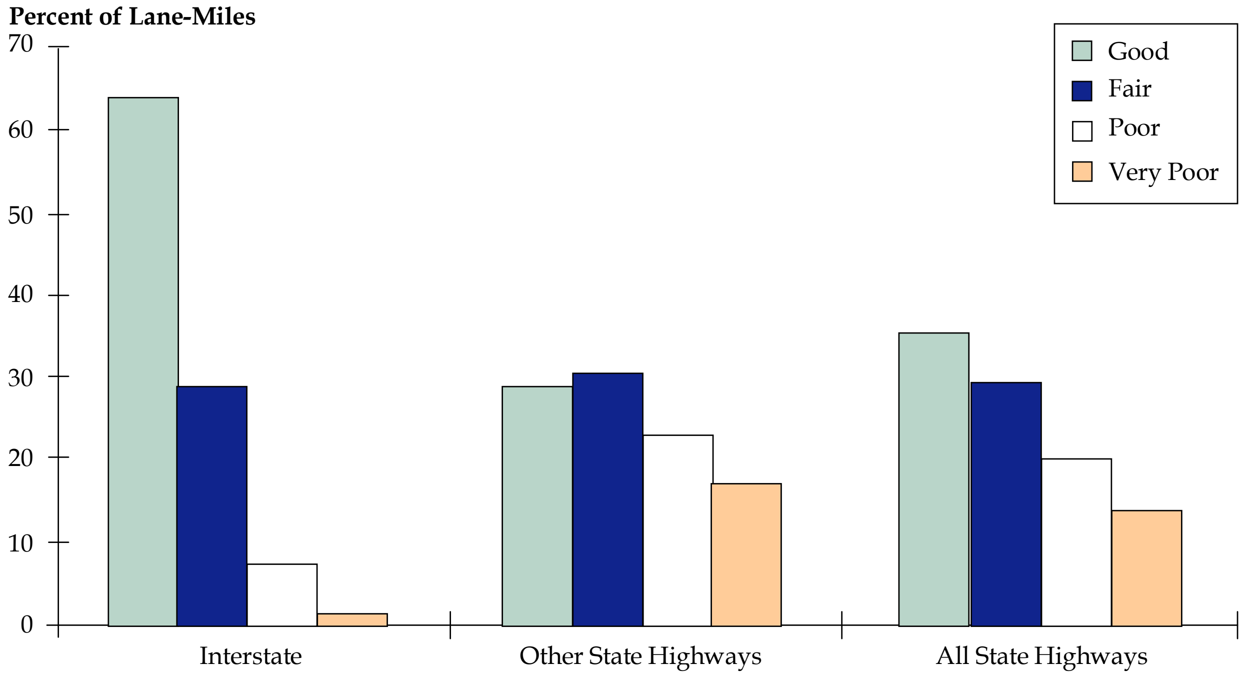
Source: VTrans Pavement Management Section, November 2002.

Table 2.2 Pavement Condition of State Highway Lane-Miles
2002

	Good (80 to 100)	Fair (65 to 79)	Poor (40 to 64)	Very Poor (Less than 40)
Interstate	64%	29%	7%	1%
Other State Highways	29%	31%	23%	17%
Total (All State)	**36%**	**30%**	**20%**	**14%**

Source: VTrans Pavement Management Section, November 2002.

Figure 2.2 Percent of Lane-Miles by Pavement Condition



Bridge Inventory

The State of Vermont has 2,659 publicly owned and five privately owned highway bridges over 20 feet in length (also known as "long structures").[1,2] Forty percent of these bridges are owned and maintained by the State (see Table 2.3). The state-owned bridges tend to be much larger than the local bridges – state-owned bridges account for over 70 percent of the bridge deck area statewide.

[1] The National Bridge Inspection Standards (NBIS) in 23 CFR 650.3 define bridges as structures over 20 feet (6.1 meters) in length. There are an additional 1,306 "short structures" (between six and 20 feet long) on the Vermont SHS.

[2] Highway bridges are defined as bridges carrying highways (NBI item 42A = 1, 4 or 5).

Table 2.3 Highway Bridges by Owner

Ownership	Number (Percent) of Highway Bridges	Deck Area in m^2 (Percent)
State	1,072 (40%)	554,856 (71%)
Town	1,507 (57%)	193,738 (25%)
City	80 (3%)	31,870 (4%)
Private/Railroad	5 (0%)	370 (0%)
Total	**2,664 (100%)**	**780,834 (100%)**

Source: VTrans Pontis database, November 2002.

Figure 2.3 provides a breakdown of bridges both by ownership and by the different portions of Vermont's Road Network. The SHS includes a total of 1,075 bridges – with 47 percent of the SHS bridges on the truck network. Most of Vermont's state-owned bridges are located on the SHS; however, the SHS includes roughly 60 local or privately owned bridges and about the same number of state-owned bridges are located off of the SHS.

The designated Commercial Vehicle Network (which includes all of the National Highway System as well as other major truck routes – see Figure 2.9) has 504 bridges, 96 percent of which are owned by the State. The remaining portion of the SHS off of the Truck Network has 571 bridges, 93 percent of which are state-owned. The 1,589 long highway structures off of the SHS are primarily owned by cities and towns – only four percent of these structures are owned by the State.

Figure 2.3 Bridges by Ownership and Highway System

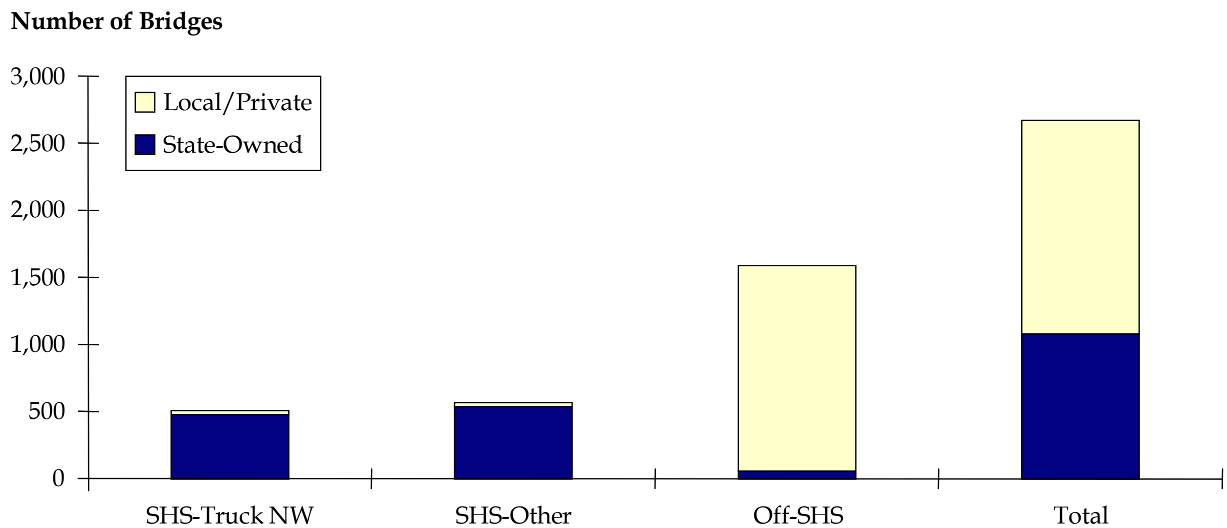


Figure 2.4 shows the breakdown of bridge deck area by ownership and highway system, indicating that while the SHS accounts for 40 percent of the highway bridges statewide, it includes over 70 percent of the bridge deck area in the State.

Figure 2.4 Bridge Deck Area by Ownership and Highway System

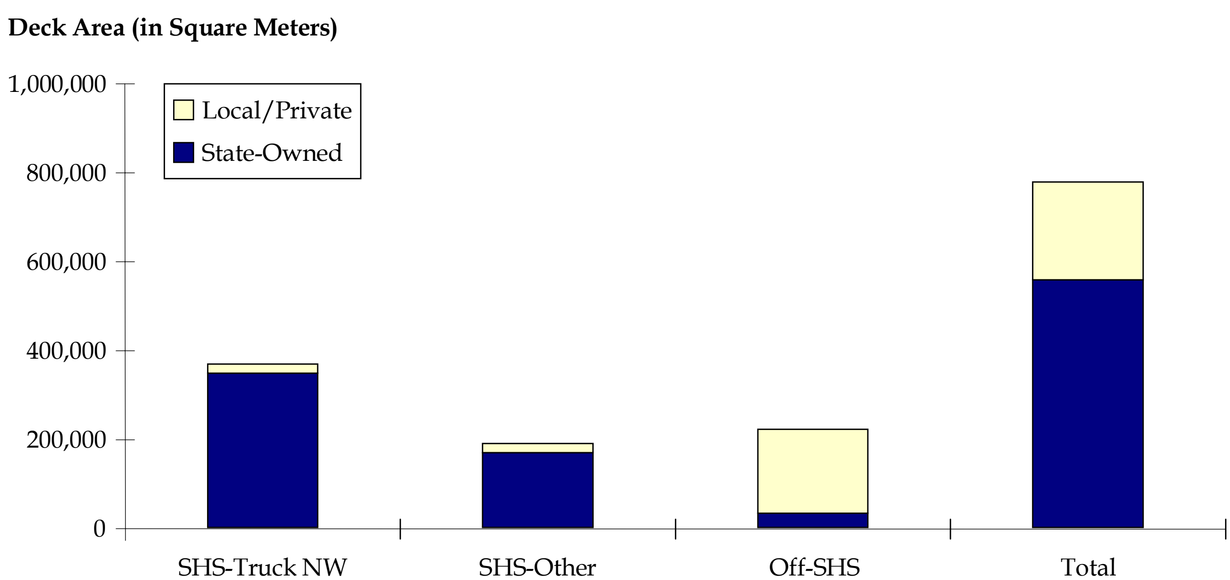


Table 2.4 shows a breakdown of bridges and bridge deck area by functional classification. Three hundred fourteen bridges accounting for 31 percent of the bridge deck area

statewide are on the Interstate system; 454 bridges (accounting for 43 percent of the bridge deck area statewide) are on the NHS.

Table 2.4 Highway Bridges by Functional Classification

Functional Class	Bridges (Percent)	Deck Area in m² (Percent)
Interstate	314 (12%)	240,236 (31%)
Principal Arterial	165 (6%)	114,603 (15%)
Minor Arterial	187 (11%)	108,817 (14%)
Major Collector	519 (19%)	137,246 (8%)
Urban Collector	41 (2%)	13,251 (2%)
Minor Collector/Local	1,338 (50%)	166,683 (21%)
Total	**2,664 (100%)**	**780,834 (100%)**

Source: VTrans Pontis database, November 2002.

Bridge Characteristics and Condition

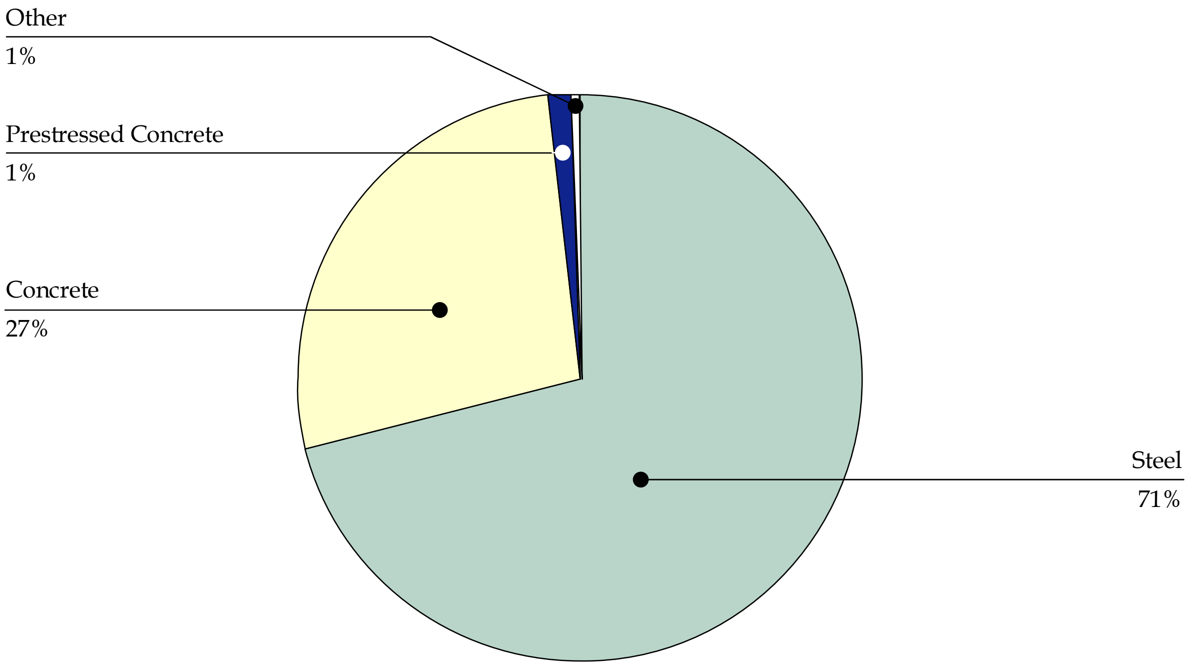
This section presents more detailed information about bridges located on the SHS.

Materials

Over 70 percent of the Vermont SHS bridges are classified as steel structures; an additional 27 percent are classified as concrete structures[3]. Figure 2.5 shows the proportional distribution of SHS bridges by material type.

[3] This classification is based on the value of NBI Item 43A – Structure Type, Main Span - kind of material and/or design. These materials refer to the superstructure; so a steel structure can have a concrete deck.

Figure 2.5 SHS Bridge Type Distribution



Source: VTrans Pontis database, November 2002.

Age

Figure 2.6 provides an overview of the age distribution for Vermont SHS bridges[4]. A total of 81 SHS bridges are over 70 years old, which means they are nearing (or have exceeded) the typical life of 75 to 80 years[5]. Ten of the bridges in this category are on the NHS. While the NHS has relatively few bridges that are very old, 61 percent of NHS bridges currently are 31 to 50 years old, reflecting the Interstate construction period between 1958 and 1971. In contrast, the age distribution for non-NHS bridges is much more spread out. Overall, roughly 63 percent of the SHS bridge inventory is over 30 years old.

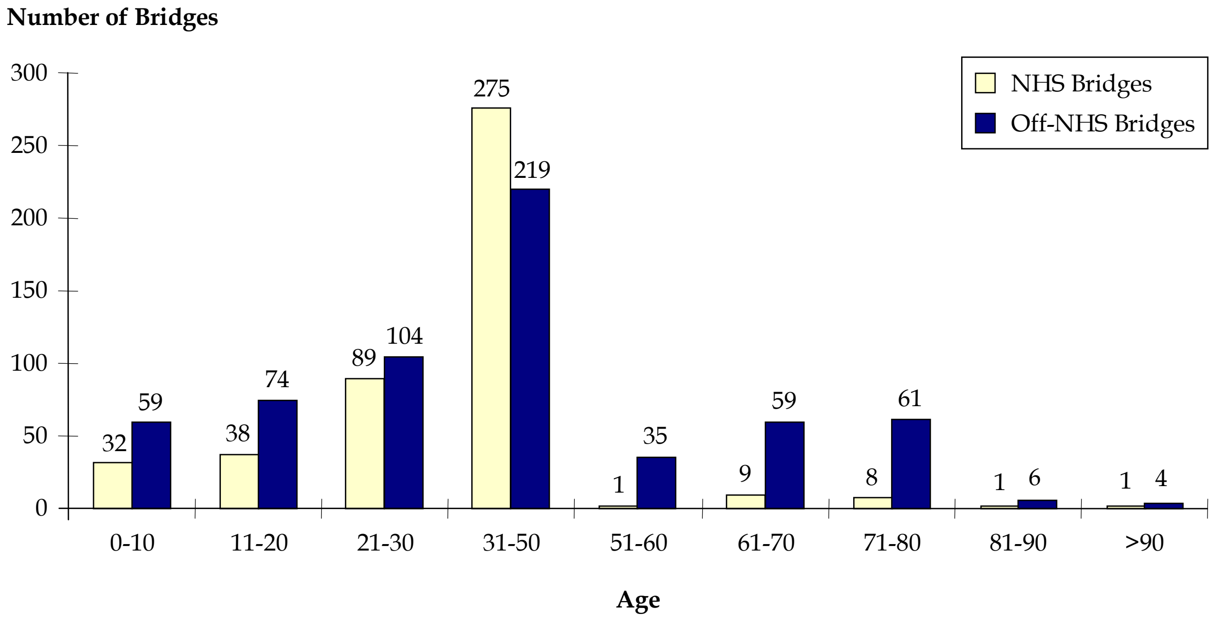
The large cohort of bridges in the 30- to 50-year range is significant because it is at this stage of a bridge's life span that substantial maintenance or rehabilitation is typically required to preserve its structural integrity.

---

[4] Age is based on either NBI item 27 (Year built) or item 106 (Year last reconstructed), whichever is more recent.

[5] A recent NCHRP project on bridge life-cycle cost analysis acknowledged the wide variation in actual service lives, but stated that "Current bridge management practice sets service life in the range of 75 to 100 years for most a bridge's sub- and superstructure, and the current AASHTO Design Code sets a design life of 75 years." [NCHRP Report 483, "Bridge Life-Cycle Cost Analysis," prepared by Hugh Hawk, National Engineering Technology Corporation, 2003].

Figure 2.6 SHS Bridge Age Distribution



Source: VTrans Pontis database, November 2002.

Bridge Condition

Bridge condition is tracked via detailed inspections of each bridge on a two-year cycle. Two key performance measures – deficiency status and sufficiency rating – are derived from inspection data that are reported to FHWA and are used to establish eligibility for Federal bridge funding.[6] Two additional measures – number of restricted bridges and the Health Index – also are tracked by the Bridge Section.

Structurally Deficient Bridges – Bridges are classified as structurally deficient if they have a poor condition rating for one of their major structural components (deck, super-structure, substructure, culvert) or if the structure's appraisal rating and waterway ade-quacy (where appropriate) is poor. Seventeen percent of Vermont's SHS bridges (188 of 1,075) are classified as structurally deficient[7]. This is slightly higher than the national average of 14 percent.

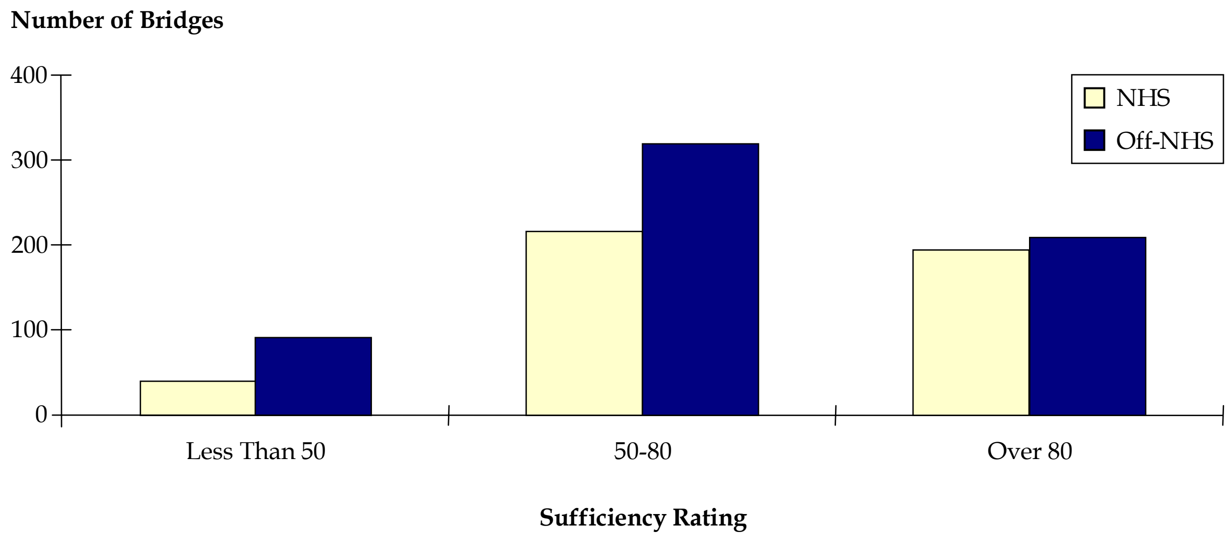
---

[6] A structurally deficient or functionally obsolete bridge with a sufficiency rating less than 50 is eligible for Federal bridge replacement funding. A structurally deficient or functionally obsolete bridge with a sufficiency rating of 80 or less is eligible for Federal bridge rehabilitation funding.

[7] This figure includes 14 locally-owned bridges on the SHS.

Sufficiency Rating – The Federal bridge sufficiency rating is a number from zero to 100 indicating the sufficiency of a bridge to remain in service. It is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. The sufficiency rating distribution for Vermont SHS bridges is shown in Figure 2.7.

Figure 2.7 SHS Bridge Sufficiency Rating Distribution



Source: VTrans Pontis database, November 2002.

The ranges in sufficiency ratings shown are those commonly used because of their relation to Federal bridge funding eligibility.[8] Roughly 12 percent of the SHS bridges have a sufficiency rating less than 50, which makes them eligible for Federal bridge replacement or rehabilitation funds. One-half of the SHS bridges have sufficiency ratings in the 50 to 80 range, which means that they are eligible for Federal bridge rehabilitation funds. Bridges on the NHS tend to be in better condition than those not on the NHS; 43 percent of NHS bridges have a sufficiency rating of at least 80, compared to 38 percent of non-NHS SHS bridges.

Restricted Bridges – The performance measure proposed for Vermont's bridges includes an indication of the number of restricted bridges. The term restricted is defined as an impediment to the free flow of all vehicles meeting Motor Carrier Safety Regulations in Vermont. The types of restrictions will include a load capacity limitation of a structure, overpass height restrictions and bridge width due to a one-lane bridge. Items that reflect the condition of a structure but do not provide an obvious impediment to the free flow of traffic, such as tem-

[8] Note that other sources of Federal, state, and local funding for bridge projects are available that do not use sufficiency rating to establish eligibility.

porary shoring, temporary bridges, deteriorated steel and concrete are not included. Currently, there are six restricted bridges on Vermont's SHS.[9]

Health Index – The health index is a number between zero and 100, used by the Agency's Bridge Management System Pontis, to define the overall condition or "remaining value" of a bridge. The health index is a useful metric for tracking the average condition of the entire network of bridges in Vermont over time. The value of the health index for a bridge is derived by comparing the current dollar value of a bridge to the replacement value of that bridge. A new bridge would have a health index of 100. The assessment of the current value is based on a detailed field inspection of the bridge by trained bridge inspectors. The inspection determines the remaining value of each major component of a bridge like the deck, superstructure, substructure, bearings, and paint system. The replacement value is determined by tracking cost data collected from actual bridge replacement projects.

The current average health index across all SHS structures[10] is 87. The average health index is higher for structures on higher functional classes – 91 for Interstate System bridges, 89 on Non-Interstate NHS system bridges, and 85 on other SHS bridges.

Roadway Features

While investments in pavements and bridges account for a substantial share of the highway system investment needs, features such as signs, lights, guardrails, ditches, and turf areas are important elements of the highway system and require ongoing maintenance in order to provide for safe and efficient operations. Table 2.5 provides an inventory of SHS roadway features from the Maintenance Activity Tracking System (MATS).

[9] One of the restricted bridges is a floating bridge which will always be restricted. VTrans Bridge Section, December 2000.

[10] Structures over 20-feet long.

Table 2.5 Roadway Features Inventory

Item	Unity of Measure	Quantity	Quantity per State Highway Mile[1]
Traffic Signs	Each	64,873	24.0
Travel Directional Signs	Each	404	0.1
Paved Shoulders	Mile	4,329	1.6
Gravel Shoulders	Mile	3,075	1.1
Signals	Each	235	0.1
Fence	Mile	1,314	0.5
Roadway Lights	Each	981	0.4
Delineators/Mile Marker Plaques	Each	64,077	23.7
Guardrail	Linear Foot	5,608,792	2,074.3
Ditches	Mile	3,228	1.2
Culverts (six feet or less in diameter)	Each	40,192	14.9
Mowable Roadside Area	Acre	11,172	4.1

[1] This column divides each quantity by 2,704 – the total number of state highway miles.

Source: VTrans Operations Division, November 2002.

■ 2.2 Operational Profile

Highway System Subnetworks

The highway system constitutes the most important component of Vermont's transportation network. Private vehicle travel is the predominant mode of transportation for the vast majority of Vermonters (approximately 98 percent).[11] In addition, trucking is the primary mode of freight transportation in Vermont. Trucks account for 91 percent (by weight) of the freight moving into, out of, within and through the State.[12] Three distinct subnetworks have been identified and are briefly discussed below which reflect the different needs and functions of the highway system – the National Highway System, the Commercial Vehicle Network, and the Scenic Road and Byways Network.

National Highway System

The 160,000-mile National Highway System (NHS) was established in 1995 by Congress, consisting of roadways judged to be important to the nation's economy, defense, and mobility. It consists of the Interstate system, the Strategic Highway Network (STRAHNET), nationally designated intermodal connectors, and principal arterials that serve both Interstate and interregional travel, and provide important intermodal connections. Vermont's NHS consists of 320 miles of Interstate Highways (which coincide with the STRAHNET system), 9.5 miles of intermodal connectors, and 374 miles of principal arterials. Figure 2.8 shows the Vermont NHS. This figure also shows Class 1 town highways, which are defined as town highways that form the extension of a state route (through a village) and carry a state highway route number.

Commercial Vehicle Network

Vermont's commercial vehicle network provides a preferred highway routing for goods through the State. Title 23 V.S.A. Section 1432 contains the definition of the truck network and establishes limits on the lengths of vehicles that can operate on different portions of the highway network. Figure 2.9 identifies the four components of Vermont's commercial vehicle network:

- **National Network –** Limited access (no overall length limit; limits on semitrailers in tractor-semitrailer combinations of 53 feet; limits on trailers or semitrailers in tractor-semitrailer-trailer combinations of 28 feet);

- **Truck Network –** No permit required for trucks less than 72 feet (including 53-foot tractor-trailer combinations);

---

[11] Vermont Long-Range Transportation Plan, January 2002.

[12] Vermont Statewide Freight Study, March 2001.

Figure 2.8 Vermont National Highway System and Class 1 Town Highways

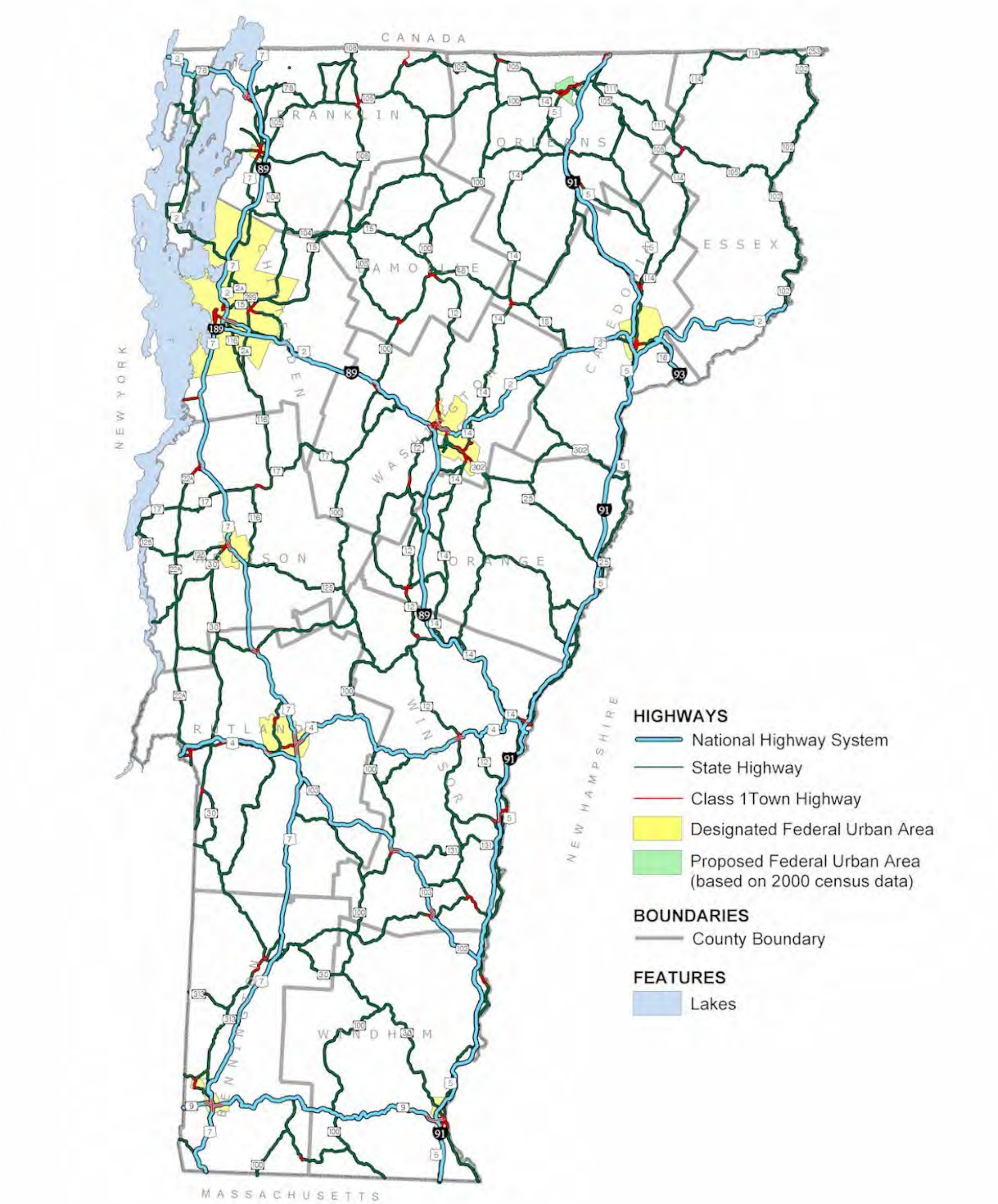
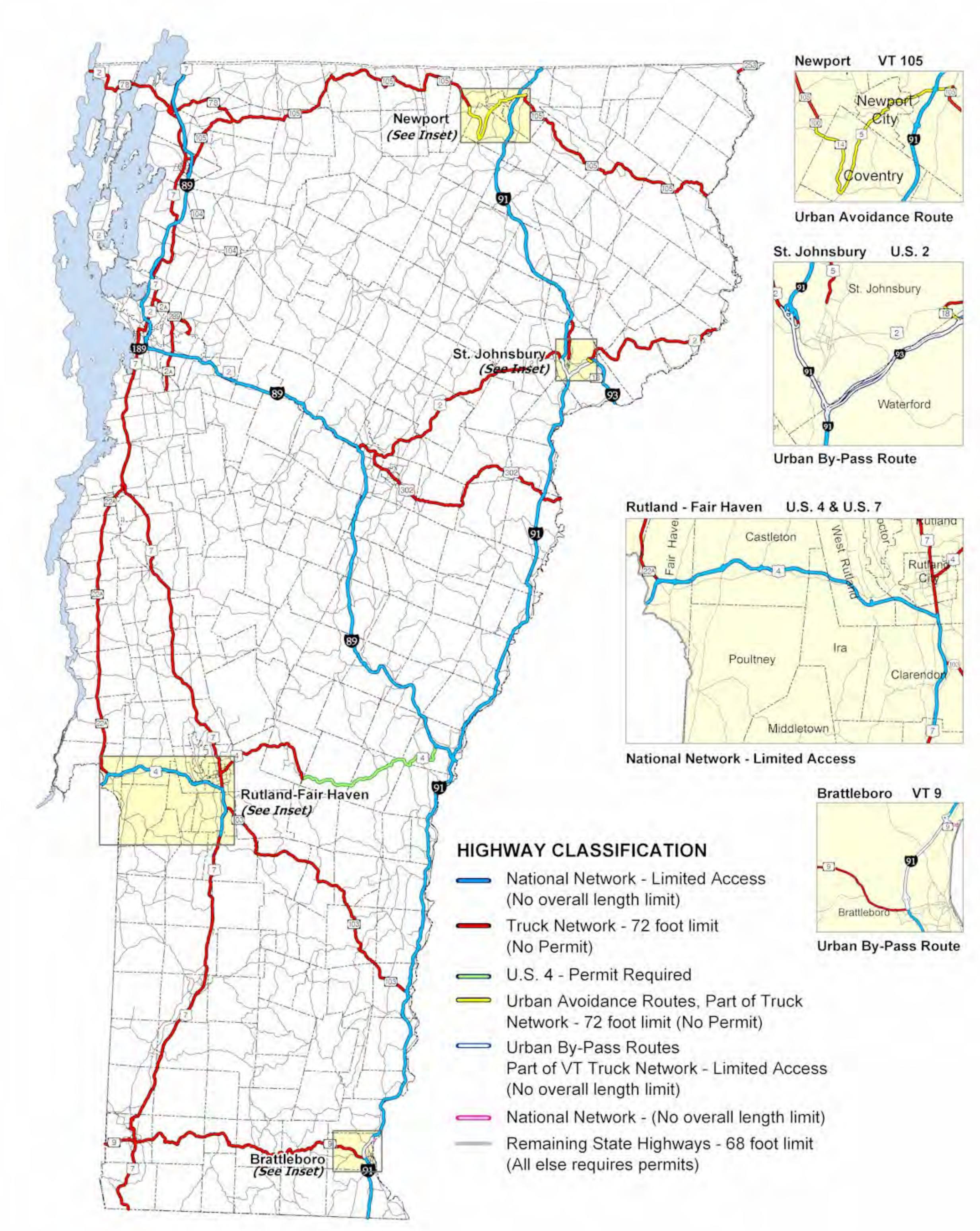


Figure 2.9 Vermont Commercial Vehicle Network



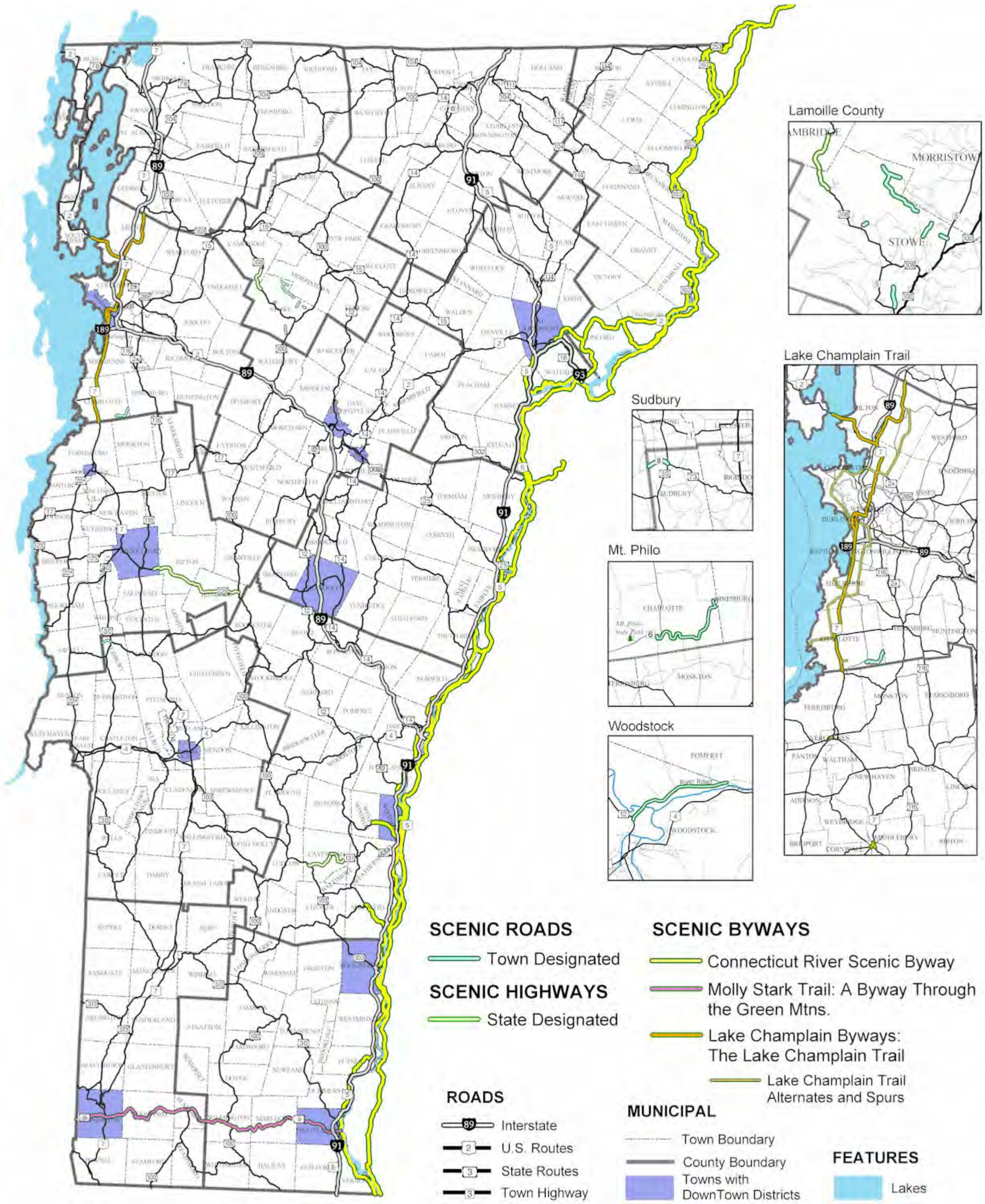
- **U.S. 4 –** Trucks with overall length between 68 and 72 feet may operate with single or multiple trip permits provided that the distance from the kingpin of the semitrailer to the center of the rearmost axle is not greater than 43 feet;

- **Remaining State Highways –** All trucks over 68 feet must obtain a permit. Trucks between 68 feet and 72 feet with trailer length of 23 feet or less may obtain a single or multiple use permit for no fee. Trucks between 68 feet and 72 feet with longer trailers may obtain a single trip permit at no fee. Trucks over 72 feet may obtain a single trip permit for a $20 fee – additional insurance is required for trucks over 100 feet.

Scenic Roads and Byways

The National Scenic Byways Program was established in 1991 by the Intermodal Surface Transportation Efficiency Act (ISTEA) in order to "identify, designate and promote scenic byways and to protect and enhance the recreational, scenic, historic and cultural qualities of the areas through which these byways pass." The Vermont Byways Program was established in 1998 through the Scenery Preservation Council. Designated scenic byways are eligible for Federal transportation funds for improvements related to tourism or resource conservation. Any reconstruction or improvement of a designated scenic road must conform to standards established by the agency. Vermont's scenic roads are shown in Figure 2.10.

Figure 2.10 Vermont Scenic Roads and Byways



Traffic and Congestion

Traffic Flow

Vermont is a predominantly rural state with low-population density and only one designated urbanized area – Chittenden County. Additional small urban areas (and urban clusters) are scattered around the State – see Figure 2.8. Daily traffic flows illustrated in Figure 2.11 indicate that the Interstate system and sections of the NHS carry the heaviest traffic in the State, while heavy traffic (mainly during peak hours) also is experienced by motorists on urban arterials and connectors. A truck flow map also was created to illustrate daily truck usage of Vermont's state highways. As illustrated in Figure 2.12, the bulk of the truck traffic in the State occurs on the designated Commercial Vehicle Network.

The latest demographic data (2000 Census) suggests that a high percentage of Vermont's residents have easy access to major highways such as the NHS and the Truck Network. Results from the State's Travel Demand Model indicate that a large percent of the population (approximately 76 percent of the households) and employment (approximately 86 percent) in Vermont is located within a 10-minute drive (congested speeds) from the NHS or Commercial Vehicle Network (Figure 2.13).

Vehicle Miles of Travel

Vehicles Miles Traveled (VMT) is a key measure of highway usage. VMT in Vermont has been steadily increasing during the past few decades at a similar pace as the rest of the country – at about twice the rate of increase in the population. Figure 2.14 shows this increasing trend in highway usage over the last 50 years. Table 2.6 provides a summary of annual VMT on Vermont's Highway System (state and local). Two different methods of estimating future VMT growth based on past trends results in a range between eight and 13 billion annual vehicle miles traveled by the year 2020.[11]

Figure 2.11 Traffic Flow Map for State Highways
2000

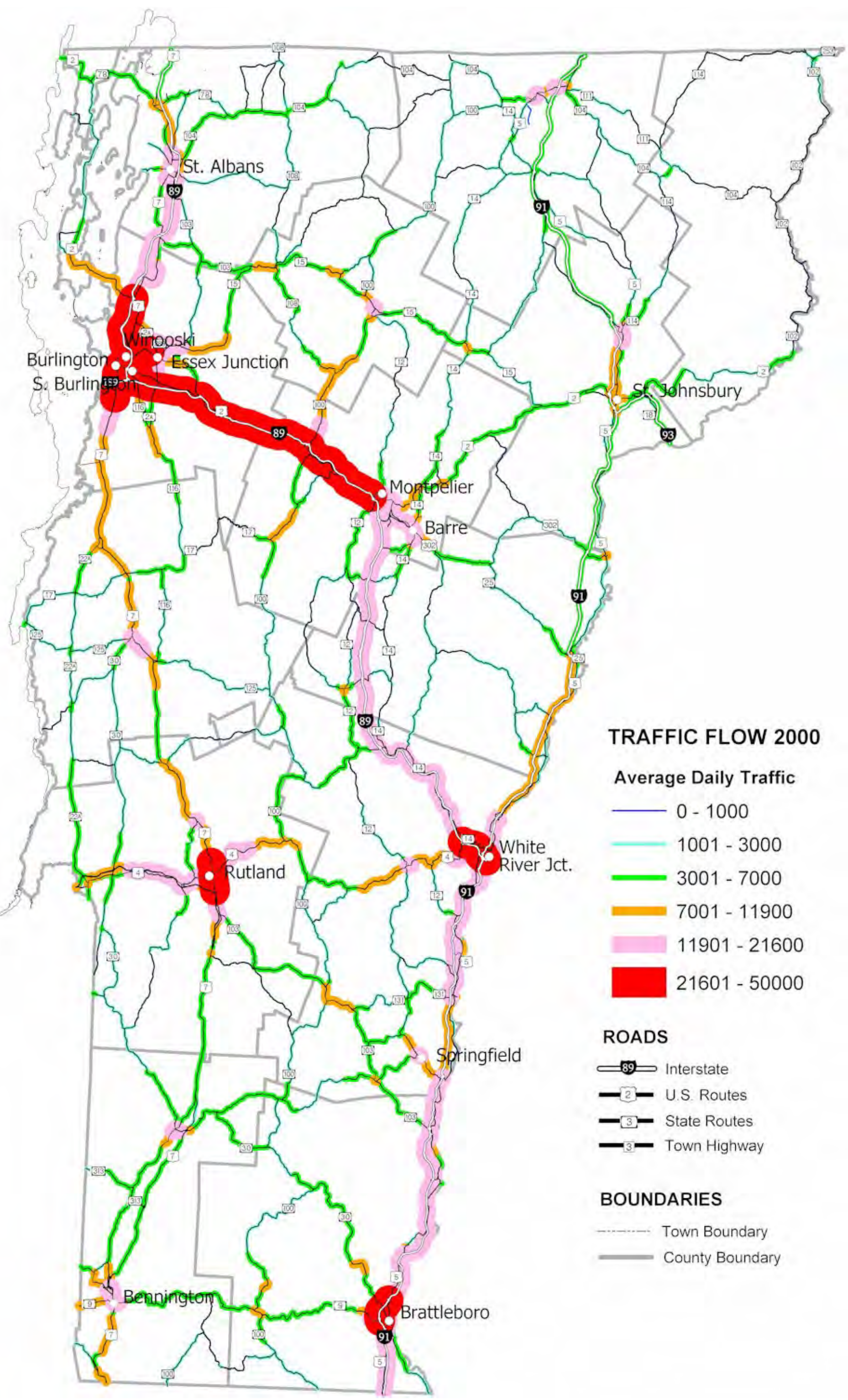


Figure 2.12 Truck Flow Map for State Highways

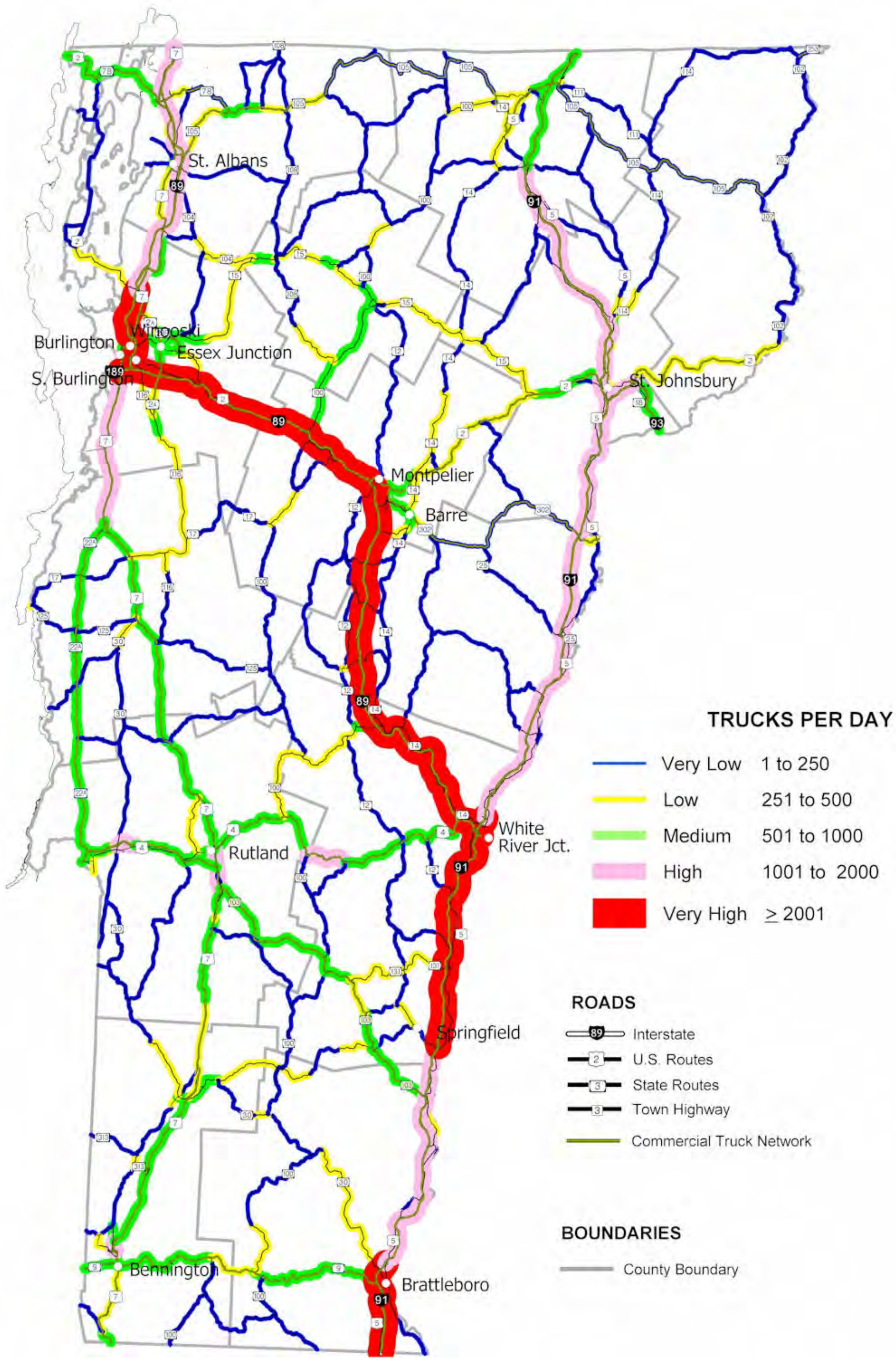


Figure 2.13 Areas within 10-Minute Drive from the NHS and Commercial Vehicle Network

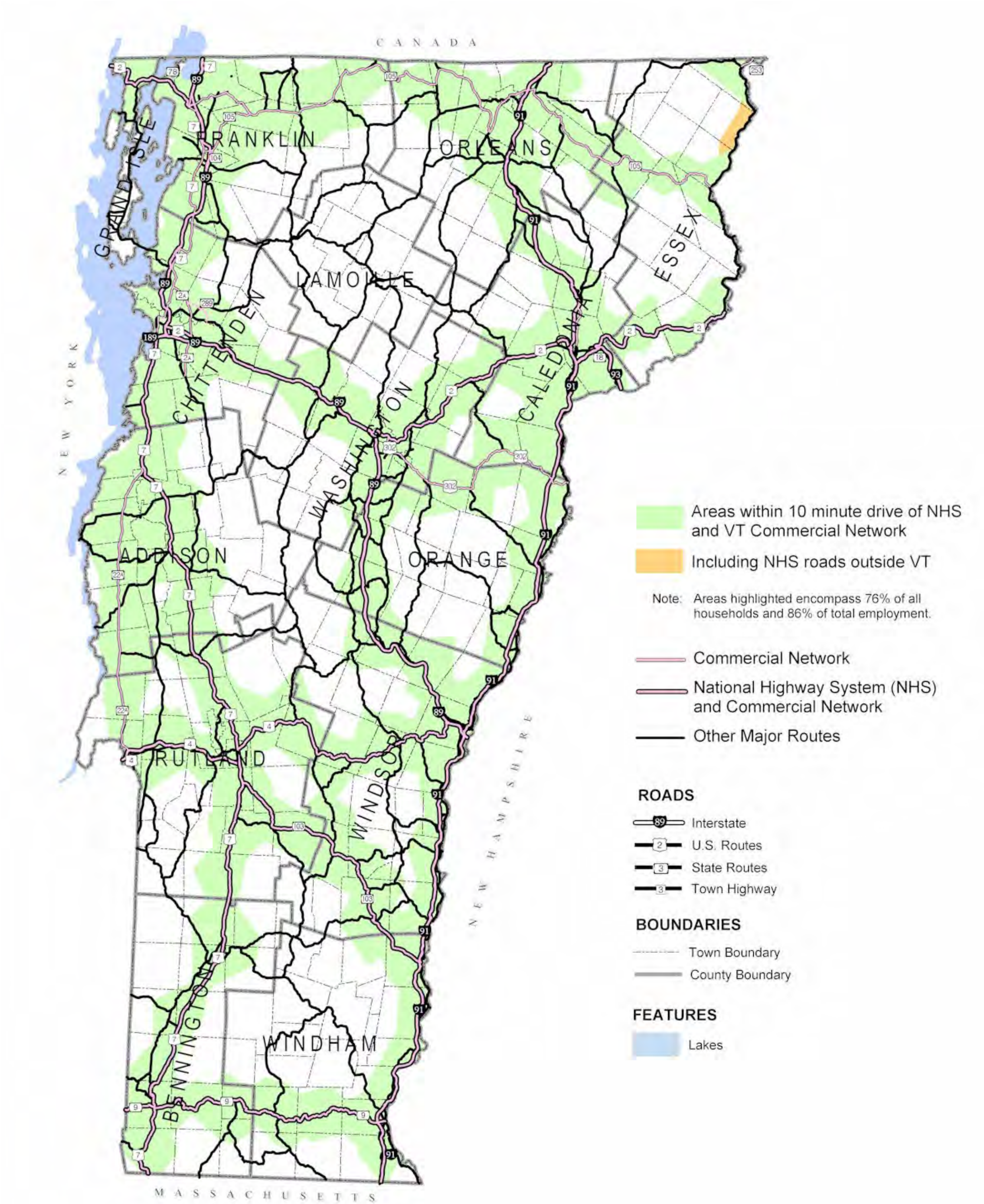


Figure 2.14 Trends in Vehicle Miles of Travel
VMT

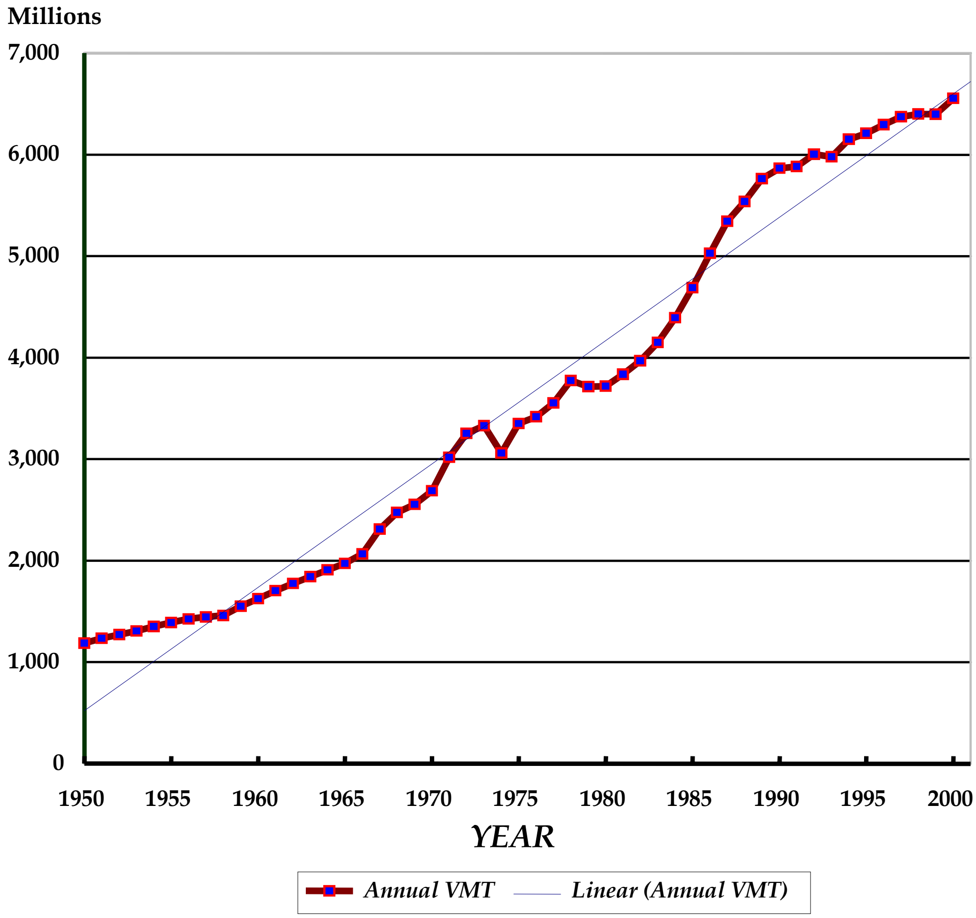


Table 2.6 Annual Vehicle Miles Traveled by Functional Class (*2000)*

Functional Class	Miles of Road	Percent	Annual VMT (Millions)	Percent
Interstate	320	2%	1,555	24%
Principal Arterial	434	3%	1,308	20%
Minor Arterial	883	6%	1,340	20%
Major Collector	2,013	14%	1,006	15%
Urban Collector	212	1%	223	3%
Minor Collector/Local	10,412	73%	1,123	17%
Total	**14,276**	**100%**	**6,554**	**100%**

Source: VTrans

Congestion

Congestion is mainly experienced by motorists in urban areas of the State, primarily during peak-hour traffic. Based on responses to surveys conducted for the 1995 and 2002 Long-Range Transportation Plans, the overwhelming majority of Vermonters surveyed indicated that congestion is not considered to be a major problem and it does not adversely affect their quality of life. A commonly used indicator for highway congestion is the volume to capacity ratio of highway segments. Using the Statewide Travel Demand Model, the daily volume over capacity ratios (v/c) for Vermont's highway network were plotted and are presented in Figures 2.15 and 2.16. Traffic projections for 2020 indicate that congestion will be developing in several areas around the State whereas in 1994, congestion was concentrated in the Burlington area. Detailed views of some of the projected 2020 congested segments of Vermont's highway network are included in Figure 2.16.

Safety

The Vermont Agency of Transportation is committed to roadway safety and diligently works to monitor crashes to ensure that there are no roadway design flaws that could contribute to hazardous roadway conditions. According to the agency's database, there were 3,461 crashes and 76 fatalities in 2000. Analysis conducted on historical crash data indicates that the crash rate has been declining steadily over the past decade, and is significantly lower than the national average (52.8 crashes per 100 million VMT in Vermont versus 232 for the United States as a whole).[12]

The Agency of Transportation compiles extensive – but not comprehensive – data on crashes occurring in the State, including location, road type, weather, time of day and cause of the crash. Selected statistics of interest about Vermont crashes (for the year 2000) are as follows:

- Forty-eight percent of all crashes and 72 percent of fatal crashes occurred on main roads; eight percent of all crashes occurred at driveways;
- Three percent of all crashes occurred on the Interstate highways; 55 percent occurred on the Non-Interstate SHS;
- Twenty-two percent of crashes occurred at times of inclement weather or impaired visibility – rain, snow, sleet, freezing rain, fog, smog, smoke (weather was not known for five percent of the crashes); and
- Thirty-six percent of crashes occurred on wet or slippery (snow/ice/slush) road surfaces (surface condition was not known for six percent of the crashes).

[12] Vermont Department of Public Safety, Vermont Crash Data Resource Book 2000.

Figure 2.15 Volume to Capacity Ratio
1994

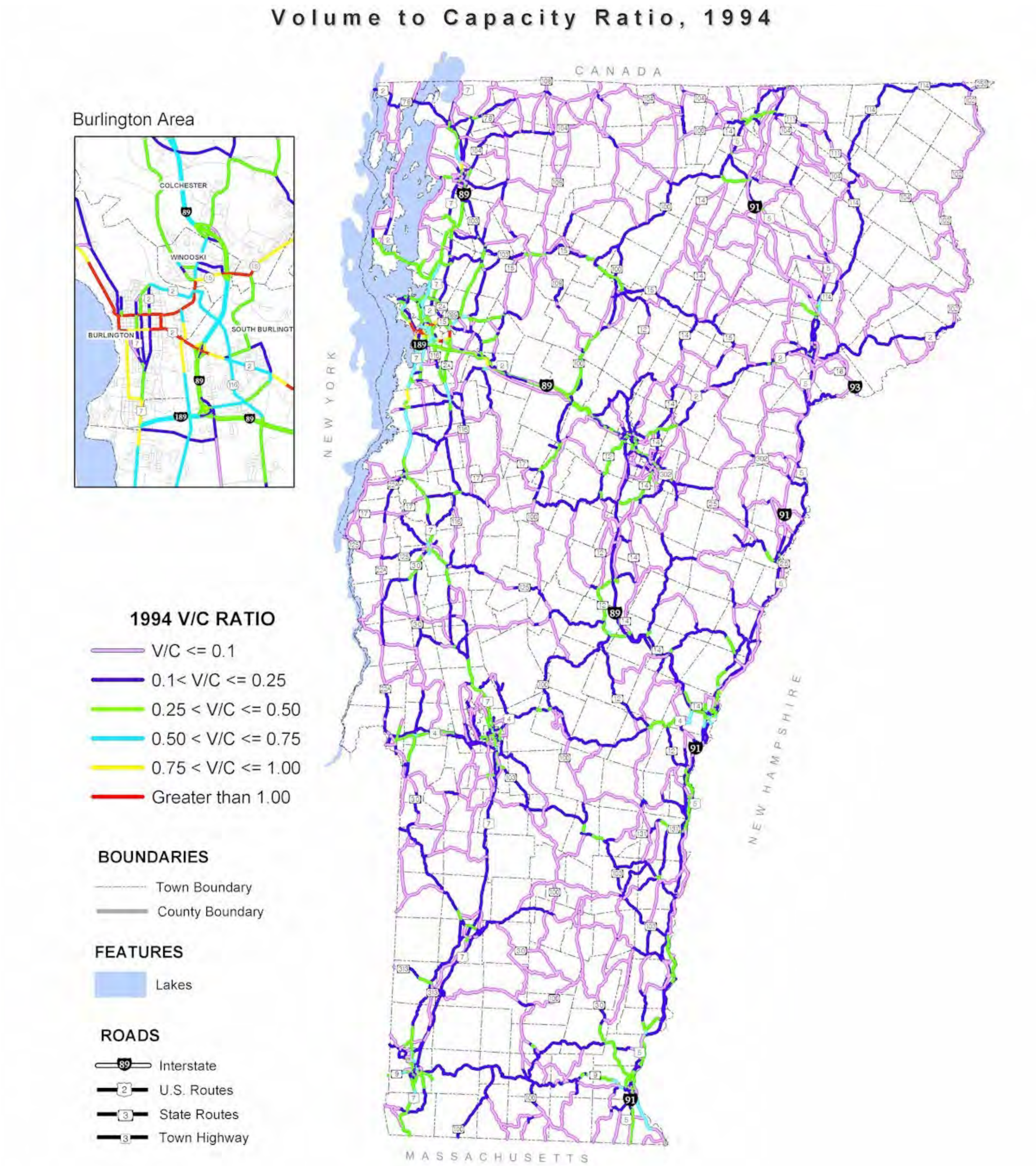
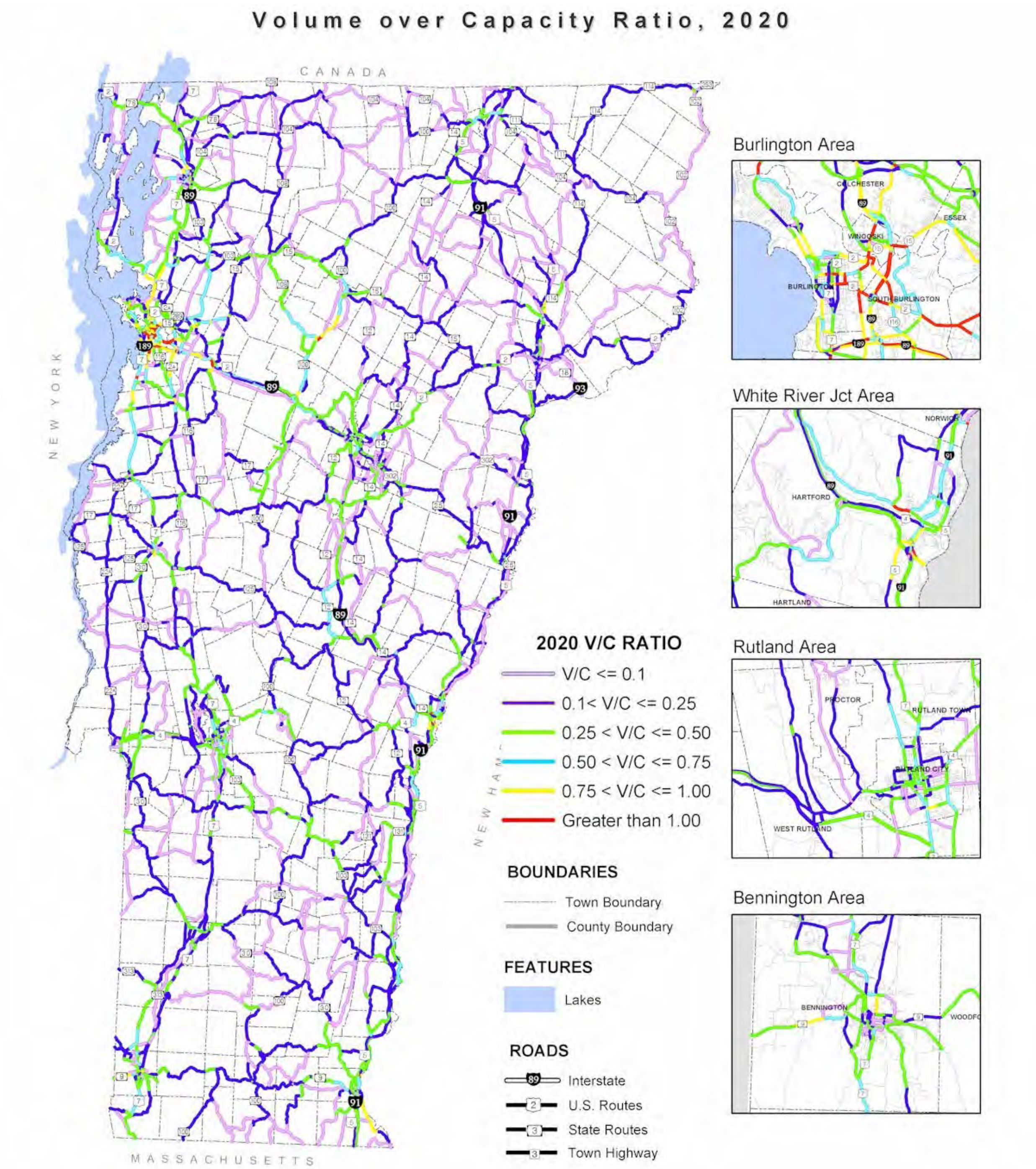


Figure 2.16 Volume to Capacity Ratio
2020



■ 2.3 Connectivity Profile

Population Centers

Vermont is a mostly rural, lightly populated state with approximately 613,000 residents.[13] Almost one-quarter of Vermont's population reside in Chittenden County, followed by Rutland and Washington Counties with about 10 percent each of the State's population.[14] Between 1990 and 2000, the population of Vermont increased by 8.2 percent. While the statewide growth rate was significantly lower than the national growth rate of 13.1 percent, Chittenden County had a more robust population growth of approximately 12 percent during that same period.

There are eight cities in Vermont with a population greater than 10,000: Burlington, Essex, Rutland, Colchester, South Burlington, Bennington, Brattleboro and Hartford. Four of the five largest cities – Burlington, Essex, Colchester, and South Burlington – are all part of Chittenden County. Table 2.7 provides a listing of all communities with populations greater than 10,000.

Table 2.7 Vermont Cities and Towns with Populations Greater than 10,000

City/Town	Population
Burlington	38,889
Essex	18,626
Rutland	17,292
Colchester	16,986
South Burlington	15,814
Bennington	15,737
Brattleboro	12,005
Hartford	10,367

13 U.S. Bureau of the Census 2000 Census.

14 Vermont: An Economic-Demographic Profile Series, 2003, Vermont Department of Employment and Training.

Employment Centers

Employment growth is an important indicator of the region's economic vitality. A strong national economy during the 1990s prompted solid job growth in Vermont. A slowdown in manufacturing and other sectors of the economy which started in 2001 raised unemployment. However, the unemployment rate has been so far consistently below the national rate. Chittenden County accounts for almost one-third of Vermont's employment (32.3 percent) followed by Washington (10.9 percent), Rutland (9.8 percent), Windsor and Windham (7.9 percent each).[14] Using the Statewide Travel Demand Model the employment density in the State – by Traffic Analysis Zone – was plotted and presented in Figure 2.17.

Designated Downtown Program

Vermont's designated downtown program was developed to assist local communities in preserving and investing in their core areas. To apply for designation, communities must:

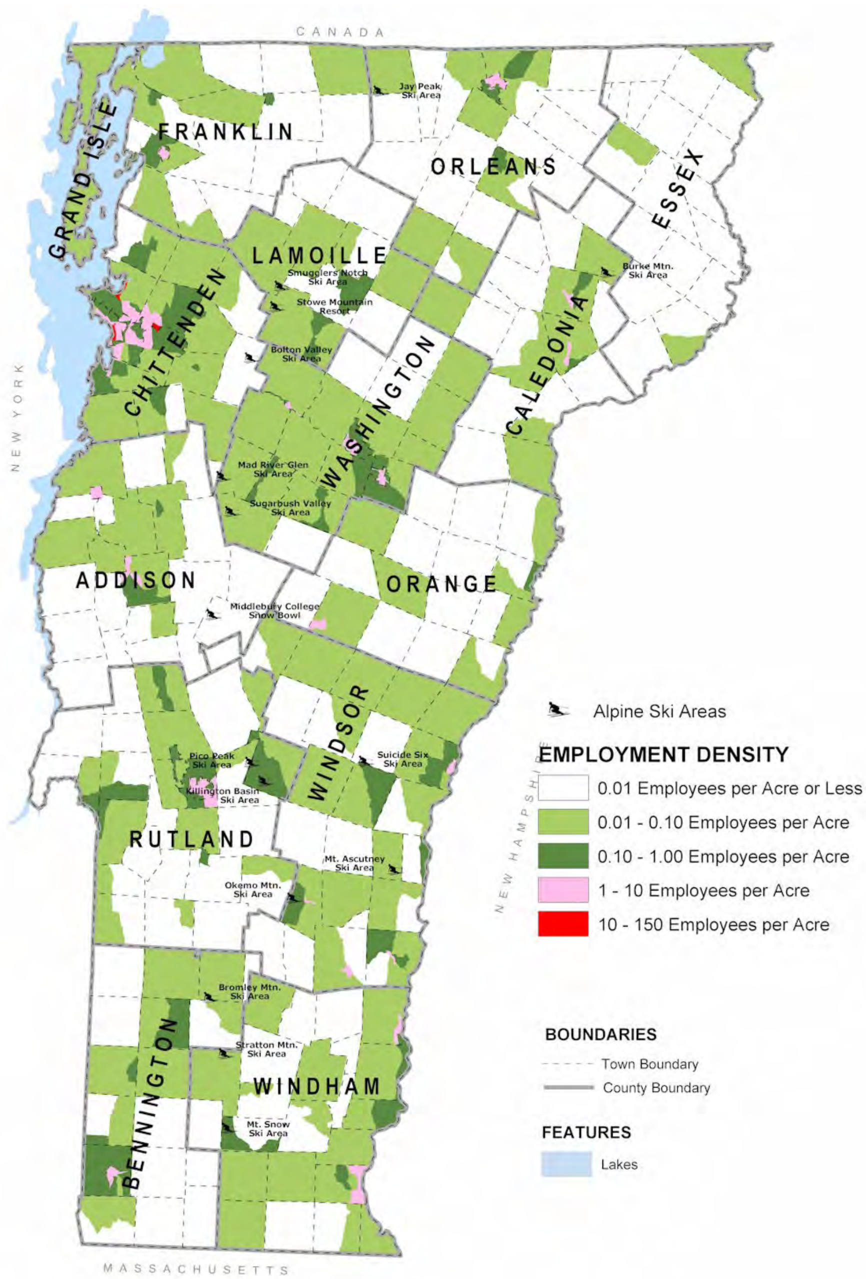
- Establish a design review district or local historic district;
- Create an urban renewal district or development review board authorized to undertake Act 250 reviews;
- Adopt a reinvestment agreement by private and public partners leading the revitalization effort;
- Create a map establishing the downtown boundary consistent with the statutory definition, the area of planning commitment and the boundary of the National Register historic district;
- Provide a capital improvement plan for the downtown district;
- Organize a structure for carrying out a comprehensive, long-term revitalization program;
- Establish funding and resources to fulfill the Community Reinvestment Agreement; and
- Provide water and sewage systems in compliance with state regulations, with reserve commitments for downtown growth.

Communities which are a part of the downtown program are eligible for a number of benefits, including:

- Loans, loan guarantees and grants for capital transportation and related capital improvement projects to support economic development;
- Flexibility for Vermont's Act 250 environmental process for mixed-income housing and mixed-use project requirements. Priority consideration is given to participating communities by state agencies administering funding or aid;
- Inclusion of special assessment districts to raise funds for operating and capital expenses;

- Traffic calming options, including reduced speed limits of less than 25 miles per hour;
- Alternative signage options for tourism and wayfinding purposes; and
- Priority for locating new state buildings.

Figure 2.17 Employment Density
2000



Intermodal Connections

While the highway network serves the majority of both passenger trips and goods movement in Vermont, air, rail and public transportation facilities are an essential part of the transportation system. Vermont is distinguished among rural states in its multimodal approach to transportation investment. Highway policy in Vermont recognizes the important role of the highway network in providing intermodal connections. It also reflects an understanding that solving transportation problems requires a broad view of multimodal alternatives.

This section presents summary information about the characteristics and locations of key intermodal facilities in Vermont.

NHS Intermodal Connectors

As indicated in Table 2.8, there are seven Federally designated NHS Intermodal Connectors in the State. These highway segments were selected due to their importance as primary links for the movements of freight and passengers from intermodal facilities to the Interstate and principal arterials on the NHS.

Table 2.8 Designated NHS Intermodal Connections

Intermodal Facility	Section	Length (Miles)
Burlington International Airport	Airport Drive, between the Airport Entrance and U.S. 2	0.45
Burlington International Airport	Kennedy Drive between U.S. 2 and I-189	1.51
Vermont Railway Yard, Burlington	Battery Street, Main Street (U.S. 2) between the Vermont Railway Rail Yard and I-89	2.10
Vermont Railway Yard, Burlington	Champlain Parkway between the Vermont Railway Rail Yard and I-189/U.S. 7 Junction (Projected)	2.35
Greyhound Bus Terminal, White River Junction	U.S. 5 between the Terminal and I-91	0.13
Amtrak Station, White River Junction	Railroad Row, Bridge Street, North Main Street, U.S. 5 between the Station and I-91	1.25
Amtrak Station, Essex Junction	VT 15, between Station and Circumferential Highway (VT 289)	1.68

Source: FHWA

Airports

There are 17 airports in Vermont that are open to public use. Two are owned by municipalities, five are privately owned and 10 are owned and operated by the State of Vermont. Figure 2.18 shows the locations of all airports in Vermont. Two of the airports have scheduled airline service (Burlington and Rutland). As with other components of the transportation network, VTrans has taken an active role in preserving the airport infrastructure by owning and operating the majority of airports in the State. The primary exception to this is Burlington International Airport, which is owned by the City of Burlington. The Burlington Airport has been identified as one of the Vermont's key assets for the provision of airline services.

Park-and-Ride Facilities

Park-and-ride facilities encourage commuters (especially long-distance commuters) to carpool. Figure 2.18 shows Vermont's current park-and-ride system. The agency, in close consultation with the Regional Planning Commissions, has recently undertaken a study to identify additional park-and-ride facility needs around the State. Detailed information (location, capacity etc.) on current and proposed park-and-ride facilities is provided at the agency's park-and-ride web page.

Rail/Highway Transfer Points

Another key component of the intermodal infrastructure of Vermont is rail. Rail is responsible for moving the second largest amount of freight (by weight after trucks), almost seven percent, into and out of Vermont. The four largest commodities transported by this mode are nonmetallic minerals; clay, concrete and glass; stone; and food and kindred products, which account for 75 percent of the mode's total.

There are a number of private facilities in Vermont that support transfers from truck to rail and rail to truck. These facilities accommodate primarily bulk transfers of materials and could serve as consolidation, distribution or warehousing centers for outbound and inbound commodities. Part of the incentive of moving freight from trucks to rail is to reduce the wear and tear on Vermont highways that results from heavy trucks. Another incentive is that it supports and enhances Vermont's business climate. There currently are 10 operating railroads in Vermont, some of whom operate over Vermont-owned right-of-way. Figure 2.19 shows the ownership for each of the railroads.

Seaport Highway Connections

Vermont's geography leaves it without a water freight terminal. As such, Vermont relies on the regional rail infrastructure and trucks for its access to water freight facilities. Most of the region's largest port facilities are within 250 miles from Vermont and therefore are accessible within a single day's drive from almost anywhere in the State. These regional ports include Quebec, Montreal, Boston, Providence, New London, and New York/New Jersey. Other major ports within a two-day drive (500 miles) from Vermont include Philadelphia, Baltimore, Saint John, and Halifax.

Figure 2.18 Vermont's Airports, Park-and-Ride Lots, and Transit Service Providers

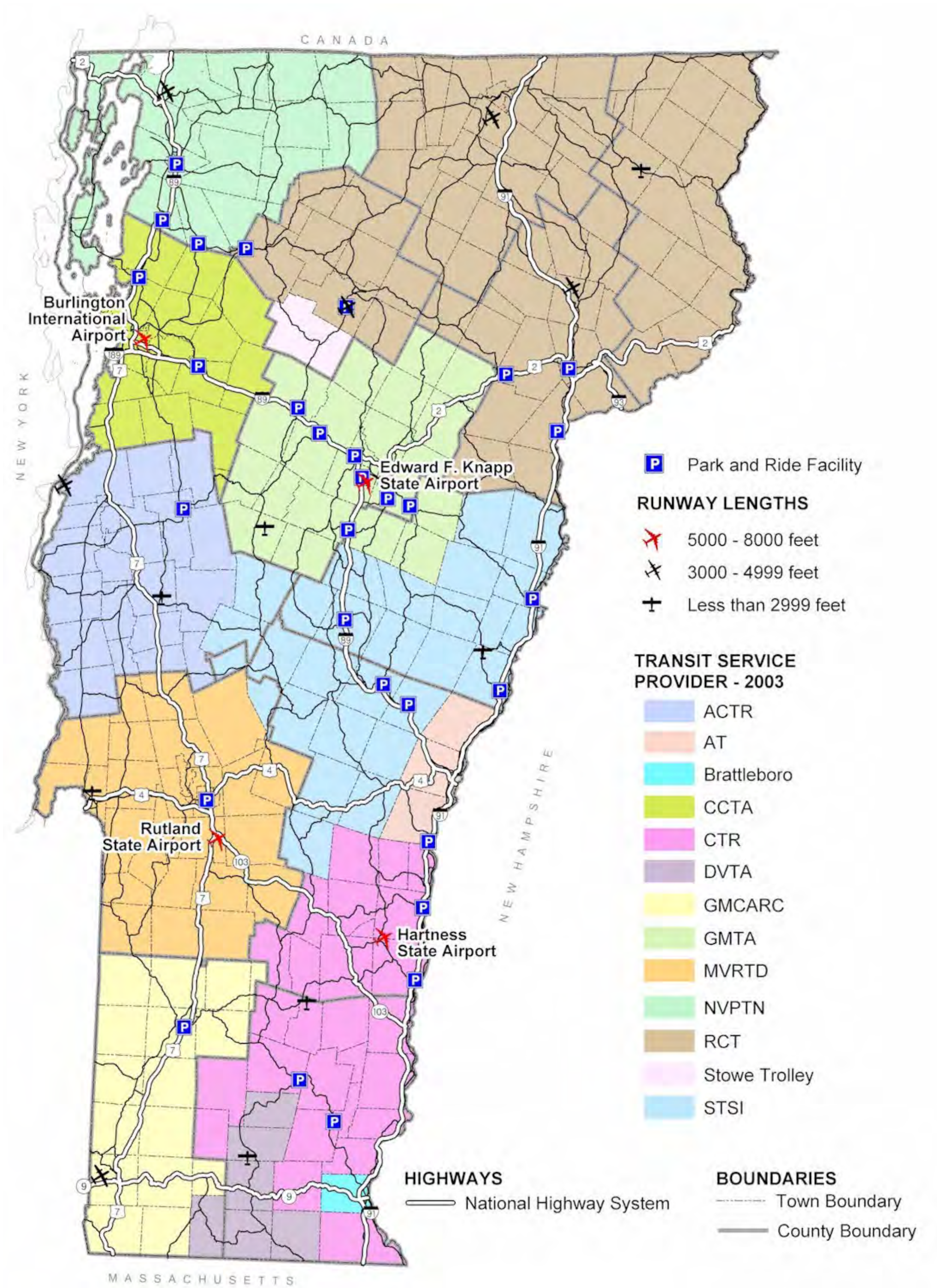
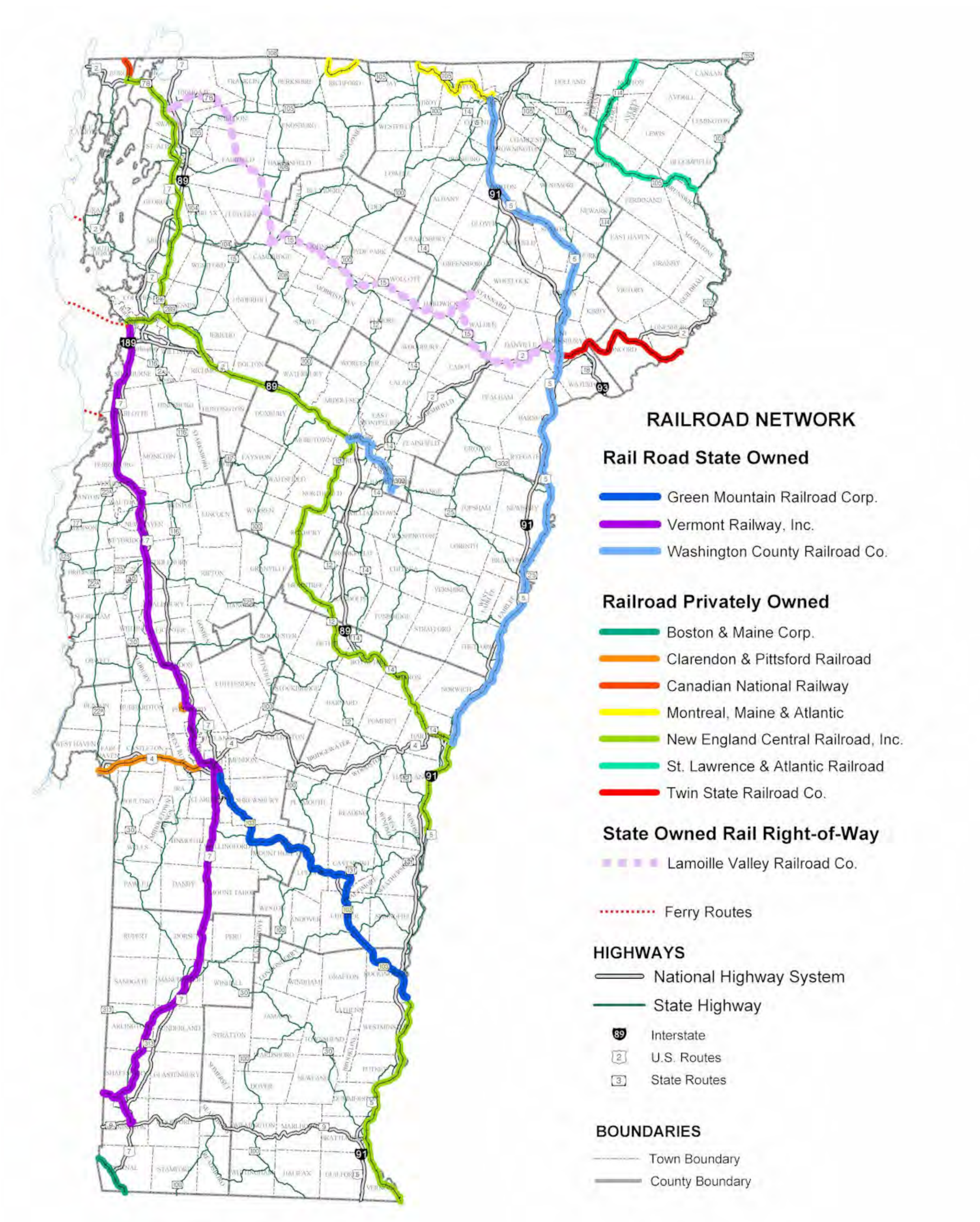


Figure 2.19 Vermont Railroad Network



The industries of Vermont rely on these regional water facilities for access to national and global supply chains (both inbound and outbound). These ports move numerous commodities to and from Vermont. For example, a manufacturer of paper products uses the Port of Quebec to import raw materials from South America. The Burlington airport utilizes the Port of Boston/Chelsea for its aviation fuel. Likewise, manufacturers utilize these ports to export their goods to their global distribution centers and international markets. Exported goods range from computer components to finished consumer goods.

To accurately characterize the role of water-borne freight on Vermont's economy it is necessary to view a wider freight transportation area. Several Vermont manufacturers utilize Pacific Coast ports (both in the United States and Canada) to access their Asian markets. These western ports typically are accessed via complex intermodal moves that include truck and rail connections.

In addition to these large container ports, Vermont's water freight infrastructure also includes ferries across Lake Champlain. These ferries are used to expedite movements of a small number of trucks, typically connecting Vermont with Northeastern New York. The ferries offer trucks the benefit of reduced trip times compared to alternate routes. Most of the data concerning these movements are anecdotal from roadside surveys conducted as part of the Vermont Statewide Freight Study.

Transit/Passenger Rail Facilities

Transit and passenger rail facilities in Vermont rely on the highway networks to serve intercity travel needs. As part of the intermodal connector network, several key facilities have been identified, including the Greyhound Bus Terminal in White River Junction. Service at this facility is provided by Vermont Transit, a private intercity carrier that connects cities in Vermont and well as providing service to New Hampshire, Massachusetts and New York.

Passenger rail service complements the highway network by providing intercity transportation between Vermont, Massachusetts and New York. Amtrak stations in Vermont are easily accessible from the highway, allowing easy dropoff and pickup for passengers traveling by rail.

Local transit service also is provided throughout the State, with fixed-route services in larger population centers and paratransit services elsewhere. The geographic coverage of local transit service providers is shown in Figure 2.18.

3.0 Future Performance and Investment Framework

Vermont's highway network serves the vast majority of all freight and passenger travel in the State, and is of critical importance to the State's economy. The system requires continuing investments to maintain its function and continue to serve the transportation needs of residents, employees, industries and visitors. The list of maintenance and improvement needs is large; including pavement resurfacing; replacement or rehabilitation of older bridges; expansion of capacity to relieve congestion in the urbanized portions of the State; roadway improvements to enhance traffic flow; measures to improve safety for motorists, bicyclists and pedestrians; traffic calming treatments, and so on. Inevitably, the dollars available for investment in the highway system fall short of the level that is desirable.

Investment choices should be made based on a detailed understanding of the specific needs and opportunities at different locations, but also with a higher-level view of the implications of different investment levels on different portions of the system. This section presents a high-level framework that facilitates a "bird's-eye" view of current and future highway system performance under different investment scenarios. This kind of view can provide valuable guidance for overall resource allocation, which complements the existing well-defined "bottom-up" methods for project identification, scoping, and design.

The performance and investment framework includes three key elements:

- Performance categories and goals, defining the major considerations driving the identification and evaluation of highway investments (Section 3.1);
- Definition of different highway system subnetworks for which different performance targets or approaches to improving performance may be appropriate (Section 3.2); and
- Specific performance measures and targets pertaining to the different subnetworks that address the performance goals (Section 3.3).

The section concludes with a 10-year analysis of future investment levels versus predicted performance for pavements and bridges, which account for the lion's share of the highway investment needs.

3.1 Performance Categories and Goals

This section describes a set of broad performance categories that provide an organizing framework for selecting appropriate performance measures for the highway system, and identifies goals for each performance category. The performance categories are:

- **Preservation –** Maintaining the physical integrity and intended function of the existing system;
- **Safety –** Preventing crashes, injuries and fatalities on the highway system;
- **Mobility –** Improving travel convenience and reducing travel time for passengers and goods movement; and
- **Environment/Quality of Life –** Protecting natural resources and historic sites, and maintaining Vermont's scenic beauty and quality of life.

These categories are intended to clearly and simply communicate desired outcomes for investments in the highway system. The categories recognize the goals established in the LRTP and subsequent objectives established by the agency's Secretary and Executive Staff as well as work completed to date by VTrans on establishing internal performance measures for the agency's budget process. The categories also relate to the highway program structure, i.e., the categories used for organizing projects or allocating funding. This allows the desired outcomes from highway investments to be directly related to the planned expenditures in each program category, and also helps to establish clear evaluation criteria for particular types of projects.

Transportation goals for each category are shown in Table 3.1. These goals are consistent with the LRTP and other existing VTrans policies such as the Safety Management System, and also reflect feedback from agency staff and other stakeholders in the development of the Highway System Policy Plan.

These goals guide the identification of specific performance measures and targets for every category and goal. Each of the goals also is considered in the development of highway policies and strategies, as discussed in Section 4.0.

Table 3.1 Performance Categories and Goals

Performance Category	Goals
Preservation	• Protect the existing investment in the highway network by keeping it in serviceable condition. • Provide acceptably smooth and safe driving surfaces. • Minimize the need to restrict or close bridges by maintaining their structural integrity in accordance with current and anticipated loadings. • Negate the risks of structure failure. • Minimize the life-cycle cost of maintaining acceptable condition levels.
Safety	• Minimize the occurrence and severity of crashes on the highway network through application of appropriate, context sensitive design standards and cost-effective improvements to address high-accident or high-risk locations. • Minimize conflicts between vehicles, pedestrians and bicycles.
Mobility	• Maintain safe and efficient flow of traffic at acceptable speeds. • Provide convenient interstate and intercity connections for passengers and freight. • Support economic development consistent with established regional and local growth plans. • Provide convenient connections to intermodal facilities.
Environment/ Quality of Life	• Support and reinforce state policies for compact growth patterns. • Manage undesirable impacts of truck traffic in downtown areas. • Minimize negative environmental impacts of highways. • Maintain existing air quality attainment status.

■ 3.2 Highway System Elements

Given the performance categories and goals for the highway system described above, the next step in the development of the Highway System Policy Plan was to identify how policies for achieving these goals, and performance measures for tracking their achievement should vary across different elements of the highway system.

For Preservation, it is useful to define different portions of the highway system based on overall function and level of importance. While it is desirable for all roads and bridges to be maintained in good condition with proper preventive maintenance, resource limitations inevitably force difficult choices. In making such choices, it is common to distinguish higher-priority components of the highway network, which tend to be more heavily traveled and/or form part of a backbone network of statewide significance, from components that are more lightly traveled and serve trips that are more local or regional in nature. Once different segments of the highway network are defined, the condition, remaining life or remaining value of infrastructure can be monitored for these different segments, and preservation resource allocation decisions can reflect the relative "health" of these different segments.

For Safety, policies and performance measures are most appropriately set on a system-wide basis – the objective is to prevent and reduce crashes, injuries and fatalities on the entire highway system in the most cost-effective manner – thus no specific highway system elements have been defined for purposes of differentiating safety-related policies.

For Mobility, it is most logical to examine system performance and establish policies at a corridor level, where corridors are defined as one or more routes connecting major origins and destinations. A corridor perspective allows for tracking of "how long does it take to get from A to B?" It also allows for policies to vary based on the presence of alternate routes and/or modes.

For both Mobility and Quality of Life goals, it is also important to consider current and planned/desired land use characteristics adjacent to the highway. The nature of adjacent land use affects both performance objectives and policies in the following ways:

- Highway users tolerate greater levels of congestion in urban areas than in rural settings – congestion-related performance targets often reflect this distinction;[1]

- Land use characteristics determine constraints on the nature of improvements that should be considered based on concerns for historic preservation, environmental sensitivity, noise and traffic disruption; and

- Access and corridor management policies need to reflect the nature of existing land uses, and account for both designated growth areas as well as areas at high risk for emerging development patterns that could adversely impact future highway operations.

Therefore, three types of overlay categories are defined for establishing highway system performance standards and policies – one based on subdivisions of the network, one based on intercity corridors within the State, and one based on land uses. Each of these categories is discussed below.

---

[1] The AASHTO Green Book (A Policy on Geometric Design of Highways and Streets 2000, 4th Edition, American Association of State Highway and Transportation Officials, Washington DC), pp. 76-85 includes a discussion of criteria influencing driver perception of congestion, as well as recommendations for higher levels of service on rural than urban facilities.

Networks

This policy plan designates a Primary Network for establishing preservation standards and certain design and investment policies (see Figure 3.1). The proposed Primary Network coincides with the existing Vermont commercial vehicle network shown in Figure 2.9. The term "Primary Network" was chosen to reflect the broader function of this network as providing not just an essential set of links for statewide goods movement, but also for statewide passenger movement connecting the primary population centers. The Primary Network includes the NHS and designated NHS Intermodal Connectors as well as portions of other routes (including VT 22A, U.S. 302, VT 105, and urban avoidance routes), which have been designated by the State as important for interregional travel, and connect the larger population centers in Vermont. As illustrated in Figure 2.13, 76 percent of the State's population and 86 percent of its employment are within a 10-minute drive from the Primary Network. The Primary Network (including the Interstate System) carries 60 percent of the vehicle miles of travel (VMT) on the SHS.

The *Interstate System* is called out as a subcategory of the Primary Network, given its particular importance to the highway transportation system in Vermont, and the nation. The Interstate system accounts for one-half of the Primary Network mileage and also carries half of the Primary Network vehicle miles of travel (or 30 percent of SHS VMT) [2].

The SHS represents the entire set of highways that are under VTrans jurisdiction. Class 1 town highways, which are extensions of state highways through towns, represent an important complement to this system, even if they are not directly under VTrans jurisdiction, because they create a continuous system of routes that are used for intrastate travel. The portion of the SHS off of the Primary Network accounts for over one-half of the total SHS mileage, and carries roughly 40 percent of the SHS vehicle miles of travel.

For performance standards in this policy plan that vary by network level, three highway subnetworks are used, reflecting the above definitions:

1. The Interstate Highway System ("Interstate");

2. Other roads on the Primary Network ("Non-Interstate Primary"); and

3. Other roads on the SHS ("Off-Primary").

---

[2] This statistic is from the pavement management system, which tracks two-lane miles rather than centerline miles. Two sides of a divided highway are treated as separate sections. Therefore, the Interstate mileage from the pavement management system is roughly double the number of Interstate centerline miles (as reported in Table 2.1).

Figure 3.1 Vermont Primary Network

Corridors

Assessing the performance of the highway system with respect to mobility is best done using a corridor approach; for example, by measuring travel time along routes that serve as major intrastate or interstate travel corridors. This policy plan defines a set of intercity corridors that consist of pairs of primary population centers, connected by the Primary Network. These corridors are shown in Table 3.2.

The corridors represent major origin-destination pairs (including connections to neighboring states). A few corridors have been defined with an origin or destination within New York State in order to reflect actual trip-making characteristics. However, performance targets for corridors apply only to the portion of the corridor within the State of Vermont.

Table 3.2 Major Intercity Corridors

Start	End	Route
North-South		
Bennington	Rutland	U.S. 7
Rutland	Burlington	U.S. 7
Albany, New York	Burlington	I-87/U.S. 4/VT 22A/U.S. 7
Burlington	Canadian Border	I-89
Burlington	Champlain, New York	I-89/VT 78/U.S. 2
Burlington	Montpelier	I-89
Montpelier	White River Junction	I-89
Brattleboro	White River Junction	I-91
White River Junction	Canadian Border	I-91
East-West		
Brattleboro	Bennington	VT 9
Brattleboro	Rutland	I-91/VT 103
White River Junction	Rutland	U.S. 4
Rutland	New York State Line (Fair Haven)	U.S. 4
Montpelier	St. Johnsbury	U.S. 2
St. Johnsbury	New Hampshire Border	I-93
Burlington	Newport	I-89/VT 105, or VT 15/100

Land Use

Land use area types are the third category for establishing performance targets and highway policies. The land use categories follow the basic structure defined in the Vermont State Design Standards, which allow for variation in roadway cross sections and levels of service based (in part) on land use category. Thus, the recommended land use categories are:

- **Large Cities and Towns.** These are downtown commercial districts within urban areas. Performance standards recognize that a higher degree of congestion is tolerated in urban areas; policies for these areas recognize the need to balance mobility with local access provisions.

- **Smaller Towns and Villages.** These include smaller downtown areas and traditional village centers that are not urban in character. Performance standards and policies for these areas recognize the smaller scale of activity as well as the desire to preserve the historic character of these centers.

- **Suburban Corridors.** These are corridors outside of downtown areas, but within or adjacent to urban areas where lower-density commercial and residential development has occurred.

- **Rural Corridors**. These are defined as highway sections outside of urban areas where adjacent land is undeveloped. Performance standards and policies for these areas facilitate the movements of primarily through traffic.

An additional overlay on the land use categories acknowledges locally designated growth centers. These may coincide with existing towns and villages, or may be new planned areas. Proactive planning to maintain capacity and service on highways serving designated growth areas is an important aspect of the Highway System Policy Plan.

The growth center concept has been developed over the past 15 years by state and local agencies, organizations, and community groups. The idea is that certain areas should be designated for future growth, in a manner that allows supporting infrastructure to be planned for and efficiently provided. Land outside of these areas will remain largely rural in character. The Agency of Natural Resources (ANR) defines growth centers as areas for concentrating development, consisting of "moderate to high-density development, a range of housing options with nearby shopping and employment opportunities, and pedestrian, bicycle and transit accessibility."[3] ANR is using the growth center concept in establishing wastewater improvement funding priorities.

[3] Agency of Natural Resources, "Infrastructure Funding Programs and Growth Centers White Paper." Draft 9, May 9, 2001. http://www.central-vt.com/legis/growctr/anrgrow.htm.

Characteristics of growth centers that are particularly relevant to transportation include:

- Lot size, road width, and setback requirements that replicate traditional growth center patterns already present within historic communities; and
- A circulation system that is conducive to non-motorized travel, and supports transit opportunities.

3.3 Performance Measures and Targets

Selected performance measures and targets for different highway system elements are discussed below by performance category (preservation, safety, mobility, and environment/quality of life) and are summarized in Table 3.3. These measures and targets were chosen based on reviews of other state practices, as well as on discussions with VTrans staff regarding which measures and targets would be most appropriate and feasible to establish for the Vermont SHS. The performance measures in this plan are designed to represent the customer's perspective, and therefore are organized by category, since these categories directly relate to how the system is perceived by the user.

Table 3.3 Vermont Performance Measures and Targets

Performance Category	Performance Measure	Level of Application	Baseline (2002)	Target
Preservation				
Pavements	Average Condition Index of Vehicle Miles Traveled	Interstate	79	Maintain existing conditions[1]
		Non-Interstate Primary	68	
		Off-Primary	62	
	Percent lane miles with "very poor" condition rating	Interstate	1%	Maintain existing conditions[1]
		Non-Interstate Primary	7%	
		Off-Primary	23%	
Structures	Number of restricted bridges (weight limits, height restrictions, one-lane bridges)	Interstate	0	0
		Non-Interstate Primary	2	Maintain adequate connectivity; keep bridges open or provide detour route
		State-owned Off-Primary	6	
	Number of structurally deficient bridges (>20 feet)	Interstate	36	Maintain existing conditions[1]
		Non-Interstate Primary	27	
		State-owned Off-Primary	116	
	Number of structurally deficient short structures (six to 20 feet)	Interstate	48	Maintain existing conditions[1]
		Non-Interstate Primary	50	
		State-owned Off-Primary	129	
	Average health index (> 20 feet)	Interstate	90	Maintain existing conditions[1]
		Non-Interstate Primary	88	
		State-owned Off-Primary	84	

Table 3.3 Vermont Performance Measures and Targets (continued)

Performance Category	Performance Measure	Level of Application	Baseline (2002)	Target
Safety				
	Number of major crashes per year[2]	All	1,244 (in 1998)	Five percent reduction from 1998 to 2008 (per Safety Management System)
	Percent of high-priority safety needs addressed (high accident location and high benefit/cost improvement)	All		100 percent within five years of identification
Mobility				
	Average travel time between major cities	Corridors on Primary Network	See Table 3.4	No decline in average travel time from current levels
	Maximum V/C ratio on state highways	Urban area downtowns		0.9
		Rural corridors		0.7
		Other (small towns/ villages, suburban corridors, growth areas)		0.8
	Percent of employment within 10 minutes of the Primary Network	All	86% (2000)	Maintain current level
	Percent of Employees Living within 10 minutes of the Primary Network	All	76% (2000)	Maintain current level
Environment/Quality of Life				
	Air quality attainment status	All	No non-attainment areas	Maintain current attainment status

[1] Pavement and bridge preservation targets to "maintain existing conditions" refer to the overall system condition and not to individual projects. These targets should be viewed as "pragmatic" given current fiscal realities. Desirable targets for preservation are discussed below.

[2] Major crashes include fatal, "serious injury," and "moderate injury" crashes.

Preservation

Pavements. The two selected pavement performance measures are consistent with those which have been used by VTrans over the past several years. Both measures are customer-oriented; i.e., they are proxies for the impacts of pavement condition on road users. The first measure – average travel-weighted condition provides a broad picture of how pavement conditions experienced by road users are changing over time. This measure reflects that fact that responsible stewardship of the highway system requires not only fixing roads in very bad condition today, but also making prudent investments to prevent worsening conditions over the long term. Because it is generally more cost-effective to invest in a pavement still in fairly good condition than it is to replace a pavement in poor condition, it is important to carefully track the distribution of system length in different condition categories or remaining life categories (e.g., zero to five years, five to 10 years, over 10 years), and make investments to minimize the overall life-cycle costs of maintaining pavements. VTrans uses a pavement management system which incorporates appropriate decision rules for what types of treatments are most cost-effective at different phases of a pavement's life. This tool should be used to track remaining life and develop replacement and rehabilitation cycles that minimize life-cycle preservation cost. The second measure – "percent in very poor condition" was selected as a supplementary measure to recognize the fact that road user costs (travel time, fuel usage, vehicle wear-and-tear, accidents) begin to increase significantly when pavement surfaces are very rough[4].

Structures. The performance measures selected by the VTrans Performance Measures Subcommittee related to structures – number of restricted bridges and number of structurally deficient bridges – also are adopted in the Highway System Policy Plan. Separate targets are established for the Interstate system, the Non-Interstate Primary Network, and for state-owned bridges off of the Primary Network.

A *restricted* bridge is one which is either closed to traffic, or posted for reduced loads. A bridge is classified as *structurally deficient* if it has a poor condition rating for one of its major components[5]. In addition, the average *health index* is established as a performance measure. The health index is calculated by the VTrans bridge management system, and reflects the remaining value of bridges, accounting for the condition of each structure element, and their replacement (or failure) costs. This measure is analogous to remaining life, in that it can be set to move towards a preservation strategy that minimizes long-term preservation costs.

Desirable Preservation Targets

The "maintain existing conditions" target for pavement and bridges under the preservation performance category refers to the overall condition of the system and it does not address the condition of specific bridges or sections of pavement. This target was selected taking into account fiscal realities in the State and it represents a pragmatic rather than a desirable target. The *desirable* pavement and bridge performance targets are:

---

[4] FHWA's Interim Technical Bulletin on Pavement Life-Cycle Cost Analysis (Publication FHWA-SA-98-079 – "Life-Cycle Cost Analysis in Pavement Design) cites research from New Zealand indicating that user costs begin to accrue at an IRI of 170 inches/mile, which corresponds to a Present Serviceability Rating (PSR) of 2.5 (fair condition) and increase non-linearly as condition declines.

[5] Structural deficiency is determined based on National Bridge Inventory inspection results. A bridge is designated as structurally deficient if at least one of the following conditions are met: the deck, superstructure, or substructure is given a condition rating of 4 or below (poor) on a scale of 1-7; a culvert is given a condition rating of 4 (poor) on the 1-7 scale; the structure appraisal rating is 2 or below on a scale of 1-9 (intolerable, high priority for replacement); or the structure spans a waterway and its waterway adequacy is 2 or below on a 1-9 scale (intolerable with a high priority for replacement).

- **Both Pavements and Bridges –** maintain a distribution of condition that is sustainable over the long term with a relatively steady investment level and which minimizes life-cycle costs.
- **Pavements –** Keep the percent of very poor length to less than five percent on the Primary Network, and to less than 10 percent on the Off-Primary Network.
- **Bridges –** Eliminate all structurally deficient long structures on the Primary Network. Reduce the number of structurally deficient long structures off of the Primary Network to five percent or less of the total (no more than 26 of the 530 structures). Reduce the number of structurally deficient short structures on all networks below five percent of the total (no more than 65 of the 1,306 structures).

Safety

Work already performed for VTrans to develop a Safety Management System (SMS) has established statewide goals for major or "serious" crash reduction of five percent by 2008. A serious crash is one involving a fatality, a serious injury or a moderate injury. The SMS recommended the use of serious crashes as the primary performance measure because these types of crashes have the highest economic and social costs. Supporting data are also more reliable for serious crashes, since minor crashes tend to be underreported.

The safety target established by the SMS is adopted by the Highway System Policy Plan, but is supplemented with an additional target that is related to the contribution to crash reduction attributable to highway safety improvements (as opposed to education, enforcement, and regulatory actions). This target is the percent of high-priority safety needs addressed, where "high-priority safety needs" are defined as consisting of an identified high accident or high-risk location with a high benefit/cost ratio for improvement. The Highway Safety Improvement Program (HSIP) identifies high-risk locations, provides a benefit/cost assessment of improvements, and includes a well-defined process for prioritizing and implementing safety improvements. The information emerging from the HSIP therefore provides a solid basis for establishing and tracking achievement of safety-related performance targets.

The social and economic costs of a crash are irrespective of the type of facility on which the crash occurs, and therefore safety performance measures are independent of highway classification.

Mobility

Mobility standards relate to the travel time and convenience with which people and goods can travel. Four basic mobility standards are defined in this policy plan:

- **Corridor travel time for major intercity corridors within Vermont.** Corridor travel time is an all-encompassing measure that reflects design speeds, levels of congestion, and directness of routing. Current corridor travel times and average travel speeds for major intercity pairs on the Primary Network were determined using the Statewide

Travel Demand Model – which estimates average daily traffic – and are shown in Table 3.4. There is no "absolute" standard for corridor mobility, and reasonably attainable travel times will depend on terrain, level of development, and other factors. Primary corridors with low average travel speeds compared to other corridors, though, are obvious candidates for improvement.

- **Volume-to-capacity (V/C) ratio.** V/C ratios relate to levels of congestion and delay on specific roadway segments. As the V/C ratio approaches 1.0, the roadway is operating at or near capacity, traffic flow conditions become unstable and delay increases significantly. This policy plan sets performance standards based on average daily traffic that vary by area type, with the most stringent standards in rural areas (V/C < 0.7) and the least stringent standards in urban area downtowns (V/C < 0.9). It is common to tolerate greater congestion levels for urbanized areas, especially densely built-up areas. Some level of congestion is inevitable in such areas, and congestion is generally more acceptable on a short-local trip than on a long-distance intercity trip. Also, the designs required to reduce or eliminate congestion may be incompatible with other fundamental qualities of the urban environment (e.g., density of population, pedestrian-oriented character, and historic character).

- **Percent of employment within 10 minutes of the primary network.** This is a measure of the extent to which the defined Primary Network adequately serves businesses in Vermont, for freight/goods access as well as access by workers and customers.

- **Percent of employees living within 10 minutes of the primary network.** This measure addresses the extent to which the primary network provides accessibility to Vermont employees living in population centers that are far away from employment centers.

  These two measures of accessibility are affected not only by the location and extent of the Primary Network, but also by land use and development patterns. Over the long-term, the public cost of achieving performance targets for these measures will be lowered by regional and local land-use strategies that encourage development within designated growth centers currently well-served by the Primary Network.

In addition to the above four mobility measures, there are other factors that should be considered in making investments to improve mobility. Adequate data are not available, however, to set specific, quantitative standards for these measures. Some of these factors include:

- **Travel time reliability.** The ability to reach a destination within a known travel time is important, even if congestion is encountered during the journey. Crashes, work zones, and major events are three factors that can negatively affect travel time reliability.

- **Intermodal access and mobility for freight and passenger travel.** Providing adequate access from major freight generators or intermodal terminals to the NHS is an important concern for businesses. Load restrictions, permit requirements, and delays on truck routes also affect freight mobility. Passenger access to airports and rail and bus terminals can be important for economic development as well as basic mobility purposes.

Table 3.4 Major Intercity Corridors: Baseline Mobility Levels[6]

Start	End	Travel Dist (Miles)	Travel Time (Minutes)	Speed (MPH)	Comments
North-South					
Bennington	Rutland	55	68	49	
Rutland	Burlington	67	96	42	via U.S. 7
U.S. 4 @ New York Border (from Albany, New York)	Burlington	65	89	43	via VT 22A
Burlington	I-89 at Canadian Border	43	44	59	
Burlington	U.S. 2 at New York Border (from Champlain, New York)	54	61	53	
Burlington	Montpelier	40	41	58	
Montpelier	White River Junction	56	56	60	
Brattleboro	White River Junction	62	63	59	
White River Junction	I-91 at Canadian Border	108	102	63	
East-West					
Brattleboro	Bennington	40	54	45	
Brattleboro	Rutland	73	90	48	via I-91/VT 103
White River Junction	Rutland	47	65	43	
Rutland	U.S. 4 at New York Border	19	25	46	
Montpelier	St. Johnsbury	37	51	43	
St. Johnsbury	New Hampshire Border	11	14	46	via I-93
Burlington	Newport	88	120	44	via I-89/VT 105

Note: Travel speeds reflect access and egress to/from town centers, so they are lower than mainline speeds.

Environment/Quality of Life

Environmental and quality-of-life concerns relate generally to the impacts of roads and vehicular traffic on noise, air quality, ecology, historic and scenic areas, and local communities. The impacts of heavy vehicle traffic, including noise and emissions, in densely

[6] All travel distances and times are measured from the downtown of the respective city using Vermont's Statewide Travel Demand Model.

settled town centers has long been a particular concern in Vermont. Broader concerns about sprawl also have been actively discussed – some Vermonters feel that highway policy should seek to prevent sprawl and encourage compact development patterns. However, the recent LRTP effort found that opinions about using transportation as a mechanism to limit urban sprawl are highly polarized.

Goals are commonly set in other states to achieve or remain in attainment with national ambient air quality standards. Currently, no areas in Vermont are in violation of air quality standards. However, the Burlington and Bennington areas may be at risk under the new eight-hour standards for ozone and particulate matter. This policy plan establishes a goal of keeping these areas in attainment.

As stated above, the mobility-related performance measure of maintaining the current proportion of employment within 10 minutes of the Primary Network reflects the Environmental goal of supporting compact development patterns.

The HSPP does not establish explicit quantitative performance measures for the remaining two goals in the Environment/Quality of Life category (manage undesirable impacts of truck traffic in downtown areas, and minimize negative environmental impacts of highways). These goals are best addressed in the context of particular locations, and there are existing environmental regulations and project development processes in place to determine appropriate standards and strategies that fit specific circumstances.

■ 3.4 Investment Tradeoffs

Advances in data analysis and modeling techniques are providing tools that can be used to assess tradeoffs resulting from different levels of investment. Two VTrans asset management systems include the capability to analyze impacts of different investment levels on performance – the pavement management system, and the bridge management system. The pavement management system can be used, for example, to predict the percentage of pavement in "poor" condition 10 years in the future, for a given level of annual investment between now and then. The 10-year period was selected because beyond this timeframe, there is significantly less confidence in the predictive models that are available.

The pavement and bridge management systems are currently being actively used to manage inventory information and store condition inspections. VTrans is now at the point for each of these systems where there is enough historical data to develop more accurate predictive performance models. Such models will allow the agency to better understand the likely changes in pavement and bridge condition given different future investment levels.

While VTrans continues to make progress towards improvement in its predictive capabilities, current pavement and bridge management system models (based on national data and expert judgment) have been used to provide a rough picture of the relationship between investment and performance.

In addition, the FHWA's national Highway Economic Requirements Analysis (HERS) model was run for Vermont's sample Highway Performance Monitoring System (HPMS) data in order to demonstrate how this model could be used in the future to supplement Vermont's understanding of the relationship between investment and highway performance. FHWA requires that all states collect a standard set of highway performance data in order to track the status of the nation's highway system over time. The HERS model takes HPMS data as its input, uses engineering standards to identify highway deficiencies, and then applies economic criteria to select the most cost-effective mix of improvements for systemwide implementation. HERS produces estimates of the costs of making these improvements. The HERS model predictions also include impacts on highway deficiencies (compared to standards), as well as changes in user costs (which are a function of travel time reductions, accident reductions, and speed changes). Because Vermont's HPMS dataset covers only a small sample of highways, and excludes rural minor collectors and all local roads, the HERS results need to be interpreted with caution. Supplementation of the Vermont HPMS data (using already existing data sources) is recommended to provide more meaningful results. The HERS model results are shown in Appendix B.

The remainder of this section presents the results of the tradeoff analysis conducted for pavements and bridges using the current management models. The results can be used for purposes such as estimating the future condition of the network if current funding levels are maintained; estimating the minimum funding required to maintain status quo performance conditions; and estimating the additional funding required to bring conditions up to a set performance target. It should be noted that these investment analyses do not take into account possible technological advances in highway engineering that could potentially decrease the costs of preserving/improving the system nor do they address the fact that the agency is continuing to improve the way it manages Vermont's highways. Note also that all of the costs are expressed in 2002 dollars, so to derive future year budget requirements they would need to be adjusted for inflation.

Pavement

VTrans' Pavement Management System is a data management and analysis tool containing information about the characteristics of each pavement segment on the Vermont State highway network. The system tracks changes in pavement condition over time based on annual field surveys. It can be used to develop pavement treatment strategies that maximize benefits given a budget constraint, and to understand future pavement performance that would result from different levels of investment.

The Pavement Management System was used to simulate pavement condition over a 10-year period, from 2002 through 2011, under varying assumptions about the size of the annual budget for pavement work. Separate scenarios were run for the three portions of the SHS defined above in Section 3.2 (Interstate, Non-Interstate Primary, and Off-Primary).

Detailed results of the analysis are shown in Figures 3.2 (Interstates), 3.3 (Non-Interstate Primary), and 3.4 (Off-Primary). Each of these figures show how pavement performance would be expected to vary at the end of the 10-year analysis period for different annual investment levels.

Key findings of this analysis are summarized as follows:

- The Interstate Primary system accounts for 21 percent of the pavement two-lane miles[2] 30 percent of all travel (VMT) and 47 percent of the truck travel on the SHS. This system will require roughly $12 million to $13 million per year to maintain the same condition as today (both with respect to the percent of very poor miles and the travel-weighted average condition). At lower levels of investment, the pavement management system results show a sharp decline in average condition and a sharp increase in the percent of miles in very poor condition. Between 1998 and 2002, the average annual investment in Interstate pavements has been $10 million. If this level of investment were to continue over the next 10 years, the results indicate that the average pavement condition index would decline from the current level of 79 (on a scale of 0 to 100) to 77, and the percent of very poor miles would increase from today's one percent to 10 percent.

Figure 3.2 Annual Pavement Investment versus Performance (2002-2011)
Interstate

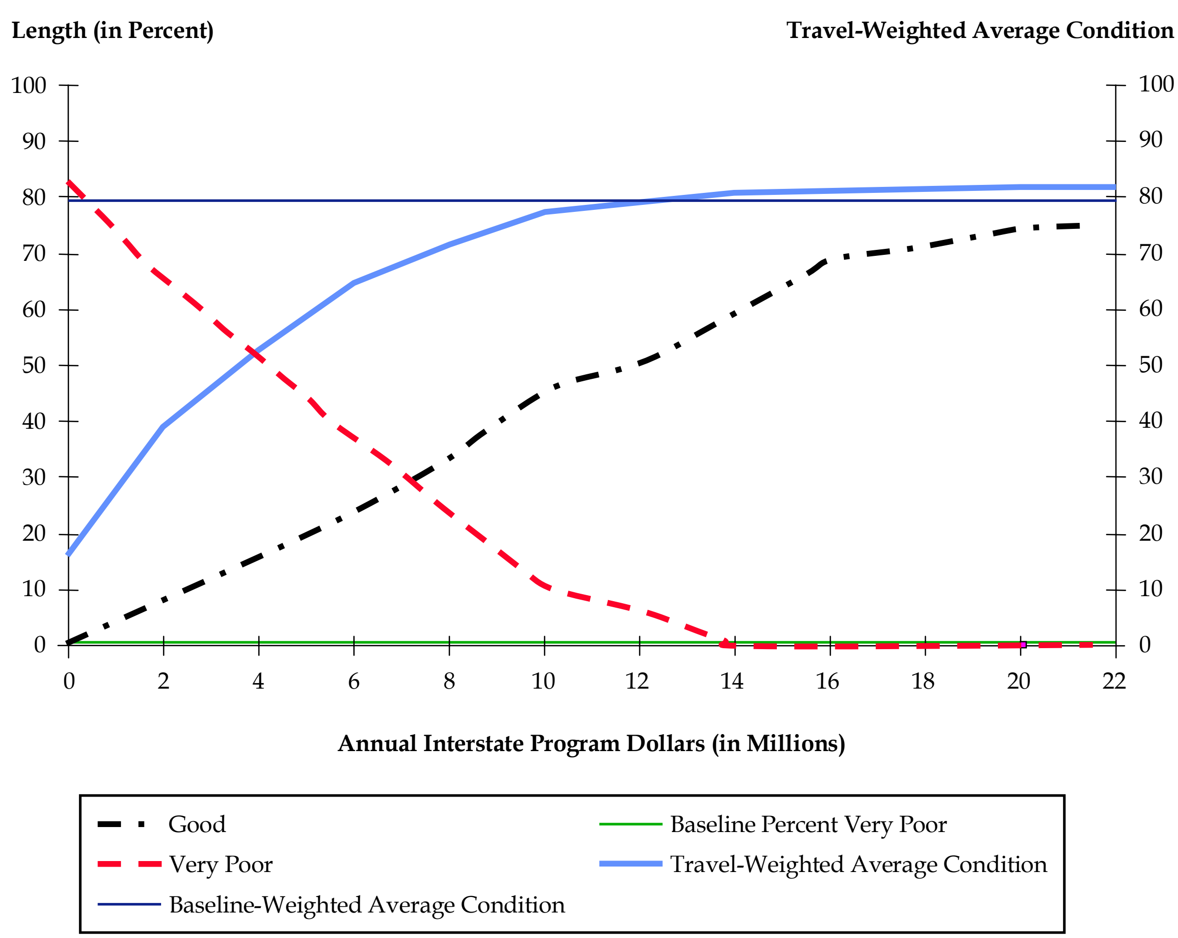
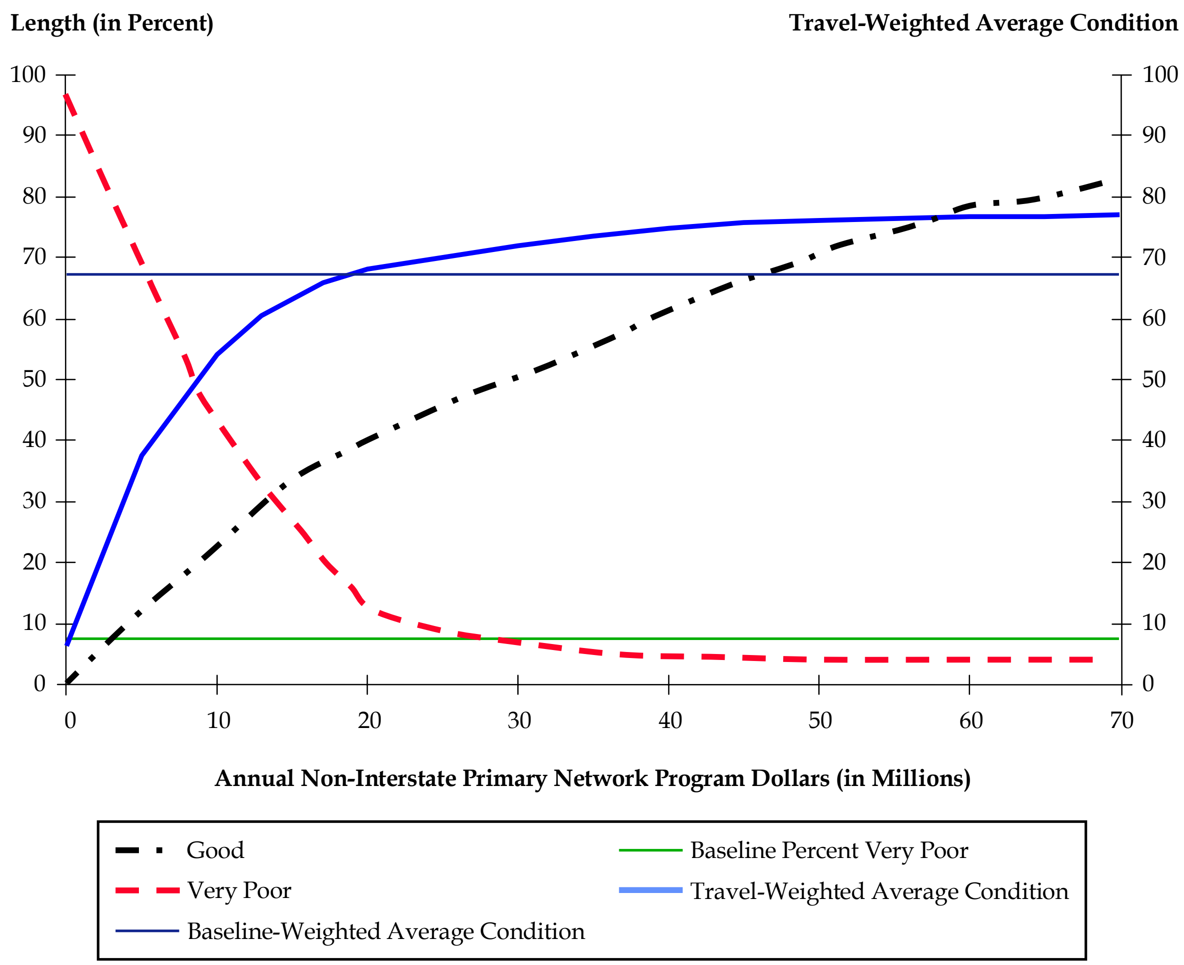
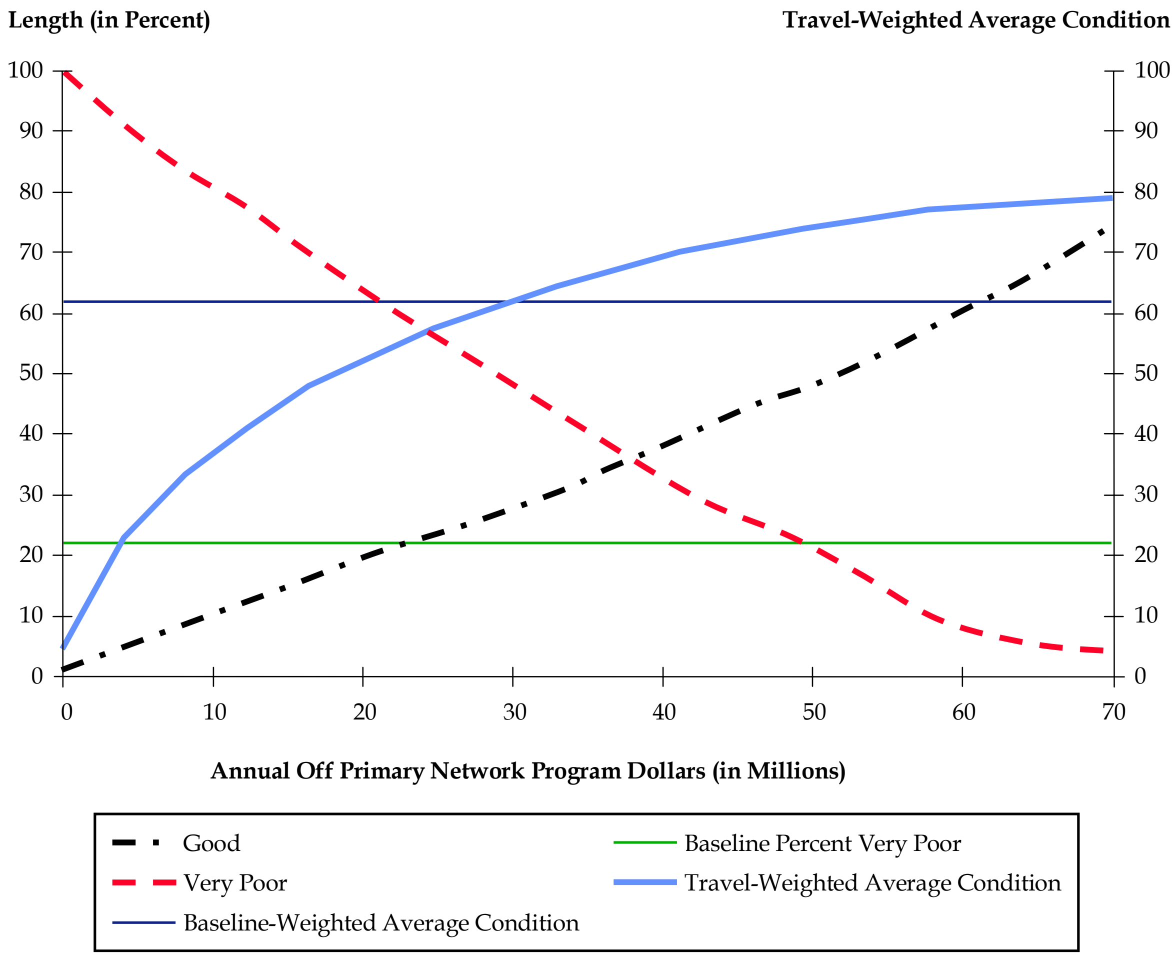


Figure 3.3 Annual Pavement Investment versus Performance (2002-2011)
Non-Interstate Primary Network



- The Non-Interstate Primary System accounts for another 21 percent of the SHS mileage, and carries 30 percent of the vehicle miles and 28 percent of the truck miles of travel on the SHS. To keep the percent of very poor miles at or below the current level of seven percent on this subnetwork, the Pavement Management System indicates the need for an annual investment of $30 million. To maintain the current travel-weighted average condition level of 68, an annual investment of $20 million would be required. The average level of investment for this subnetwork over the past five years has been $11 million. If this funding trend were to continue over the next decade, the Pavement Management System predicts a decline in the travel-weighted average condition index to 56, with the percent of very poor miles rising to 40 percent.

Figure 3.4 Annual Pavement Investment versus Performance (2002-2011)
Off-Primary Network



- The Off-Primary System accounts for 58 percent of the SHS mileage, 40 percent of the vehicle miles, and 25 percent of the truck miles of travel on the SHS. To maintain the current travel-weighted condition index of 62, an annual investment level of $38 million would be required. To maintain the current percentage of poor miles at the current level of 23 percent would require an investment of $57 million annually. The five-year trend funding level for this subnetwork has been $17 million annually. The predicted performance if this trend continued over the 10-year analysis period would be an increase in very poor pavements from 23 percent to 73 percent. The travel-weighted average condition would decline from the current level of 62 to 43.

Based on this analysis, four investment scenarios have been developed involving different annual investment levels and allocations across the three subnetworks. The first three scenarios ($63 million to $109 million) represent increased funding levels over the historical average; the fourth scenario represents maintaining roughly the same average funding for pavement as over the past five years ($40 million).

- **Scenario 1: High Investment Level –** This scenario would improve pavement condition on all systems. The share of very poor miles would be negligible on the Interstate, five percent on the non Interstate Primary, and 21 percent on the Off-Primary Network. Average travel-weighted conditions would be 81 on the Interstate, and in the 73 to 74 range on the other two systems. This scenario would cost an average of $109 million per year.
- **Scenario 2: Medium Investment Level –** This scenario would allow very slight deterioration of the Intestate system, but still keep this system in very good condition (three percent of the system in very poor condition; average travel weighted condition of 80). It would hold the share of Non-Interstate Primary miles in very poor condition to its current level (seven percent), but would improve the travel-weighted average condition on this network from 68 to 72. It would allow a moderate decline in the condition of Off-Primary system, both with respect to the share of very poor miles (from 23 percent to 30 percent) and with respect to the average travel-weighted condition (from 62 to 69). This scenario would cost an average of $93 million annually.
- **Scenario 3: Low Investment Level –** This scenario is the same for Interstates as the previous scenario. It holds the travel-weighted average condition for the Non-Interstate Primary network to the existing level of 68, but does allow the share of very poor miles on this network to increase from seven percent to 12 percent. The Off-Primary network experiences significant declines in condition – 55 percent of its length would be in very poor condition, and the average travel weighted condition would decrease from 62 to 56. This scenario would cost an average of $63 million per year.
- **Scenario 4: Current Funding Level** – This scenario is for an investment level roughly equal to the historical level ($40 million annually). It allows significant deterioration on all three systems. The Interstate system would be maintained at the highest condition level; the Off-Primary would be in the worst shape, with 76 percent in very poor condition.

Table 3.5 compares the required annual funding for these scenarios by network level, and their performance outcomes in the year 2011.

Table 3.5 Alternative Pavement Investment Scenarios

Investment Scenario	Network Level	Funding (per year)	Percent Length in "Very Poor" Condition		Travel-Weighted Average Condition	
			Baseline	Projected	Baseline	Projected
1. High Investment Level *$109 million/year*	Interstate	$14 million	1%	0%	79	81
	Non-Interstate Primary	$35 million	7%	5%	68	74
	Off-Primary	$60 million	23%	21%	62	73
2. Medium Investment Level *$93 million/year*	Interstate	$13 million	1%	3%	79	80
	Non-Interstate Primary	$30 million	7%	7%	68	72
	Off-Primary	$50 million	23%	30%	62	69
3. Low Investment Level *$63 million/year*	Interstate	$13 million	1%	3%	79	80
	Non-Interstate Primary	$20 million	7%	12%	68	68
	Off-Primary	$30 million	23%	55%	62	56
4. Current Funding *$40 million/year*	Interstate	$10 million	1%	10%	79	77
	Non-Interstate Primary	$15 million	7%	25%	68	63
	Off-Primary	$15 million	23%	76%	62	40

Bridge

The analysis of bridge investment versus performance included the following three groups of long structures (over 20 feet in length) on Vermont's SHS[7]:

1. Interstate Primary (314 structures);

2. Non-Interstate Primary (190 structures); and

3. State-owned structures on the SHS but off the Primary Network (530 structures).

This set of 1,034 bridges accounts for 96 percent of the bridges on the SHS. The remaining four percent are bridges off of the Primary Network that are locally or privately owned.

Two of the three structure performance measures were analyzed – the average health index, and the number of structurally deficient bridges. These measures were described

[7] This analysis does not include 1,307 large culverts and large retaining walls that the agency is responsible for managing.

above in Section 3.3. Predictive capabilities for the third measure (number of restricted bridges) are not available in the bridge management system.

Rather than looking at performance at the end of the 10-year period as was done for the pavement analysis, the bridge analysis results are presented in terms of the average performance over the entire 10-year period. This is because the number of structurally deficient bridges exhibits considerable variation from year to year in the bridge management system simulation results and does not follow the same smooth trend line as pavement condition does. Looking at the result for the end of the 10-year period could be misleading.

Detailed results of the analysis are shown in Figures 3.5 (Interstates), 3.6 (Non-Interstate Primary), and 3.7 (Off-Primary). These figures show how the average bridge performance during the 10-year analysis period would be expected to vary for different annual investment levels. Because the bridge management system cost models have not been calibrated to historical data, the analysis was done using two sets of costs that represent likely low and high estimates. Results for the "low" cost assumptions are shown in the graphs below, but results for the "high" cost assumptions are reflected in the figures cited in the text.

Figure 3.5 Annual Bridge Investment versus Average 10-Year Performance
Interstate Bridges (314)

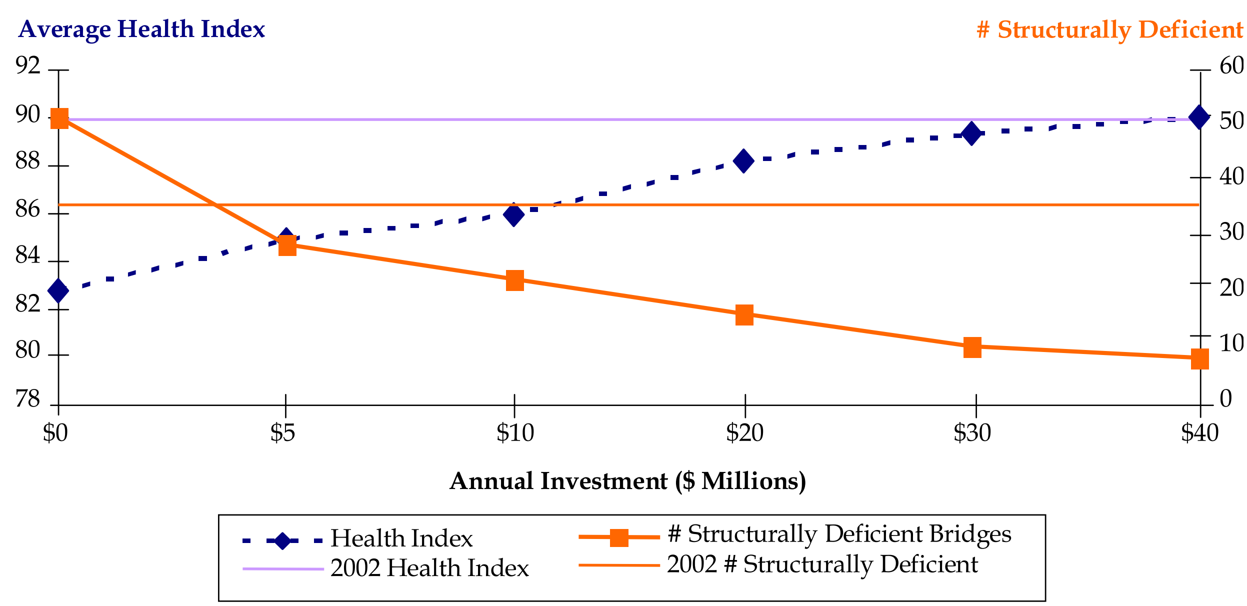


Figure 3.6 Annual Bridge Investment versus Average 10-Year Performance
Non-Interstate Primary Network Bridges (190)

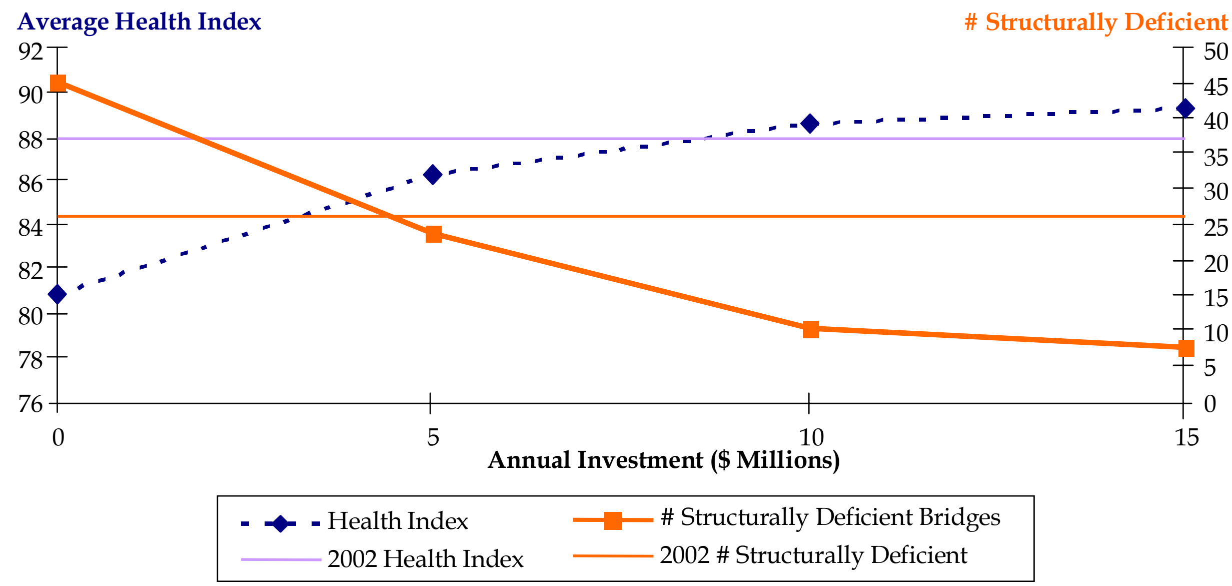
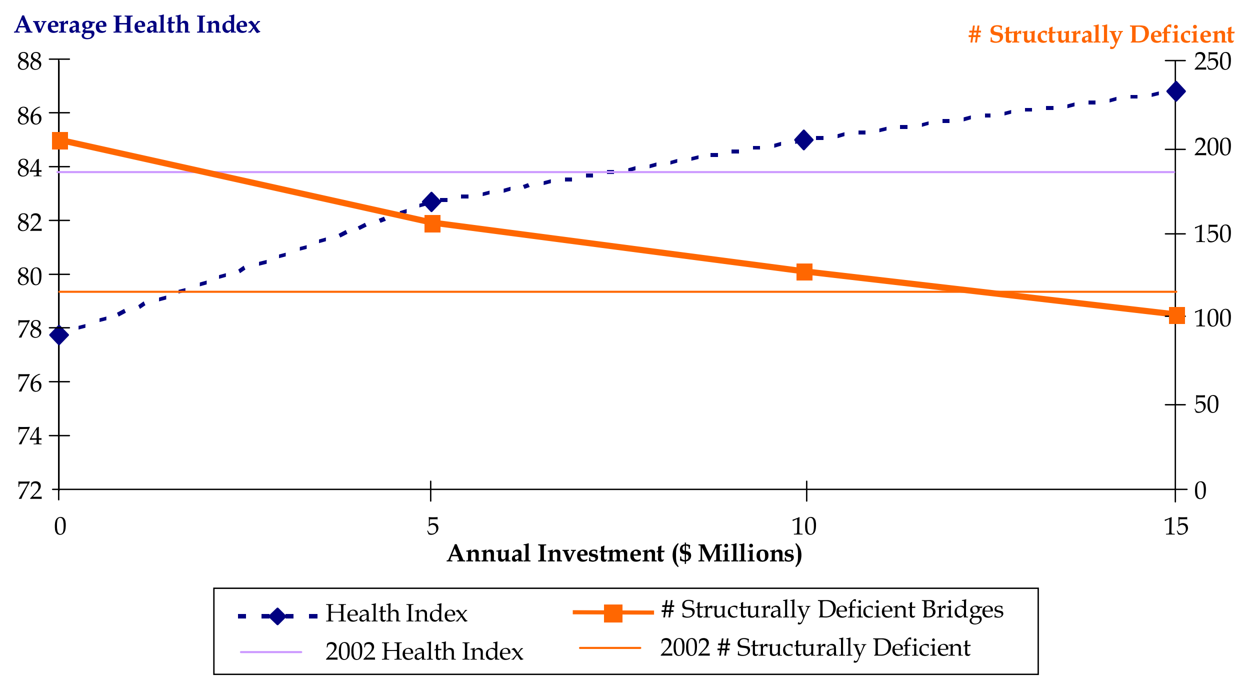


Figure 3.7 Annual Bridge Investment versus Average 10-Year Performance
State-Owned Off-Primary Network Bridges (530)



Key findings of this analysis are summarized as follows – ranges are shown based on the two sets of cost assumptions utilized:

- For Interstate bridges, the analysis indicates that an annual investment level between $3 million and $5 million would be required to keep the 10-year average number of structurally deficient bridges at the current level (36 of 313, or 11 percent). However, at least a $40 million annual investment over the 10-year period would be required to maintain the 10-year average health index at the current level of 90. At the historical investment level between $5 million and $6 million per year[8], the 10-year average health index would decline to the 84 to 86 range.

- For bridges on the Non-Interstate Primary Network, an annual investment level between $4 million and $5 million would be required to keep the 10-year average number of structurally deficient bridges at the current level (27 of 190, or 14 percent). An annual investment level of $7 million to $12 million would be required to maintain the 10-year average health index at the current level of 88.

- For state-owned bridges off of the Primary Network, $12 million to $14 million per year would be required to keep the 10-year average number of structurally deficient bridges from increasing over the current level (116 of 530, or 22 percent). An annual investment of $7 million to $10 million would be required to maintain a 10-year average health index equal to the current level of 84.

The historical investment level for non-Interstate SHS bridges over the past five years has been roughly $11.6 million per year. If this amount were split evenly between the Non-Interstate Primary and the off-Primary networks, the result would be a slight (one point) decline in the 10-year average Health Index on both networks, a slight decrease in the 10-year average number of structurally deficient bridges on the Non-Interstate Primary network, and a fairly significant (30 percent) increase in the 10-year average number of structurally deficient bridges on the Off-Primary Network (from 116 to over 150).

Based on this analysis, four bridge investment scenarios have been developed involving different annual investment levels and allocations across the three subnetworks. The results for the "low" set of unit costs were used for these scenarios – therefore they represent an optimistic view of performance (using the higher cost assumptions would result in lower predictions of performance).

- **Scenario 1: High Investment Level –** This scenario includes sufficient funds to maintain the 10-year average health index for Interstate bridges at the current level (while reducing the 10-year average number of structurally deficient Interstate bridges down to three percent), and to make moderate improvements in the condition of Primary Network and Off-Primary Network bridges. This scenario would cost an average of $70 million annually.

---

[8] Based on an analysis of bridge projects between 1998 and 2002 – does not include bridge work done as part of highway projects that did not use federal "BR" funds.

- **Scenario 2: Medium Investment Level –** Maintaining the 10-year average performance at the current level on all of the three subnetworks. This scenario would cost an average of $59 million annually.

- **Scenario 3: Low Investment Level –** Allow the 10-year average Interstate bridge health index to drop below the current average of 90 to 88 but reduce the 10-year average number of structurally deficient Interstate bridges to 16 (currently 38). Allow the remainder of the bridges on the Primary Network to deteriorate slightly with respect to average health index (decline of one point), while slightly reducing the 10-year average number of structurally deficient bridges. Maintain the current performance level off of the Primary Network, given that the number of structurally deficient bridges on that network is already quite high, and would increase considerably at lower investment levels. This scenario would cost an average of $37 million per year.

- **Scenario 4: Current Funding Level –** This scenario assumes an investment level of $18 million per year, split evenly across the three networks.

Table 3.6 compares the required annual funding for these three scenarios by network level, and their average performance outcomes over the 10-year analysis period.

Table 3.6 Alternative Bridge Investment Scenarios

Investment Scenario	Network Level	Funding (per Year)	Ten-Year Average Health Index	Ten-Year Average Number Structurally Deficient
1. High-Level Investment *$70 million/year*	Interstate	$40 million	90	8 (3%)
	Non-Interstate Primary	$10 million	89	11 (6%)
	Off-Primary	$20 million	89	77 (14%)
2. Medium-Level Investment *$59 million/year*	Interstate	$40 million	90	8 (3%)
	Non-Interstate Primary	$7 million	88	27 (14%)
	Off-Primary	$12 million	84	116 (22%)
3. Low-Level Investment *$37 million/year*	Interstate	$20 million	88	16 (5%)
	Non-Interstate Primary	$5 million	87	24 (13%)
	Off-Primary	$12 million	84	116 (22%)
4. Current Funding Level *$18 million/year*	Interstate	$6 million	85	27 (9%)
	Non-Interstate Primary	$6 million	87	22 (12%)
	Off-Primary	$6 million	83	150 (28%)

4.0 Policy Guidance

This section establishes policy guidance for preserving and improving the Vermont SHS. This policy guidance is general in nature and is not intended to replace the kinds of detailed technical analyses or public involvement processes required to support major investment planning. Its intent is to clearly identify the types of strategies to be pursued in order to meet established performance objectives in the most cost-effective manner.

Section 4.1 summarizes the key highway system policies. Section 4.2 provides guidance for implementation of specific strategies. Specific implementation steps for achieving these policies are presented in Section 5.0.

■ 4.1 Highway System Policies

Based on the goals and performance targets established in the previous section, six key policy areas have been established for the highway system:

A. Investment Priorities;

B. Keeping Highways Safe;

C. Maintaining Primary Network Continuity;

D. Preserving the Existing System;

E. Improving the System; and

F. Managing Access to Maintain Mobility and Safety.

Policies within each of these areas are presented below.

A. Investment Priorities

A-1

Highest priority shall be placed on investments in the highway system that improve safety, preserve its physical integrity, enhance existing operations, and foster economic development.

A-2

Under limited funding conditions, investments shall be focused on high-priority safety improvements and on preserving highways and bridges on the Interstate and Non-Interstate Primary Networks.

B. Keeping Highways Safe

B-1

The established Safety Management System (SMS) process will be used to identify and implement cost-effective actions for reducing the number of serious crashes and fatalities on the SHS. A wide spectrum of actions shall be considered to address highway and driver-related causes of crashes. Such actions include: highway system improvements (geometrics, sight distance improvement, improved lighting, striping, adding signals, uniform traffic control devices), design of safe facilities and crossings for pedestrians and bicyclists, and non-engineering solutions such as improved commercial motor vehicle enforcement and safety-related driver education.

B-2

VTrans shall strive to implement all spot safety improvements that address high-accident and high-risk locations in a cost-effective manner, as identified through the State's Highway Safety Improvement Program (HSIP), within a five-year period from their time of identification.

B-3

Safety considerations should be an integral part of the project identification processes for pavement, bridge and roadway projects through a well-defined work flow process and shared safety information across the Agency.

C. Maintaining Primary Network Continuity

C-1

VTrans will keep all Interstate bridges open and free of load restrictions.

C-2

VTrans will keep all other Primary Network bridges either free of load restrictions or provide a convenient detour.

D. Preserving the Existing System

D-1

Cost-effective investments in preservation projects will be made to keep the SHS infrastructure in safe, structurally sound condition, with a minimum of cost and discomfort to road users. Condition targets for different portions of the system will be periodically adjusted based on the best available understanding of highway user perceptions, as well as an analysis of what can be achieved on different systems given the likely levels of available resources.

D-2

Available analysis tools will be used to determine least life-cycle cost preservation strategies to maintain established target conditions. In particular, for non-engineered pavements on the Primary Network, analysis will be conducted to assess whether replacement of the pavement (full-depth reconstruction) would be more cost-effective over the long term than periodic resurfacing treatments.

D-3

When feasible, the timing of pavement, bridge and other asset preservation projects on higher-volume roadways (over 20,000 ADT) will be coordinated in order to minimize work zone and associated highway user costs.

D-4

When a preservation project is programmed for a highway segment, other high-priority preservation needs along this segment will be evaluated to determine if they can be addressed simultaneously in a cost-effective manner while avoiding significant scope creep. Other potential needs may include safety needs, as indicated by high crash rates; drainage systems, and guardrails.

E. Improving the System

E-1

Corridor management plans for primary network highways should be developed in order to build consensus on transportation solutions that reflect different stakeholder interests and involve coordinated actions on the part of multiple agencies and jurisdictions.

E-2

Major operational, safety and mobility improvements shall be pursued in a coordinated fashion in a given corridor or location so that all existing needs and issues are addressed at one time and the full range of alternatives examined.

E-3

The existing Level of Improvement (LOI) policy in the Vermont State Design Standards should be followed limiting roadway reconstruction to Interstates/freeways, other principal arterials and high-volume minor arterials.

E-4

The following priorities for improvements are established: 1) Prevent safety and capacity problems from developing through the use of access management and coordinated land use planning; 2) improved traffic operations and/or demand management strategies; 3) minor improvements to improve efficiency and capacity, such as widening shoulders, adding climbing lanes or truck pullouts; 4) major improvements such as new general purpose lanes or re-alignments; and finally 5) new facilities, including new interchanges and new bypasses.

E-5

General policy considerations for new facilities and major improvement projects may include the following: 1) the project's scope is appropriate given long-range projections of need; 2) the project is consistent with state, regional and corridor-level transportation and land use plans; 3) strategies are in place for protecting the improved facility's function in the future including intergovernmental agreements that require local jurisdictions to adopt actions supportive of access management in their local plans; 4) funding for the project (and any associated work to be undertaken by local governments) can reasonably be expected to be in place; and 5) the project was developed using established public involvement procedures.

F. Managing Access to Maintain Mobility and Safety

F-1

Access to the SHS will be managed according to the principles and approaches identified in the existing VTrans Access Management Guidelines. Consistent with these guidelines, each SHS segment will be identified with an access management category reflecting the balance between through and local traffic. These designations will be kept up-to-date, reflecting traffic patterns and land use plans. Ensure that the guidelines are effectively serving their intended purpose, through education and outreach, and if needed, through formal rulemaking.

F-2

Access management standards applicable to each category of highway will be used to ensure maintenance of safe and efficient traffic flow.

4.2 Highway System Strategies

This section provides policy guidance for four types of strategies: preservation of the existing system, addition of capacity to the system, safety and operational improvements, and access management.

Preservation

System preservation investments serve the purpose of maintaining the physical integrity and the originally intended function of the existing system elements, including pavements, bridges and other highway system elements. Investments made for preservation of the system frequently also address safety concerns.

A useful shorthand way of describing the thrust of the preservation strategy (now used by several other DOTs) is to "do the right thing at the right time in the right place." The "right thing" means identifying an appropriate and cost-effective solution to address a given set of deficiencies or needs – one that does not do too much or too little, and is an appropriate use of funds considering the full array of other needs on the system. The "right time" means planning ahead in a strategic fashion to prolong asset life and prevent problems from occurring that will require more costly solutions. The "right place" means focusing investments to achieve stated goals for different portions of the system, in a manner that yields the desired level of balance, and gets the most "bang for the buck."

Preservation actions should be implemented with two key factors in mind:

1. Protection of existing infrastructure investment in a cost-effective manner; and

2. Providing acceptable levels of service to highway system users.

Condition targets discussed in Section 3.0 for the maximum percentage of poor pavements, and for the number of restricted and structurally deficient bridges reflect the level of service delivered to highway system users. The pavement and bridge management system tools in place at VTrans should be used to determine preservation strategies that are cost-effective from a life-cycle perspective.

Techniques

Pavement full-depth reconstruction – The VTrans Level of Improvement (LOI) policy establishes thresholds related to traffic volume and functional class that identify when full-depth reconstruction may be considered. Given its high-cost, full-depth reconstruction should be pursued primarily to address pavement structural needs when other major work such as widening or realignment is undertaken. However, in order to sustain desired condition levels over time in a cost-effective manner, reconstruction also should be considered for non-engineered pavements[1] on higher-volume Primary Network roads, with a long-term goal of replacing all non-engineered pavements on the Primary Network. Such investments should be justified by a quantitative life-cycle cost analysis, and should be pursued when feasible within funding constraints.

Pavement resurfacing and major maintenance (crack sealing, rut filling) – These are preventive maintenance and safety strategies appropriate for state highways that are still in reasonably good condition. Resurfacing and major maintenance should be applied to preserve safe conditions on the highway system and achieve condition targets (see Section 3.4) by minimizing life-cycle costs. This may require that some segments in poor or very poor condition are not given immediate treatment, while others in fair or better condition are given immediate treatment to prevent their long-term deterioration.

Bridge maintenance and rehabilitation – Bridge maintenance and rehabilitation should be pursued to maximize bridge lifespan and minimize life-cycle costs. Appropriate bridge maintenance and rehabilitation strategies are determined based on inspection results and available information on the costs and effectiveness of different treatments. Preventive maintenance (including painting, deck repair, bearing replacement, drainage system restoration) should be pursued in order to prolong structure life in a cost-effective manner. As of January 2002, Federal Highway Bridge Replacement and Rehabilitation Program (HBRRP) funds can be used for this purpose, if it can be demonstrated that the proposed treatments are cost-effective and part of an overall infrastructure preservation strategy. Use of an approved bridge management system (such as the Pontis® system in use at VTrans) satisfies this requirement. Tradeoffs should be made between investing in relatively few costly bridge replacements versus a larger number of lower-cost preventive maintenance projects that would collectively provide more benefits and serve more travelers.

Bridge replacement – In general, preventive maintenance and rehabilitation investments should be made to keep existing bridges in service for as long as possible. Bridge replacement should be performed where rehabilitation is not a feasible or cost-effective option, or when there is a need for functional improvements to address safety concerns or weight restrictions. Where funding is limited, replacement of older structures with "temporary" structures should be considered where this is determined to be a more cost-effective way to ensure safety and maintain network continuity. (Due to restrictions on use of Federal funds for temporary bridges, this would require the use of state funds.)

Priorities for bridge work should be set based on a number of factors, including safety concerns, the ability of the structure to carry intended loadings, the condition of the structure, functional concerns (e.g., narrow widths, restricted clearances or poor alignment), the cost-effectiveness of the proposed project, the traffic level, and the importance of the structure to maintaining continuity on the transportation network (which is a function both of location and available detour routes). An overriding policy is that network continuity must be maintained, either through rehabilitation and

[1] See Section 2.1 for a definition of "non-engineered pavements."

replacement or through establishment of adequate detours. This is consistent with the performance target set forth in Section 3.0 of minimizing the number of restricted bridges.

Drainage systems, guardrails, and other roadside repair and rehabilitation – Problems that create immediate safety hazards, structural problems or which have the potential to disrupt the flow of traffic should be addressed as soon as feasible. Otherwise, roadside and drainage improvements should be coordinated with other improvements to be undertaken along the same stretch of roadway.

New Capacity

New capacity projects include lane widenings, realignments, bypasses, new interchanges, and climbing or passing lanes. New capacity projects are pursued with the primary objective of improving mobility and safety, although they also contribute to meeting preservation objectives.

New capacity projects may be undertaken to address significant current or anticipated congestion and/or safety problems, or to meet economic development objectives where there is a high level of confidence that the project's cost is justified based on the estimated benefits. Significant congestion problems are identified by the mobility performance measures (V/C ratio) established in Section 3.0, while safety problems are identified through the Safety Management System. In recognition of the fact that resources are limited, the general policy of evaluating lower-cost strategies with low or no adverse impacts should be applied.

Techniques

Roadway realignment and widening – Widening or realignment may be needed for highway segments with capacity or safety problems. Locations with discontinuities in width judged to pose safety problems should be considered candidates for these treatments. Locations with narrow shoulder widths are also candidates, particularly where there are significant levels of bicycling or where primary bicycling routes have been identified by regional bicycle and pedestrian planning efforts. The LOI policy establishes thresholds related to traffic volume and functional class that identify when realignment or widening should or should not be considered. Within the LOI classifications, realignment and widening should be applied first to roads on the state Primary Network.

Climbing/passing lanes – These strategies are appropriate for improving traffic flow, reducing delays caused by trucks and/or improving safety on high-volume roads. As they are relatively capital-intensive, they should be considered first on the Primary Network. Under exceptional circumstances, they also may be appropriate for high-volume road segments that are not on the Primary Network.

New/expanded interchange – A new or expanded interchange may be appropriate for serving a high-volume arterial road or to relieve traffic congestion at another nearby interchange or road.

Bypass – Bypasses should be considered only on the Primary Network. They should be considered primarily in cases where the investment is needed to reach one of VTrans highway performance goals (Safety or Mobility). Bypasses may be appropriate in a small number of circumstances where there is a high percentage of through trips and the bypass would provide significant relief from traffic congestion without generating undue environmental impacts. Bypasses should be considered in cases where there are marked adverse effects on historic villages due to heavy truck traffic. They should be implemented only when strict access management controls can be implemented to support concentrated development patterns and maintain downtown vitality. Local agencies should be encouraged to implement supportive land use controls in conjunction with bypass projects.

Safety and Operational Improvements

Safety and operational improvements including roadway and intersection treatments that meet safety and mobility goals. Policies are primarily differentiated by area type, rather than by level of network.

Safety improvements should be implemented consistent with the VTrans Safety Management System. Safety improvements should be prioritized towards intersections or highway segments with a history of high crash rates or high crash risk, and for which crash risk can be related to specific design or operational features to be addressed. Within these high-priority locations, improvements should first be programmed that can be implemented in conjunction with other scheduled work, such as pavement maintenance or roadway rehabilitation. Safety improvements should be selected and implemented, to the extent possible, on a benefit/cost basis.

Operational improvements that address mobility should be implemented where significant congestion/delay is present. Different standards are provided for target mobility thresholds, depending upon area type, as discussed in Section 3.0.

Techniques

Roadway design features – Roadway design features such as high-visibility pavement markings, non-skid pavement surfaces, wider shoulders, drainage improvements, and signs can be used to improve the safety of high-risk highway segments. They can also be used to address identified needs for pedestrian and bicycle travelers. The first priority should be to implement safety-improving design features on identified segments in conjunction with preservation projects programmed for these segments. The second priority should be to implement these features on other segments. They do not need to be implemented on segments with little or no crash history (or identified non-motorized travel improvement needs), unless they have been adopted as standard design practices and can be implemented in conjunction with preservation projects at minimal additional cost. All roadway improvements on non limited-access highways should consider improvements to support safe and convenient pedestrian and bicycle travel, consistent with the Vermont Pedestrian and Bicycle Design Manual.

Signals and other traffic control devices – These are appropriate for any area type or network level – where warranted based on the Manual on Uniform Traffic Control Devices (MUTCD). Their installation and application should be consistent with standard VTrans policies and procedures.

Roundabouts – These are appropriate as alternative intersection designs for any area type and network level. They may be considered whenever major intersection work is contemplated to improve safety, improve mobility and reduce traffic delays.

Intersection improvements – Other intersection improvements, such as turn lanes or geometric realignments, are appropriate in rural corridors, small towns/villages as well as in larger cities and towns. They may be considered whenever major intersection work is contemplated to improve safety or reduce traffic delays.

Traffic calming – Traffic calming may be considered on roads in small towns/villages as well as in larger cities and towns, where speeding traffic has created safety or quality of life concerns. Traffic calming should be evaluated, prioritized and implemented consistent with the VTrans Traffic Calming Study and Approval Process for State Highways and companion Traffic Calming Standards.

Intelligent Transportation Systems (ITS) – ITS, including motorist information and incident response, could be used at all network levels and area types in accordance to VTrans policies and procedures.

Access Management

Access management strategies involve both roadway design features and land use, and meet the goals of improving mobility and safety.

Effective implementation of access management will require that VTrans coordinate with local jurisdictions. To focus its resources where they can be most effective, VTrans should first identify a set of "at risk" road segments where immediate work on access management would be beneficial. These are likely to include segments in locally designated "growth areas," as well as other areas of current or potential high growth on the fringes of cities, towns, and villages. Segments on the Primary Network should be prioritized first for implementation of access management strategies. High-risk segments where municipalities are undertaking comprehensive or area plan updates also should be prioritized, so that VTrans ensures that these local plan updates address land use and access management along state highway corridors.

Techniques

Turning restrictions and access control – These strategies are appropriate for levels of the network and area types as discussed in the existing VTrans Access Management Guidelines. Proactive efforts to implement access management strategies should be targeted to "at-risk" corridors identified by VTrans. These corridors represent areas of current or potential high growth, where access management efforts can have the most benefit in the near term.

Purchase of access rights – Purchase of access rights for access management purposes should be considered in major rural and suburban corridors, as well as near Interstate highway interchanges. Proactive efforts to purchase access rights should be targeted first to identified "at-risk" corridors.

Corridor management plans – Corridor management plans that address both transportation and land use issues should be considered for rural and suburban corridors that are experiencing high growth or have the potential for significant growth. These include designated growth areas. Corridor management plans should be developed in conjunction with municipalities. Priority for these corridor planning efforts should be given to the Primary Network, although in some cases it also may be desirable to undertake such efforts on other higher-volume state highways.

Summary

Table 4.1 summarizes the strategies described above for each investment category and identifies the network or area type to which each strategy applies. It also identifies other policies, such as those related to priority of application and coordination with existing policies.

Table 4.1 Methods, Level of Application, and Other Policies

Investment Category and Strategies	Level of Application	Policies
Preservation		
Pavement Full-Depth Reconstruction	Per LOI: Interstate, principal arterials, higher volume minor arterials	Primary Network first Coordinate with safety and operational improvements
Pavement Resurfacing	ALL	Identify and prioritize with Pavement Management System
Pavement Capital Maintenance	ALL	Identify and prioritize with Pavement Management System
Bridge Rehabilitation	ALL	Primary Network first
Bridge Replacement	ALL	Primary Network first
Drainage System Repair/Rehabilitation	ALL	Coordinate with other improvements
Guardrail/Other Roadside Repair/ Rehabilitation	ALL	Coordinate with other improvements
Rest Area Rehabilitation	ALL	
New Capacity		
Roadway Reconstruction/Widening	Per LOI: Interstate, principal arterials, higher volume minor arterials	Consider lower-cost strategies first
Climbing/Passing Lane Only	Primary Network	
New/Expanded Interchange	Interstate	
Bypass	Primary Network	Associated strict access and community land use controls
New Roadway	N/A	
Safety/Operational Improvements		
Signalization/Traffic Control Devices	ALL	
Roundabouts	ALL	
Intersection Improvements	ALL	
Traffic Calming	Large city/town or small town/village	VTrans Traffic Calming Study and Approval Process
Other ITS (Incident Response, Motorist Information)	ALL	
Access Management		
Turning Restrictions	ALL	VTrans Access Management Guidelines
Access Control	ALL	VTrans Access Management Guidelines
Purchase of Access Rights	Rural/suburban corridors, Interstate interchanges	Consider for areas "at risk" – development likely to occur which would cause degraded travel speeds without significant new infrastructure investment
Corridor Plans (Land Use/ Transportation)	Rural/suburban corridors and designated growth areas	

5.0 Implementation Plan

5.1 Introduction

Implementation of this Highway System Policy Plan will involve a coordinated set of actions across different units of the Vermont Agency of Transportation. Procedures and programs are already in place that are supportive of the majority of policies in this plan. Appendix A describes the already existing programs that are relevant to highway policy. This section presents a set of actions items that are needed to supplement existing procedures in order to reinforce and strengthen the effectiveness of the policies that have now been made more explicit. These actions are all supportive of the major LRTP objectives, and represent logical next steps for VTrans as it moves towards a more integrated, performance-based approach to managing its transportation assets.

5.2 Recommended Actions

Action 1. Pursue Increased Funds for Highway System Preservation

The investment analysis conducted for this plan indicates a clear need for increased resources for preservation of the SHS. Increases in funding for preservation should be sought in order to allow for both reconstruction of facilities at the end of their life and cost-effective preventive maintenance and rehabilitation actions to prolong the life of facilities throughout their life cycle.

The level of analysis conducted was not sufficiently precise to recommend an exact figure, but it does indicate that conditions are likely to decline precipitously over the next decade without a significant funding increase.

Possible approaches include:

- Continued allocation of available resources to emphasize the preservation component of the program.
- Work with the legislature to identify additional transportation revenue sources.

Lead Responsibility – Executives/Program Development

Action 2. Increase Emphasis on Preventive Maintenance

Because resources for preservation have been limited, Vermont has been in the unfortunate position of having to decide between preventive maintenance and major reconstruction or replacement work to address facilities in poor condition. While this is a difficult choice, it is important to increase understanding and awareness both within the agency and among the general public of the implications of under-funding preventive maintenance. A "worst-first" approach to prioritizing projects is rarely the least-cost long-term investment strategy.

It is therefore recommended that as part of the annual budgeting process, a "preventive maintenance" emphasis option be prepared, which involves allocating an increased share of resources to work to extend the life of facilities that are still in fair to good condition.

Consideration also should be given to establish a preventive maintenance funding category within the pavement and bridge areas. The amount of funding in this category could be established at a relatively modest level at first, with future increases to levels recommended by pavement and bridge management systems. Other states (e.g., Michigan) have found that earmarking funds for preventive maintenance is an effective way to ensure that this important, cost-effective preservation work is accomplished.

Lead Responsibility – Program Development

Action 3. Move Towards a Performance-Based Planning and Programming Process

VTrans should continue making progress towards a performance-based planning and programming process through implementation of the following steps:

- Monitor actual values of the established performance measures and document performance trends over time;
- Establish performance targets as part of the annual budgeting process, which reflect the current performance levels and an understanding of what can be achieved with available resources;
- Periodically conduct customer surveys or focus groups to obtain feedback on highway user sensitivity to different condition levels, and use this information in the target-setting process; and
- Investigate development of a new performance measure reflecting the remaining life or value of the highway network along with methods for calculating this measure using available asset management systems.

Lead Responsibility – Policy and Planning

Action 4. Support Development of Corridor Management Plans

A subset of the Primary Network corridors identified in this policy plan should be selected for the development of corridor management plans which may include:

- Identification and involvement of stakeholders (e.g., local jurisdictions, regional planning agencies, business, residents, environmental agencies, etc.);
- Investigation and documentation of existing and future land-use and transportation conditions and issues;
- Stakeholder agreement on goals and objectives to guide development of future strategies;
- Identification and evaluation of alternative strategies, including both transportation and land-use actions; and
- Consensus-building on a recommended set of actions, and development of implementation approaches (agreements, commitments, partnerships, etc.) and monitoring plans.

Sufficient resources should be allocated to undertake these plans. Possible criteria for selection of corridors include:

- Corridors likely to experience new development over the next decade, where coordination among multiple jurisdictions will be key to managing new transportation needs associated with that development;
- Corridors with significant safety, operational and/or congestion issues; and
- Corridors where there is a potential for improving travel alternatives via multimodal approaches involving improved intermodal connections and/or strategies that encourage modal shifts.

Develop a set of standard guidelines indicating the structure, content and process for developing a corridor plan in order to ensure consistency across plans. These guidelines should define mechanisms for involvement of local agencies, as this is a critical element of successful corridor planning efforts. (For further information, see overview of corridor planning practices in Appendix C).

Lead Responsibility – Policy and Planning

Action 5. Implement Coordinated Approach to Highway Needs Identification and Project Scheduling

In conjunction with the Asset Management initiative, VTrans should examine its current process of highway needs identification and project programming to ensure that 1) all available information on pavement, bridge, safety, pedestrian/bicycle needs and traffic flow/mobility conditions and needs is taken into account in a coordinated fashion, and 2) project programming and scheduling is done in a manner that ensures coordination of different types of work. The result of this effort would be a re-engineered set of business processes, along with new supporting analysis tools. This process should include the following elements:

- Annual mapping of projected five to 10-year needs or deficiencies, including but not limited to high-accident locations, locations where the Pavement Management System shows a resurfacing or reconstruction need, structurally deficient or restricted bridges, other bridges which are recommended for rehabilitation or reconstruction, retaining wall and culvert rehabilitation and replacement locations, locations with traffic congestion, locations with identified pedestrian/bicycle needs, locations with steep grades, and high volumes of commercial vehicles. This map should be used to assist with project identification and scoping.

- Annual program review process, assisted by a map showing locations of programmed and recommended projects (of all types), by corridor. This map should be used to assist in the identification of opportunities to coordinate project timing.

Current VTrans efforts in the area of data integration should be considered as an important input to the coordinated needs identification and project development process. These efforts are providing a route-log tool that allows for examination of a wide variety of inventory and condition information at a selected location. The data assembled for the route-log tool can be used as the basis for a broader GIS/query tool to provide the types of mapping capabilities suggested above.

VTrans also should continue to explore use of integrated asset management systems in order to better support coordinated identification of projects.

Lead Responsibility – An individual within Policy and Planning or Program Development should be tasked with this responsibility serving as a liaison across the different program areas (roadway, pavement, bridge), and working to bring together information from studies and plans, asset management systems and GIS for consideration in the program development process.

Support Responsibility – GIS

Action 6. Strengthen and Reinforce Access Management Program

Continue current access management practice based on the established Access Management Guidelines. Pursue additional efforts to educate local officials, the development community, and the public at large about the benefits and importance of access management. Continue to monitor compliance with the guidelines, and consider additional formal rulemaking if the guidelines do not appear to be effective.

As part of corridor management planning activities, develop a list of locations in major rural and suburban corridors, and near Interstate highway interchanges where proactive purchase of access rights would be desirable, either to preserve right-of-way for future highway capacity expansion or to prevent future pressure for additional access points (where the Access Management Guidelines may not be sufficient). Explore initiation of a program to selectively acquire access rights for the highest-priority locations. Seek legislative action as needed to allow for proactive purchase of access rights. (See Appendix C for a brief review of state practices in this area).

Lead Responsibility – Program Development

Action 7. Review and Update Design Standards and Project Development Process Description

The 1997 Vermont State Design Standards, including the Level of Improvement (LOI) policy, and the Project Development Process Description should be updated over the next two years, and then every five years to ensure that they reflect current practice and continue to serve their intended function. Specific issues to be addressed in the update effort are:

- Assess the extent to which the LOI policy has been followed since its implementation; were the exceptions to this policy justified based on the established criteria within the policy? Based on the results, build in mechanisms to strengthen this policy, or discuss ways in which it may need modification.

- Include reference to the overall performance-based planning and programming context within which project development takes place.

- Consider incorporating the LOI policy earlier in the project identification process (e.g., as part of the TPI) so that this policy serves as a "ground rule" for screening project ideas rather than as a scoping consideration.

- Consider adding reference to standards for pavement design in order to move towards the goal of fully engineered pavements on the Primary Network.

Lead Responsibility – Program Development, Policy and Planning

Action 8. Periodically Review Functional Classification and Facility Ownership

Periodically review the functionality of SHS roadways, and modify the classifications when changes occur in the nature of use or function of a highway segment. Pursue inter-governmental transfers as appropriate:

- Where a road segment transitions from one of statewide significance to one serving exclusively local traffic (e.g., as in the case of a bypass replacing an old state route); or

- Where a local road segment begins to take on statewide significance (e.g., to serve as a detour route for a bridge that is load-posted).

Lead Responsibility – Program Development

Action 9. Continue Implementation of Integrated Asset Management Systems

Continue to improve and integrate individual asset management systems and make use of these systems as an integral part of highway investment decision-making processes. Improvements in asset management systems should focus on integration of data, providing cost and performance tracking and prediction capabilities in support of the Agency's planning and programming process, and providing a coordinated approach to programming of pavement, bridge, and highway projects.

Lead Responsibility – Policy and Planning

Action 10. Enhance Pavement and Bridge Performance Models

Pavement and bridge management systems are valuable tools for understanding the relationship between investment levels and performance over the long term, and for assisting in the development of cost-effective preservation strategies. VTrans now has a solid base of historical condition data for both pavements and bridges, which allows for development of improved predictive capabilities. A project is currently underway to develop new pavement performance models; a similar effort is recommended for the bridge management system. In addition, a review of cost models based on actual bid-tab data from projects is recommended for both pavement and bridge management systems. This action will allow VTrans to develop more accurate and reliable predictions of pavement and bridge needs, and will enhance the usefulness and credibility of these important management system tools.

The preliminary analysis of Vermont Highway Needs using the HERS/ST model conducted for this Highway System Policy Plan effort indicated that this tool could serve as a useful complement to the pavement management system in understanding highway needs and their relationships to user costs. An effort to determine the feasibility of expanding the HPMS data set (which is used as the HERS/ST input) to cover a larger share of the Vermont State Highway Network, and to further examine and calibrate HERS/ST model parameters to Vermont conditions also is recommended. (See Appendix B for further detail).

Lead Responsibility – Pavement Management, Bridge Management, Policy and Planning (HERS/ST)

Appendix A

Current Highway Policies and Programs

Current Highway Policies and Programs

This section reviews existing agency policies and administrative rules with relevance for highway/bridge preservation, rehabilitation, and reconstruction. The following items have been included in this review:

- Long-Range Transportation Plan (LRTP);
- Strategic Planning – Performance Measures;
- Vermont State Roadway Design Standards;
- Pedestrian and Bicycle Design Manual;
- Level of Improvement Policy;
- Project Development Manual;
- Access management Program Guidelines;
- Safety Management System objectives;
- Smart Growth policies (transportation/land use linkage);
- Asset management policies; and
- State statutes related to aid for town highways.

■ Long-Range Transportation Plan

The 1995 Long-Range Transportation Plan (LRTP) and the 2002 LRTP update provide a framework for transportation planning, design, construction, operation and maintenance in Vermont. The updated plan states three key objectives which are consistent with the Vision and Mission Statement developed as part of the VTrans strategic planning effort:

- Manage the State's existing transportation facilities to provide capacity, safety and flexibility in the most effective and efficient manner;

- Improve all modes of Vermont's transportation system to provide Vermonters with choices; and

- Strengthen the economy, protect and enhance the quality of the natural environment, and improve Vermonters' quality of life.

The plan update also includes the four principal questions that evolved from VTrans' strategic planning efforts:

1. Are you satisfied that the transportation system in Vermont is safe?

2. Are you satisfied that the financial investment in Vermont's transportation system is paying off?

3. Are you satisfied that Vermont's transportation solutions respect the natural environment?

4. Are you satisfied with the length of time that it takes to get yourself and your goods to another place?

A number of recommendations are made in the plan to support these objectives. Those most relevant to development of the Highway System Policy Plan include:

- **Maintenance –** Continue to use the pavement and maintenance management systems to maintain all facilities. Develop a program that over time upgrades those facilities that are currently below desired serviceability standards.

- **Safety –** Continue to develop and use tools such as the Safety Management System to promote a safe transportation system.

- **Access Management –** Develop access management guidelines to enable compatible land development while preserving traffic flow.

- **ITS –** Further examine the role that ITS can plan to manage transportation issues.

- **Roundabouts** – Continue to study and implement roundabouts where appropriate.

- **Intermodalism –** Identify and enhance the State's key intermodal connections, and Investigate the use of ITS tools to reinforce intermodal connections.

- **Park-and-Ride Lots –** Explore the use of shared facilities (those that are not solely owned or operated by VTrans such as churches, shopping centers, etc.) to expand the primary park-and-ride lot system.

- **Transportation Modes –** Continue to implement and update each modal policy and capital investment plan.

- **Traffic Calming –** Continue to implement traffic calming measures where and when appropriate.

- **Transportation and Land Use Connections –** Develop transportation projects that adhere to the State's emerging Smart Growth policy; do not support transportation projects that promote sprawl.

- **Air Quality –** Continue to play an active role to support other State agencies' efforts to improve Vermont's air quality.
- **Project Scoping: Process –** Continue to use and refine the project scoping process.
- **Project Backlog –** Continue to address the project backlog and implement "shelf projects."

Performance Measures

As part of its strategic planning and budgeting process, VTrans has been working to establish a set of desired results, indicators, strategies and performance measures for each program area. This work is continuing to evolve and has been coordinated with the work done as part of the development of the HSPP.

Safety Management System

Goals and objectives for the Safety Management System (SMS) were developed in the Phase I VTrans Safety Management System Study, which was completed in 2001.[1] These are summarized in Table A.1.

[1] Wilbur Smith Associates, Safety Management System (SMS) Phase I Study, Final Report, May 2001.

Table A.1 Safety Management System Goals and Objectives

Goal A. Create More Effective Process and Safety Management	
Objective A-1	Create a standing safety management system steering committee
Objective A-2	Establish clear policies for managing highway safety issues
Objective A-3	Provide appropriate resources to the Highway Safety unit
Objective A-4	Develop a clear process for identifying, prioritizing and implementing safety improvements
Objective A-7	Implement community-based safety programs to engage local partners in highway safety issues
Objective A-10	Produce an annual report
Objective A-11	Develop and implement prioritization techniques for highway safety projects
Objective A-16	Periodically review and update safety-related design standards
Goal B. Improve Information and Decision Support	
Objective B-1	Complete improvements planned in the ongoing accident record system project
Objective B-6	Develop road safety features management systems
Objective B-7	Conduct evaluations of the effectiveness of projects and programs
Goal C. Make Roadways Safer	
Objective C-1	Evaluate the safety implications of traffic calming techniques
Objective C-3	Insure safe driving surfaces
Objective C-4	Review winter maintenance policies
Goal D. Minimize the Consequences of Leaving the Road	
Objective D-1	Institute a program to upgrade roadside safety devices
Objective D-3	Review and revise utility permitting procedures
Goal E. Make Intersections Safer	
Objective E-3	Implement more effective access management policies
Goal F. Make Work Zones Safer	
Objective F-1	Require work zone traffic control training
Objective F-2	Ensure that all major work zones are reviewed
Goal G. Make Truck Travel Safer	
Objective G-1	Review truck inspection procedures
Goal H. Make Walking and Street Crossing Safer	
Objective H-1	Make both pedestrians and drivers more aware of pedestrian safety
Goal I. Improve Driver Performance	
Objective I-1	Reduce the frequency of crashes involving impaired younger drivers
Objective I-2	Remove repeat offenders as drivers
Objective I-3	Review older driver licensing issues and develop appropriate legislation

The following policy for safety management was established in 2001:[2]

> "It is the policy of the Vermont Agency of Transportation to utilize the Agency Safety Management System to help minimize the occurrence and severity of accidents on the Vermont transportation network through safety education and promotion of practical and effective safety measures incorporated into the planning, design, construction, maintenance, and operation of network assets.
>
> There is formed within the Agency a Safety Management Steering Committee that is responsible for ensuring that Safety Management System goals and objectives are reached by providing a continued focus on safety and encouraging agencywide involvement in the process.
>
> The Safety Management System Steering Committee shall include the Deputy Secretary of Transportation, the Commissioner of Motor Vehicles, and the following Agency managers: the Directors of Policy and Planning, Project Development, Maintenance and Aviation, Rail, and Technical Services. The director of the Criminal Justice Services Division and a representative from the Federal Highway Administration (FHWA) also shall serve as members. The Deputy Secretary of Transportation shall act as committee chair.
>
> The committee may appoint task forces to develop procedures, needs, and policies. The Agency's Traffic Safety Unit will serve as full-time staff of the steering committee."

Design Standards

The Vermont State Standards for Construction, Reconstruction and Rehabilitation of Roadways and Bridges were completed in 1997, and represent a flexible approach to establishing designs which provide access, mobility and safety for users but also consider the specific social and environmental context for the project. They were developed by a committee with representation from (then) VAOT engineering, planning and legal staff; the Agency of Natural Resources; the Division of Historic Preservation; Regional Planning Commissions; the Vermont Council on the Arts; the Preservation Trust of Vermont; the Federal Highway Administration; and private citizens.

The design standards vary by functional class (freeways, principal arterials, minor arterials, collectors, and local roads and streets). They cover level of service (LOS), design speed, lane and shoulder widths, bridge capacity and clearances and other geometric standards. Many of the standards are expressed as ranges in order to allow for flexibility to respond to specific situations. The standards also include considerations for bicycle and pedestrian accommodation, and special guidelines (including common tools) to ensure that the project is context sensitive and minimizes or avoids negative impacts.

Pedestrian and Bicycle Design Manual

This design manual was completed in 2002, and serves as the standard for development, design, construction and maintenance of pedestrian and bicycle facilities implemented by VTrans – including on-road bicycle facilities (bicycle lanes, wide curb lanes, paved

[2] Vermont Agency of Transportation On-Line Policy Manual, http://www.aot.state.vt.us/policies/.

shoulders). The manual states that all highways, except limited access highways where cyclists are legally prohibited, should be designed and constructed under the assumption that they will be used by pedestrians and bicyclists. The manual also notes that special design consideration should be paid to areas where motorists and bicyclists will be in conflict with each other, including driveways, curb cuts, intersections and turning lanes.

Level of Improvement

The Level of Improvement (LOI) concept is incorporated as part of the Vermont State Design Standards, and is used as a way to focus limited state and Federal transportation resources on the portions of the system that are most important to statewide mobility. LOI establishes three investment categories: Reconstruction, Rehabilitation and Preservation. Each segment of the SHS is assigned to one of these categories and based on functional class, average daily traffic (ADT), and Equivalent Single-Axle Loadings (ESALS).

Interstates/freeways, other principal arterials and high volume minor arterials are eligible for reconstruction, rehabilitation or preservation treatments. Lower volume minor arterials without significant levels of truck traffic are eligible for rehabilitation or preservation. Collectors – i.e., roadways whose function is primarily one of providing local access – are not eligible for reconstruction (involving Federal and state funds), and are only eligible for rehabilitation if they have over 2,500 ADT or carry significant truck traffic (>0.5 million ESALS for a major collector; >1.5 million ESALs for an urban collector).

Additional criteria are defined in the LOI policy to address system continuity, safety, structural deterioration, pedestrian/bicycle accommodation, and land use. Determination of LOI occurs during the project scoping process.

Project Development Process

Roles and responsibilities, procedures and considerations for each phase of highway project development are documented in a Project Development Manual. A summary of the key activities in each of the phases are as follows:

- **Project Selection –** SHS improvement projects in areas without a metropolitan planning organization (MPO) are selected via the Transportation Planning Initiative (TPI) process, which is a cooperative effort between VTrans and the Regional Planning Commissions (RPC) and their member jurisdictions. The Chittenden County MPO is responsible for selecting projects in the Burlington metropolitan area. State pavement and bridge projects are identified by VTrans based on inspection data and management system analysis. Town highway bridge projects are selected based on deficiencies identified in inspections and requests from municipalities. Enhancement projects are nominated by towns and recommended by the Transportation Enhancement Advisory Council (TEAC) for approval by the Secretary of Transportation and the Legislature. Maintenance projects including bridge deck rehabilitation, bridge painting, culvert replacement, and guardrails are selected by VTrans maintenance personnel.

- **Project Authorization –** This phase includes assignment of projects to appropriate Program Managers, checking for adequate funding, verification that the projects are on the approved State Transportation Improvement Program (STIP) and/or metropolitan TIP (where applicable), establishing Expenditure Account and Subjob numbers in the State Transportation Accounting and Reporting System (STARS), and making formal requests for authorization to proceed from FHWA where Federal funding is involved.

- **Project Definition –** This involves development of a formal Purpose and Need Statement, a detailed scoping report, and (for major projects involving acquisition of land or rights) a conceptual design. The scoping process involves developing and evaluating a set of alternatives consistent with the design standards and the Level of Improvement category for the facility, including a “no-build” option. The manual states that intermodal/multimodal possibilities are to be explored during the alternative development process. The project definition phase involves extensive data collection and review, and meetings and coordination with affected agencies and groups. Where applicable, this phase also involves application for Act 250 permits, informational or 502 public hearings, and National Environmental Policy Act (NEPA) documentation.

- **Project Design** – This phase includes development of preliminary, semifinal and final plans, obtaining permits, acquiring right-of-way, executing utility agreements, and assembling the plans, specifications and estimate (PS&E) package for advertising the project.

- **Project Construction** – During the construction phase, specific procedures are defined for the preconstruction conference, establishment of material supply and disposal areas, staging areas, mitigation work, inspections, change orders, right-of-way changes and storm water runoff permits and staging areas.

Access Management Policies

Title 19 V.S.A. Section 1111 provides the statutory basis for controlling access to state and town highways in Vermont. The law requires that VTrans consider access permit applications based on “safety, maintenance of reasonable levels of service on the existing highway system, and protect the public investment in the existing highway infrastructure.” It also allows for conditions on access permits for developments contributing 75 or more peak-hour trips to state or Class 1 town highways in order to protect service levels on these facilities. In 1998, criteria for granting access permits were broadened to include consistency with state land use goals, state agency plans, and regional and local land use plans.

In addition, 19 V.S.A. 1703-1708 gives VTrans the authority to designate “limited access facilities” – where “reasonable access” to abutters may be denied – in order to protect existing or future businesses or traffic conditions.

VTrans published Access Management Program Guidelines in 1999. They establish an access classification system and associated standards in order to ensure consistency in the access permitting process for the SHS. The stated objectives of the Access Management standards are to 1) protect and promote public safety of the traveling public, 2) provide for the mobility of people and goods by preserving reasonable LOS, and 3) preserve the functional integrity of the SHS by protecting the public investment in the existing highway infrastructure. Standards cover criteria for granting direct accesses and for allowing right and left turns, spacing of accesses that are or may become signalized, and separation of opposing traffic movements. They also include design standards and specifications for accesses.

The Guidelines establish six categories of highways:

- **Category One** includes facilities serving high-speed and high-volume traffic movements over long distances. The Interstate system and certain "other principal arterials" are included in this category. Access on these facilities is limited to grade-separated interchanges with public highways.

- **Category Two** includes highways with the capacity for high speed and high volume traffic movements. These facilities are typically other principal arterials and major collectors. This category includes ramps and access roads to the Interstate system. For this category, direct access to abutting land is subordinate to serving through traffic movements. Access consists of at-grade or grade-separated intersections with public highways at one-half to one-mile intervals.

- **Category Three** includes facilities serving medium to high speed and medium to long-distance travel. These facilities are generally NHS routes, falling into the "other principal arterials" functional class – though minor arterials and major collectors with greater than 5,000 ADT also are included. A single point of direct access from a parcel (or contiguous parcels under the same ownership or control) is generally allowed unless other reasonable access alternatives are already present. The standard for spacing of signalized intersections or accesses is one-quarter mile for urban and one-half mile for rural segments. Turning movements may be limited, and left and/or right turn lanes are required.

- **Category Four** includes facilities serving moderate travel speeds and moderate traffic volumes over medium and short-travel distances. Direct access is allowed for these facilities where it will not be unreasonably detrimental to the safety and operation of the highway, and multiple access points from a single parcel may be allowed. Spacing of signals is the same as for Category Three. Turning movements may be limited.

- **Category Five** includes roadways designated as frontage or service roads with no long distance or high volume traffic movements. This category has the least restrictive access standards. The minimum spacing for signals is 500 feet.

- **Category Six** includes urban highway sections serving moderate to low travel speeds and moderate to high traffic volumes over short to medium-travel distances. This category of facility typically has a density of 40 accesses (including both sides) per mile or greater, and a posted speed of 25 to 40 mph. Direct access for this category is granted if no other reasonable opportunities for access exist, unless denial of access would create unacceptable traffic or safety problems at other locations. The minimum spacing for signals is the same as for Category Five. Turning movements may be limited.

The guidelines state that the categories will be determined on an interim basis based on functional class and ADT, but in the long term, categories will be assigned based on additional criteria including potential land development characteristics (in zoning and land use plans), regional growth patterns, and existing density of accesses.

Access Management Public Outreach

VTrans also recognizes that education of town officials, developers, business owners and the general public on the numerous benefits of Access Management is paramount to the success of the agency's access management program and policies. The agency, in partnership with the RPCs and the CCMPO, hired a consultant to develop marketing material to promote and educate local officials and the public on the benefits of access management. Following are the overall goals of this project:

- Achieve public support from our target audiences for our access management program and have well educated citizens that understand why access management is a good thing – even when it affects their own property; and
- Develop additional tools for local officials to implement good access management policies.

Smart Growth Policies

Vermont's emerging Smart Growth policies and programs support a coordinated approach to land use and transportation decisions, and promotes efficient, compact mixed-use development patterns. As noted above, the 2001 LRTP contained recommendations for VTrans to play a support role in Smart Growth, which is necessarily a cooperative effort on the part of many agencies and groups across the State. The VTrans access management program and the flexible design standards discussed above are important supporting elements that work to preserve the capacity and safety of existing facilities, control the need for costly highway investments, and ensure that highway improvements are made in a context-sensitive fashion.

Some of the other key laws and programmatic initiatives related to Smart Growth (as it pertains to highway transportation) are as follows:

- Vermont's Land Use and Development Law (Act 250) was passed in 1970 to ensure that new development would occur in a well-planned, controlled fashion that was sensitive to environmental and natural resource considerations. Act 250 established a process for regulatory review of large development projects according to 10 criteria. These criteria consider the impacts of proposed developments on infrastructure needs (including roads) and traffic conditions, and require that projects conform with adopted local and regional plans. Act 250 does not address the kind of sprawl created by small-scale strip development – commercial and industrial projects on less than 10 acres are not generally affected.

- Act 200 was passed in 1988 to ensure that regional and local plans are consistent with a set of statewide goals, including maintaining "the historic settlement pattern of compact village and urban centers separated by rural countryside." The Agency of Commerce and Community Affairs assists municipalities in preparing plans in accordance with Act 200. However, lack of funding and enforcement mechanisms have been cited as factors which have limited the impacts of this legislation.

- Involvement of the RPCs in the TPI since 1992 has promoted coordinated land use and transportation planning, since the RPCs also are responsible for preparing Act 200 compliant regional plans.

- The Interstate Executive Order was signed in 2001 to promote planning for Interstate interchanges that supports conservation and appropriate development. This executive order includes objectives that interchange development does not exacerbate traffic congestion and increase need for roadway infrastructure improvements, and that the social and economic vitality of downtowns and villages are not adversely affected. The Vermont Department of Housing and Community Affairs (DCHA) developed an inventory of the Interstate interchanges that is designed as a reference for state officials in implementing the executive order. It includes information on existing land uses, local planning and regulatory status, public infrastructure availability, and conservation efforts. The DCHA was awarded a Sustainable Development Challenge Grant from the U.S. EPA which funded proactive community planning projects at four interchanges and development of a design guidelines manual.

- Passage of the Development Cabinet Law (Act 112) in 2000 created a mechanism to ensure collaboration and coordination among state agencies on land use issues. The Development Cabinet includes the secretaries of the Agencies of Administration, Natural Resources, Commerce and Community Affairs, and Transportation, key entities on planning efforts to discourage scattered development and encourage downtown revitalization and compact growth centers.

- The 1998 Downtown Development Act provided incentives and funding for downtown revitalization. In 2002, the downtown program was expanded to include benefits for new town centers and village centers.

Asset Management Policies

In 2001, the Vermont General Assembly required VTrans to develop an asset management plan which identifies all infrastructure assets and their condition, and determines the annual funds necessary to fund infrastructure maintenance at the recommended performance level. It also required that a plan be developed for assets constructed within the last 10 years which includes activities to be undertaken, the associated costs, and documentation of the comparative cost differential between maintaining the infrastructure, utilizing a preventive maintenance program versus deferring those maintenance costs (19 V.S.A. Sections 24 and 25).

In response, VTrans developed an Asset Management Vision and Work Plan[3]. The goals of VTrans' asset management efforts are to:

- Operate, maintain and/or upgrade infrastructure assets with appropriate performance and cost-effectiveness;
- Deliver to VTrans' customers the best value for the dollar spent; and
- Enhance VTrans' accountability and credibility.

The work plan laid out a number of initiatives to fully implement asset management at VTrans, including:

- Assign a lead role for asset management, and form a committee with representation from various sections and divisions;
- Incorporate asset management principles into the performance measure initiatives;
- Institute a phased approach to compliance with Sections 24 and 25, starting with currently available data in the pavement, bridge, maintenance, and airport runway management systems, master plans, and other sources; and
- Enhance the practice of performance-based planning and programming, with emphasis on strengthened project evaluation criteria, guidelines to assist decisions as to appropriate treatments (replacement, rehabilitation, preventive maintenance), and cross-program resource allocation and prioritization methods.

Asset Management Activities

Since the completion of the "Asset Management Vision and Work Plan," the agency has moved swiftly to implement a number of the plan's recommendations. A committee representing a diverse group of interests and expertise within the agency was formed and a lead role for asset management was assigned to form a vision on how asset management practices would be incorporated into the way the agency does business. Some of the achievements from this ongoing effort are listed below:

- During the summer and fall of 2003, the agency developed strategic performance measures that focus on programs and asset classes rather than individual projects. In

---

[3] Cambridge Systematics, Inc., VTrans Asset Management Vision and Work Plan, prepared for Vermont Agency of Transportation, January 15, 2002.

January, 2004 the legislature agreed that the agency should use that approach for the FY'06 budget process.

- The Agency must first practice good asset management principles within individual programs before making comparisons between programs. To that end, meetings were held with each program manager to determine current practices and to define ways to improve.

- The Agency is also developing operational performance measures that will provide feedback to Agency program managers. The measures are being developed in conjunction with managers responsible for asset classes and services.

- Agency staff are in the early planning phases of a Consolidated Asset Database that will facilitate project comparisons and selection.

Town Aid for Highways

The following discussion summarizes Vermont's aid programs for town highways, as well as Vtrans' responsibilities with respect to town highways.[4]

Federal-Aid Town Highway Grants – Funds are provided for reconstruction of Class 1, 2, and 3 town highways on the Federal-aid system. These require a 10 percent match. Projects are recommended by RPCs as part of the VTrans TPI planning process.

Local Transportation Facilities and Enhancements – Funds are available for enhancement projects, park-and-ride facilities, scenic byways, re-use of historic bridges and other "local" projects. This program is managed by the VTrans Local Transportation Facilities section.

Town Highway Grants – Annual state appropriations (19 V.S.A. Section 306(a)) are distributed by formula based on mileage of Class 1, 2, and 3 highways. Grants may be used for town highway construction, improvement and maintenance or for the local match of public transit assistance. Municipalities must submit annual plans detailing how the grant will be spent.

Town Highway Bridge Program – Annual state appropriations (19 V.S.A Section 306(b) are provided for rehabilitation and reconstruction projects on bridges with a span of six feet or more on Class 1, 2, and 3 highways. Project eligibility is based on VTrans inspection information which is used to identify critical defects. A five to 10 percent local match is required. VTrans is responsible for preliminary design on many of these projects.

Town Highway Structures Program – Grants are provided for repair, reconstruction or replacement of bridges, culverts and retaining walls on Class 1, 2, or 3 town highways. Improvements must extend the useful life of the structure and be of a permanent nature. A 10 to 20 percent local match is required – the lower match is provided for towns that

---

[4] VTrans Handbook for Local Officials, 2004.

have adopted town highway codes and standards, and that have conducted a highway infrastructure study to identify all structures, roadway deficiencies/condition and estimated repair costs within the past three years. Towns submit annual applications for these funds with a limit of $150,000 per project. Funds are allotted to VTrans Maintenance Districts, and projects within each district are selected by the District Transportation Administrators.

Town Highway Class 2 Roadway Program – Grants are provided for resurfacing or reconstruction of Class 2 highways. A local match of 20 to 30 percent is required (with the same requirements as noted above for the lower match). The funding limit and application process matches that of the Town Highway Structures Program.

VTrans Participation in Town Highway Maintenance – VTrans has the authority to designate Class 1 town highways, and assumes responsibility for scheduled surface maintenance or resurfacing, and center line pavement markings. VTrans is responsible for center line pavement markings on Class 2 highways, which are designated by municipalities and approved by VTrans. VTrans bears no responsibility for maintenance or upkeep of Class 3 or Class 4 town highways.

Appendix B

HERS Analysis

HERS Analysis

This Appendix describes the methodology used to analyze the performance of Vermont's highway system using the Highway Economic Requirements System (HERS), and summarizes the performance of the road network under a high, medium, and low-budget scenario.

Analysis Methodology

The Highway Economic Requirements System (HERS) was used to analyze the condition and performance of Vermont's highway system over the 10-year analysis period from 2001 to 2010. HERS was developed by Cambridge Systematics for the Federal Highway Administration (FHWA). The HERS model predicts future conditions and performance levels on the highway system given current network conditions and future highway improvement funds. The HERS model is designed to work with Highway Performance Monitoring System (HPMS) sample data. Recently, the HERS model was used in preparing the 2002 *Conditions and Performance* report for the U.S. Congress.[1]

The 2001 HPMS sample data for Vermont were used for the current analysis. This sample includes 17 percent of the state's highway miles overall, with the best representation of the higher functional classes:

- 96 percent of Interstate mileage;
- 38 percent of principal arterial mileage;
- 21 percent of minor arterial mileage;
- 15 percent of urban collector mileage; and
- Seven percent of rural major collector mileage.

Three scenarios, representing different assumptions regarding the annual funds available for highway improvement, were analyzed. Under the first (high-budget) scenario, an annual funding of $200 million was assumed to be available. Under the second (medium-budget) scenario, an annual funding of $100 million was assumed. Under the third (low-budget) scenario, an annual funding of $50 million was assumed.

[1] U.S. Department of Transportation, *2002 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, Washington, D.C., 2003.

Standard HERS default values were used for this analysis. Key inputs to HERS include unit costs for different types of work and standards for what constitutes a deficiency. Table B.1 summarizes the deficiency standards utilized for the analysis; Table B.2 summarizes unit costs.

HERS does not include analysis of bridge needs.

Table B.1 HERS Default Deficiency Standards

Rural/ Urban	Functional/ AADT Class[1]	Terrain	Right Shoulder Width	Lane Width	V/C Ratio	PSR[2]
Rural	Interstate:	Flat	10	12	0.70	3.2
Rural		Rolling	9	12	0.80	3.2
Rural		Mountainous	7	12	0.90	3.2
Rural	OPA ADT>6000:	Flat	9	12	0.70	3.2
Rural		Rolling	9	12	0.80	3.2
Rural		Mountainous	7	12	0.90	3.2
Rural	OPA ADT<=6000:	Flat	9	12	0.70	3.0
Rural		Rolling	9	12	0.80	3.0
Rural		Mountainous	7	12	0.90	3.0
Rural	MA ADT>2000:	Flat	7	12	0.70	2.6
Rural		Rolling	7	12	0.80	2.6
Rural		Mountainous	6	12	0.90	2.6
Rural	MA ADT<=2000:	Flat	7	12	0.70	2.6
Rural		Rolling	7	12	0.80	2.6
Rural		Mountainous	6	12	0.90	2.6
Rural	Coll.'s ADT>1000:	Flat	6	12	0.70	2.4
Rural		Rolling	6	12	0.80	2.4
Rural		Mountainous	6	12	0.90	2.4
Rural	Coll.s ADT=400-1000:	Flat	4	11	0.95	2.4
Rural		Rolling	4	11	0.95	2.4
Rural		Mountainous	4	11	0.95	2.4
Rural	Coll.'s ADT<400:	Flat	2	10	1.00	2.2
Rural		Rolling	2	10	1.00	2.2
Rural		Mountainous	2	10	1.00	2.2
Urban	Interstate		9	12	0.90	3.4
Urban	Other Freeway		9	12	0.90	3.2
Urban	OPA		8	12	0.90	3.0
Urban	MA		8	12	0.90	2.6
Urban	Collectors		6	12	0.90	2.4

[1] OPA = Other principal arterial
MA = Minor arterial
[2] PSR = Present Serviceability Rating

Table B.2 HERS Unit Costs
$1,000s per Lane-Mile

Rural/ Urban	Functional System	Terrain	Work Type: Reconstruct and Widen	Reconstruct	Resurface and Widen	Resurface and Improve Shoulders	Resurface
Rural	Int.	Flat	633-1585	595	323-1143	221	125
Rural	Int.	Rolling	741-1590	612	346-1232	233	120
Rural	Int.	Mountainous	854-2507	870	475-1677	286	155
Rural	OPA	Flat	609-1199	520	315-1143	153	78
Rural	OPA	Rolling	684-1380	588	348-1232	167	78
Rural	OPA	Mountainous	895-1786	735	495-1489	228	115
Rural	Minor Art.	Flat	469-1041	370	262-1028	155	66
Rural	Minor Art.	Rolling	590-1261	503	275-1030	157	71
Rural	Minor Ar.	Mountainous	920-1551	661	364-1309	195	110
Rural	Major Coll.	Flat	534-1143	379	212-805	108	37
Rural	Major Coll.	Rolling	648-1117	468	223-975	118	43
Rural	Major Coll.	Mountainous	829-1361	646	296-1017	151	54
Urban	Freeways/Expressways	-	2889-9160	1769	1716-9289	513	238
Urban	Other divided	-	1779-5447	1008	946-2554	351	160
Urban	Other undivided	-	1407-3848	922	1001-4347	306	181

■ Baseline Conditions (2001)

Based on Vermont's HPMS File, the Vermont highway network analyzed by HERS comprises 3,856 miles,[2] of which 320 miles are on the Interstate system, and 709 miles are on the National Highway System (NHS). The network carries 5.9 billion vehicle-miles of travel annually, of which 27 percent is carried by the Interstate system. Some key measures regarding the extent, condition, and performance of the highway network are summarized in Table B.3.

[2] These figures do not include rural minor collectors, rural local roads, and urban local streets as these are not part of HPMS sample data.

Table B.3 Highway Network Conditions in 2001

Performance Measure	System			
	Interstate	Other NHS	Off-NHS	Entire System
Miles	320	389	3,147	3,857
Lane-Miles	1,280	954	6,340	8,575
VMT (Millions)	1,625	1,116	3,163	5,904
Present Serviceability Rating (PSR)	3.6	3.23	3.17	3.30
Average Speed	71.6	41.8	39.8	45.8
Total Delay (hours/1,000 VMT)	0	3.68	2.43	2.00
Congested Link VMT (Percent of Total)	0.50	6.26	3.31	3.09
Congested Link Miles (Percent of Total)	0.19	2.30	0.62	0.75
Deficient Pavement VMT (Percent of Total)	14.33	41.93	19.67	22.41
Deficient Pavement Miles (Percent of Total)	11.18	37.21	20.98	21.81
Deficient Lane Width VMT (Percent of Total)	0.00	18.41	57.39	34.23
Deficient Lane Width Miles (Percent of Total)	0.00	24.57	66.09	56.41
Deficient Shoulder Width VMT (Percent of Total)	0.00	67.81	89.78	60.92
Deficient Shoulder Width Miles (Percent of Total)	0.00	73.56	90.90	81.60
Travel Time Costs ($/1,000 VMT)	295	491	512	448
Operating Costs ($/1,000 VMT)	337	249	231	264
Safety Costs ($/1,000 VMT)	62	192	172	143

■ Model Predictions

Model predictions for the year 2010 under the high, medium, and low-budget assumptions are summarized in Tables B.4, B.5, and B.6 respectively. Overall, there is a marked deterioration in network condition and performance under the low-budget scenario. Network conditions also get slightly worse under the medium-budget scenario. Under the high-budget scenario, network conditions improve significantly. The Interstate network shows the least improvement under the high-budget scenario, reflecting the high condition and performance standards existing on the network. The NHS network excluding Interstates shows the most improvement under the high-budget scenario. Under the low-budget scenario, the Interstate network shows the most significant deterioration in measures of pavement condition, while the NHS network excluding Interstates shows the most significant deterioration in measures of travel time and congestion.

Table B.4 Highway Network Conditions in 2010 under the High-Budget Scenario ($200 Million/Year)

Performance Measure	System			
	Interstate	Other NHS	Off-NHS	Entire System
Miles	320	389	3,147	3,857
Lane-Miles	1,283	985	6,392	8,663
VMT (Millions)	1,993	1,291	3,664	6,949
PSR	3.66	3.81	3.42	3.54
Average Speed	71.8	42.8	40.2	46.6
Total Delay (hours/1,000 VMT)	0	3.32	2.41	1.88
Congested Link VMT (Percent of Total)	0.25	5.37	1.28	1.54
Congested Link Miles (Percent of Total)	0.13	3.75	0.40	0.67
Deficient Pavement VMT (Percent of Total)	4.87	3.17	1.07	2.91
Deficient Pavement Miles (Percent of Total)	6.37	3.77	3.16	0.67
Deficient Lane Width VMT (Percent of Total)	0.00	14.87	55.26	31.25
Deficient Lane Width Miles (Percent of Total)	0.00	20.58	67.92	57.07
Deficient Shoulder Width VMT (Percent of Total)	0.00	28.67	47.92	30.23
Deficient Shoulder Width Miles (Percent of Total)	0.00	31.06	56.50	49.02
Travel Time Costs ($/1,000 VMT)	294	480	502	441
Operating Costs ($/1,000 VMT)	336	232	223	257
Safety Costs ($/1,000 VMT)	64	190	170	143

Table B.5 Highway Network Conditions in 2010 under the Medium-Budget Scenario ($100 Million/Year)

Performance Measure	System			
	Interstate	Other NHS	Off-NHS	Entire System
Miles	320	339	3,147	3,857
Lane-Miles	1,283	970	6,370	8,628
VMT (Millions)	1,992	1,289	3,660	6,942
PSR	3.57	3.32	3.18	3.19
Average Speed	71.8	39	38.8	41.7
Total Delay (hours/1,000 VMT)	0	3.99	2.46	1.98
Congested Link VMT (Percent of Total)	0.25	7.77	2.18	2.46
Congested Link Miles (Percent of Total)	0.13	4.78	0.57	0.91
Deficient Pavement VMT (Percent of Total)	14.03	32.50	16.33	33.25
Deficient Pavement Miles (Percent of Total)	13.91	4.78	27.82	28.22
Deficient Lane Width VMT (Percent of Total)	0.00	15.73	57.36	33.03
Deficient Lane Width Miles (Percent of Total)	0.00	21.19	68.65	58.11
Deficient Shoulder Width VMT (Percent of Total)	0.00	39.28	58.53	35.65
Deficient Shoulder Width Miles (Percent of Total)	0.00	45.54	72.63	60.54
Travel Time Costs ($/1,000 VMT)	294	526	525	459
Operating Costs ($/1,000 VMT)	339	249	232	268
Safety Costs ($/1,000 VMT)	64	191	171	144

Table B.6 Highway Network Conditions in 2010 under the Low-Budget Scenario ($50 Million/Year)

	System			
Performance Measure	**Interstate**	**Other NHS**	**Off-NHS**	**Entire System**
Miles	320	389	3,147	3,857
Lane-Miles	1,283	959	6,362	8,615
VMT (Millions)	1,992	1,287	3,655	6,936
PSR	3.32	3.12	2.9	2.94
Average Speed	71.2	33.2	34.3	41.7
Total Delay (hours/1,000 VMT)	0	4.61	2.56	2.04
Congested Link VMT (Percent of Total)	0.25	10.99	2.83	3.08
Congested Link Miles (Percent of Total)	0.13	6.79	0.70	1.14
Deficient Pavement VMT (Percent of Total)	44.94	41.19	29.16	45.43
Deficient Pavement Miles (Percent of Total)	42.56	42.07	41.78	42.15
Deficient Lane Width VMT (Percent of Total)	0.00	18.01	57.43	33.57
Deficient Lane Width Miles (Percent of Total)	0.00	23.85	68.67	58.42
Deficient Shoulder Width VMT (Percent of Total)	0.00	43.81	67.21	42.48
Deficient Shoulder Width Miles (Percent of Total)	0.00	50.84	82.38	71.13
Travel Time Costs ($/1.000 VMT)	296	619	593	492
Operating Costs ($/1.000 VMT)	347	264	246	277
Safety Costs ($/1.000 VMT)	64	192	171	144

Figures B.1 through B.3 summarize differences from the baseline (2001) for the three different budget scenarios. Figure B.1 shows variations in pavement condition (PSR)[3], illustrating that the $100 million scenario would allow Vermont's average pavement condition to stay at the baseline condition.

[3] Present Serviceability Rating (PSR) is a subjective measure of pavement condition, ranging from 0 to 5.

Figure B.1 Average Pavement Condition

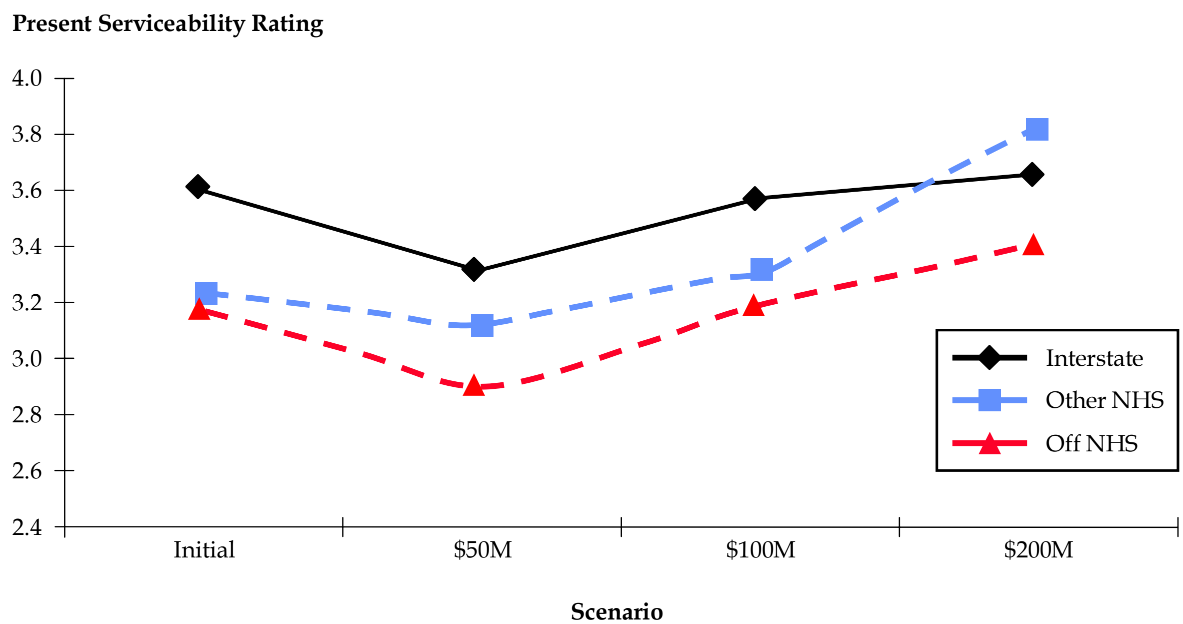


Figure B.2 User Costs

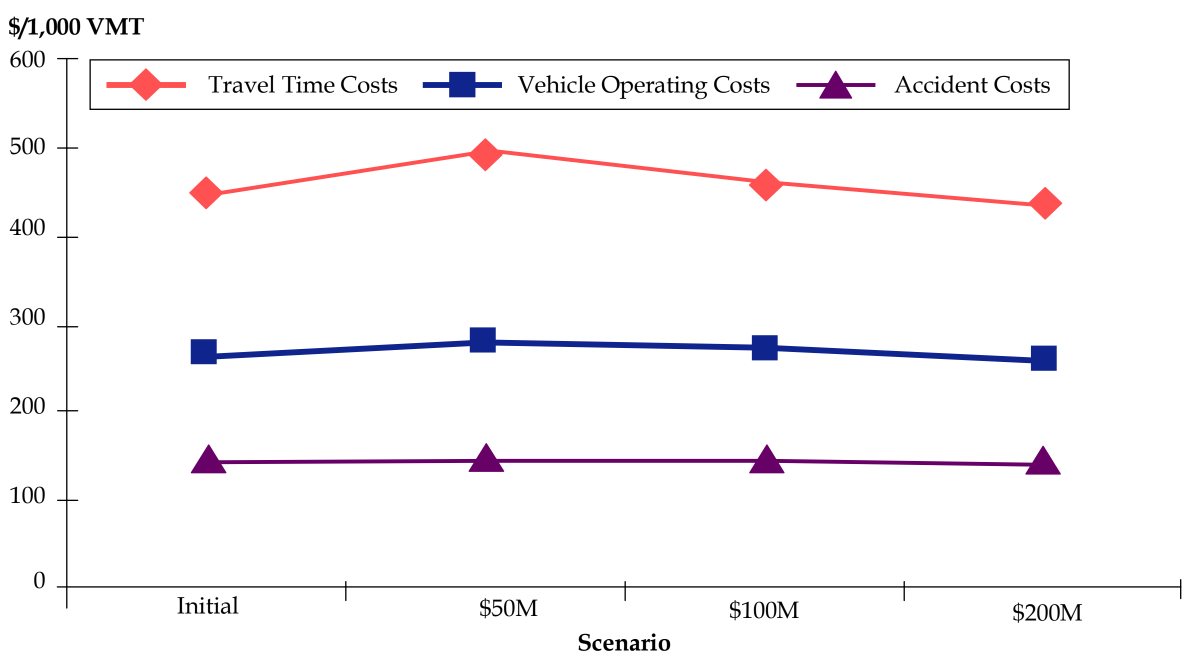


Figure B.3 Percent of Vehicle Miles Traveled (VMT) on Deficient Miles

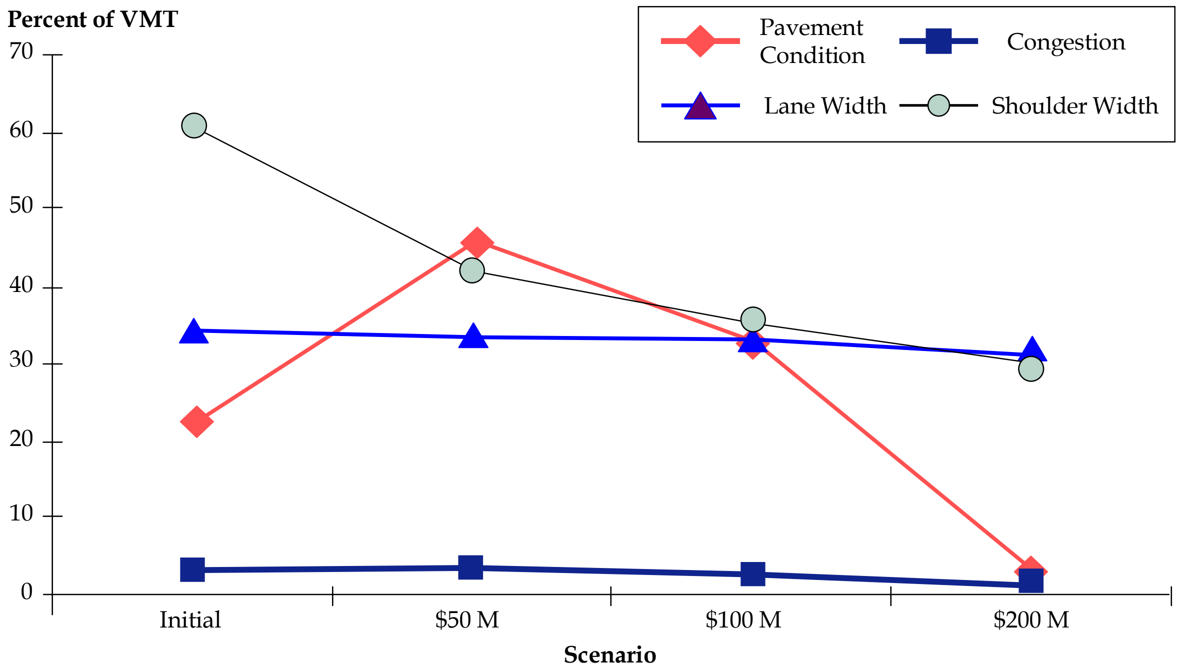


Figure B.2 shows the costs to highway users predicted by HERS for the baseline and the three budget scenarios. The analysis indicates travel time costs are the largest and most sensitive component of user costs, and that the $100 million per year scenario would keep user costs from increasing over the baseline level.

Figure B.3 shows the percentage of travel (VMT) on deficient highways – for different types of deficiencies. Deficiency thresholds vary by functional class, traffic volumes and terrain, as shown in Table B.1. The analysis indicates that a very small percentage of travel is on congested facilities for the initial baseline, and this already small share of congested travel would decline further as the investment level increases. The percent of VMT on highways with deficient pavement condition is very sensitive to the investment level – the results show an increase from 22 percent to over 40 percent at the low investment scenario, dropping back down to 33 percent for the medium budget scenario, and to three percent for the high-budget scenario. Lane width deficiencies are relatively insensitive to budget levels (indicating that the model calculates higher benefits from pavement improvement over widening); shoulder width deficiencies on the other hand are fairly sensitive to investment levels, and steadily decrease from the initial baseline of 60 percent (of VMT on highways with deficient shoulder widths) down to 30 percent for the high-budget scenario.

Summary

The HERS analysis indicates that a $100 million per year investment level in the highway system (exclusive of bridge work) would allow Vermont to maintain status quo pavement conditions, improve shoulder widths and keep congestion in check. HERS predicts that an investment level half this size would result in a significant long-term decline in pavement condition, and an increase in user costs of $58 per 1,000 VMT, or roughly $340 million per year (at 5.9 billion VMT per year).

The $100 million level is quite close to the "status quo conditions" scenario investment level of $93 million per year predicted by the pavement management system. However, the pavement management system does not include any reconstruction work on the Interstate, and no widening or shoulder work, whereas much of the work selected in the HERS simulation involved widening and shoulder improvements. Thus, for roughly the same investment level, the HERS simulation model (using standard defaults) appears to indicate that pavement condition can be improved over existing conditions and lane and shoulder widenings can be achieved as well. This could be due to a combination of factors, including differences in work unit costs and in pavement deterioration models in the two systems. Reasons for these differences need to be investigated further.

This rough analysis does indicate, however that HERS produces useful results that provide an understanding of a wide spectrum of impacts associated with different highway investment levels. These impacts include both highway system-level conditions, as well as customer-oriented impacts (i.e., user costs). The order-of-magnitude of the HERS results is consistent with the pavement management system results; therefore HERS provides an independent confirmation as to the scale of Vermont's highway needs.

A number of steps are recommended to better calibrate the HERS model to Vermont conditions and increase the level of confidence in its results:

- Investigate the feasibility of developing a more complete HPMS database, using existing information from the pavement management system and other highway inventory databases. In conjunction with this effort, subsamples representing the three networks analyzed for the Highway System Policy Plan should be prepared to provide better comparability of results.
- Compare the HERS default pavement deterioration curves to those currently used in the VTrans Pavement Management System.
- Compare the HERS unit costs for different work types to those assumed by the pavement management system.
- Modify the HERS PSR deficiency standards to better match the VTrans definitions of "poor" so that better comparability across results for the two models can be assessed.
- Develop a new set of Vermont-specific unit costs and deterioration model parameters for HERS.

Appendix C

Examples of Relevant Highway Policy Practice

Examples of Relevant Highway Policy Practice

Access Management

Overview

The statutory authority for access management is generally granted to a state department of transportation through the state code or general statutes. This may be accomplished through adoption of a specific statute relative to access management by the state legislature. Alternatively, the section of the state code specifying the authority of the department of transportation includes the ability to regulate access. The state statutes directing access management generally apply expressly to state highways. Non-state highways (county and local/municipal roads) fall under the jurisdiction of local governments. The access management program of state departments of transportation is commonly administrated in two ways; either through centralized state-level offices or through district offices.

The implementation of state-level access management programs varies substantially from state to state, but generally includes similar components. These components commonly include a documented set of standards for access design onto state highways, a permit process for access to a state highway, a system for revoking a permit or closing a driveway, a process for purchase of access rights, and a public information or outreach program.

Examples of State Statutory Authority and Administrative Structure

Colorado

The Colorado access management code is promulgated under the Colorado Department of Transportation (CDOT) rule making authority granted through the state legislature. The code was first adopted in 1981 and has been amended as recently as 1998. Colorado does not have a specific access management act.

The Colorado access management program is centralized within a state-level program office. Administrative procedures, access classifications, and design criteria are contained in one document.

Delaware

The Delaware access management program is implemented through the Delaware Department of Transportation (DelDOT) rule making authority granted through the state legislature. Delaware does not have a specific access management act.

DelDOT has a both a centralized Corridor Capacity Preservation Program administered through the Development Coordination Section of the Division of Planning and a decentralized highway access permit program. The Development Coordination Section reviews access proposed as part of development applications (zoning and subdivision) forwarded to them by local jurisdictions, and takes responsibility for administering acquisition of access rights. However, the highway access permit process is administered through the office of the Permit Supervisor in each state highway district.

Florida

The Florida access management program was established through a specific statute enacted in 1988 and amended in 1992. Requirements and authority for access management are spelled out in the statute. The statute makes a distinction between significant and “not-significant” increases in traffic generation for the purposes of regulating access.

The access management program in Florida is decentralized. The seven Florida Department of Transportation (FDOT) district offices have authority and responsibility for administering the program. Permit applications are made to the district maintenance offices. However, where an application requires more extensive technical review, it is forwarded to the District Permits Office and district permits engineer.

New Jersey

Authority for access management in New Jersey is established through the State Highway Access Management Act adopted in February 1989.

The New Jersey Department of Transportation (NJDOT) has a specific staff assigned to access and development. This staff is administratively centralized in the state-level office, but many individuals are located in district offices. There is a separate bureau for major access permits, while minor access permits are processed in the district offices.

Examples of State Access Management Program Structure

Colorado

The CDOT program includes:

- Formal procedures for purchase of access rights.
- Functional access classification of state highways.
- Procedures for issuing access permits. Permits can be revoked for failure to adhere to the terms of the access permit.
- Regulatory provisions allowing for denial or closure of direct access to a state highway when alternative access to a secondary roadway is available.
- The CDOT can, within its own initiative and expense, reconstruct or relocate an access when required by changes in roadway operations, design, and safety.
- Information on the access management program on the CDOT web site.

Delaware

The DelDOT program includes:

- Formal departmental policies and regulations for access management.
- A corridor capacity preservation program that provides for the purchase of access rights, development rights, or acquisition of properties in whole.
- A process for review of local zoning and subdivision applications that could have impacts to the State roadway system.
- An entrance-permit program that includes controlling location of access points and requiring compliance with access guidelines.
- Citizen guidebooks to the access management program, accessible through the DelDOT web site.

Florida

The FDOT program includes:

- Formal policies and administrative rules/directives. These include the administrative process, permit requirements, fee structures, and procedures for driveway closures.
- Defined design criteria for access, contained in the FDOT Standard Index, which includes standard plan sheets for the design of Florida highways.
- Field inspections are conducted to ensure driveways are being constructed as allowed by a permit.
- Information/educational documents and FDOT conducts extensive state staff training.
- Extensive use of informal public hearings and one-on-one meetings with property owners.

New Jersey

The NJDOT program includes:

- The State Highway Access Management Code (NJAC) (1992) that serves as a master plan, establishing policy and implementation procedures for the program.
- The NJAC limits redevelopment of a lot having access to a state highway based on whether or not the projected increase in traffic generation is significant (an increase in peak-hour trips of 100 or more and a 10 percent increase in ADT).
- Functional classification of all State highways.
- A specific set of access standards appropriate to each designated functional classification, including standards for geometric design and spacing.

- A procedure for issuing, amending, and revoking access permits. Permits are classified as major or minor based on estimated increase in traffic generation.
- A procedure for closure of driveways.

References

1. Access Management Manual, Transportation Research Board, 2003.
2. Access Management, Location and Design; NHI Course No. 15255, National Highway Institute, June 1998.
3. National Transportation Library – http://ntl.bts.gov/data/policy-plan/access.
4. Delaware Department of Transportation web site – http://www.deldot.net.
5. Colorado Department of Transportation Access Permits web site –http://www.dot.state.co.us/AccessPermits/index.htm/.
6. Florida Department of Transportation web site – http://www11.myflorida.com/planning/systems/sm/accman/.
7. New Jersey Department of Transportation web site – http://www.state.nj.us/transportation/business/accessmgt/.

■ Corridor Planning

Overview

A corridor plan is a long-range plan for managing and improving transportation facilities. Many states undertake corridor planning as an outgrowth of the strategic planning directives of the Intermodal Surface Transportation Efficiency Act of 1991 (known as ISTEA) and in association with the development of statewide transportation plans. Corridor plans assist in the identification of important transportation projects for implementation as included in each state's Statewide Transportation Improvement Plan (STIP).

Roadway corridors in need of a long-range plan are initially identified by state departments of transportation as part of statewide system planning or by local jurisdictions, regional planning agencies, or metropolitan planning organizations. Recommendations for corridor planning projects may be included in local and regional transportation plans, which are, in turn, incorporated in state transportation plans. Priorities for which corridor plans should be developed are commonly determined within the context of written strategies for statewide transportation system enhancements. Priority corridors are often identified based on the need to resolve major planning issues, to protect transportation investment, to preserve transportation rights-of-way, and to respond to Federal and state planning requirements. A key element of corridor planning is consideration of the interrelationship between land use and transportation.

Examples

Case Study 1. Connecticut

The transportation system in Connecticut is described in the *2001 Master Transportation Plan* (Connecticut Department of Transportation [ConnDOT], 2001) as being comprised of numerous corridors. These corridors consist of highways as well as other transportation systems. The recommendations for corridor improvements normally evolve from corridor studies and/or other types of studies related to specific modes or problems.

The emphasis of the corridor planning process in Connecticut is to develop strategies that focus on resolving the most critical transportation problems while meeting broader ConnDOT goals. A number of corridor planning studies are currently underway for various congested highway corridors in Connecticut. The need for these studies was identified in the long-range plans prepared by the regional planning organizations (RPO). While ConnDOT has the lead responsibility for most of these studies, some are being led by the RPOs. In either situation, however, the corridor planning effort is a collaboration among ConnDOT, the RPOs and the towns affected by the corridor.

The corridor plans lay out an integrated plan of transportation improvements for each corridor, including the scheduling and prioritizing of projects for implementation over a 20-year period. Most of the studies also include access management plans for the corridor towns. The towns actively participate in the process through Corridor Advisory Committees.

Case Study 2. Minnesota

The Minnesota Department of Transportation (Mn/DOT) began identifying key transportation corridors in 1999 as part of the development of the State Transportation Plan (STP). The key corridors were included in the designation of an Interregional Corridor System (ICS), formally adopted as part of the STP in January 2000. In conjunction with the identification of the ICS, Mn/DOT undertook a policy study to establish a "core transportation philosophy" for the ICS. The adopted policies correlate to the Mn/DOT's four Smart Growth Principles. These guiding principles provided a framework for adoption of the seven interregional corridor planning policies.

Mn/DOT has published a corridor planning guidebook entitled *Interregional Corridors – A Guide for Plan Development and Management* (2000). The guide is intended for use by Mn/DOT staff as well as other agencies and local units of government to provide a framework for preparing a corridor plan. Mn/DOT notes that key features of the interregional corridor planning process that may be different from traditional corridor planning approaches include:

- Performance-based planning approach;
- Management and analysis based on longer corridors;
- Implementation based on longer timeframes; and
- Ongoing corridor management teams.

Case Study 3. Oregon

In response to ISTEA, the state-level Oregon Transportation Commission (OTC) adopted the *Oregon Transportation Plan* (OTP) in 1992. The OTP established goals and policies to guide state and local transportation system development in an effort to "balance highways with other means of transportation, and transportation with other resources and community values." The Oregon Department of Transportation (ODOT) develops plans for transportation corridors identified in the OTP as being of statewide importance, generally for urban area arterial roads and interchange areas where development pressures have or are threatening operations. The OTP defines transportation corridors as "major or high-volume routes for moving people, goods and services from one point to another."

Corridor planning in Oregon is a three-phase process. In Phase 1, transportation facilities and systems in each corridor are identified and analyzed for present and future performance. In addition, characteristics of the corridor and the role it plays in the region are described in terms of land use, social, environmental, and economic development impacts. From these analyses come key findings and conclusions regarding the present and future performance and impact of the corridor. These findings and conclusions are the basis for a formal corridor strategy. Phase 1 corridor planning concludes with the endorsement of an "interim corridor strategy" by cities, counties and metropolitan planning organizations within individual corridors, and by the OTC.

During Phase 2, a "corridor improvement and management element" of each corridor plan is developed to establish implementation priorities. At the conclusion of Phase 2, the interim corridor strategy is refined to reflect the implementation decisions made. The corridor improvement and management element, together with the corridor strategy, is adopted by OTC as the "corridor plan."

Some portions of corridors may require refinement planning during a Phase 3 to resolve particular land use, access management, or other issues that require more in-depth analysis. Corridor plans may then be amended to incorporate the products of these refinement plans.

Federal and state agencies, tribal representatives, and transportation service providers in Oregon have been invited to participate in a standing Statewide Agency Coordinating Committee to facilitate their involvement in corridor planning. A statewide stakeholders group also facilitates public involvement in corridor planning at the state level. Those interested in a specific corridor can participate directly in corridor planning through involvement on a corridor planning management team.

References

1. Connecticut Department of Transportation 2001 Master Transportation Plan.
2. National Transportation Library web site – http://ntl.bts.gov/data/policy-plan/access.
3. Oregon Department of Transportation Access Management web site – http://www,odot.state.or.us/tdb/planning/access_mgt/.

Acquisition of Access Rights

Overview

One of the mechanisms used by many state departments of transportation for controlling access onto state highways is the acquisition of access rights. This means the state department of transportation may be authorized to purchase the right of access to a property, acquire an easement across a property, implement eminent domain, or purchase property in part or in whole for the purposes of managing access. So that property owners are not denied use of their land, in situations where access or development rights are purchased, property access to a state highway may be entirely eliminated only when some other access to a public street is possible.

The intent of acquiring access rights is twofold. Access rights may be acquired to reserve options for the State to develop future access points along a state highway. Access rights also may be acquired to prevent access from property abutting a state roadway. The effect is to control or limit the number of access points. In conjunction with this, whole properties may be acquired when access limitations imposed by the state creates unreasonable hardship for a property owner in terms of use or sale of his property. Funding for acquisition may be incorporated into a roadway construction budget or, in some states, may be included as a separate package in the state's six-year capital transportation funding program for corridor preservation.

Examples

Case Study 1. Delaware

Access rights are acquired in Delaware through the Corridor Capacity Preservation Program. Highlights of this program include:

- The Corridor Capacity Preservation Program objectives are documented in the Delaware State Code. These objectives include focusing development towards existing locations, reducing the need for expansion of the transportation system, and enhancing quality of life for Delaware residents.

- Four corridors have been identified along the SHS within which access management and capacity preservation are primary objectives.

- Funding for corridor preservation and acquisition of rights-of-way within the identified corridors is included in the state's six-year Capital Transportation Program.

- If a property owner is denied an entrance permit due to the Corridor Capacity Preservation Program, DelDOT must compensate the property owner through purchase of access rights, purchase of development rights, easements, or a fee simple acquisition. The property owner is expected to initiate the acquisition process.

- DelDOT negotiates with individual property owners to tailor the program to each situation.

Case Study 2. Wisconsin

Wisconsin's program for acquisition of access rights is described in the Wisconsin Department of Transportation (WisDOT) report, *Corridor Preservation and Access Management Guidance* report (January 1994). The primary purpose of the program is to acquire access rights to preserve rights-of-way for future transportation system needs. Highlights of the WisDOT program include:

- WisDOT may undertake negotiated purchase of additional rights-of-way at the time of initial roadway construction. Purchased land may then be leased back to former owners or others until such time as it is needed for project construction. The cost of purchase of access rights is part of the overall construction budget.

- WisDOT purchases easements within which no development can be undertaken.

- WisDOT may purchase access restrictions that prohibit driveways from changing from their current use. Such a restriction disallows the use of a driveway for any change in property use that increases traffic generation in excess of existing volumes.

- WisDOT collaborates with local jurisdictions in the official mapping of future transportation corridors. When a future corridor is officially mapped, the governmental entity having authority over the roadway has full control over access to the planned facility.

Impacts of Access Rights Acquisition on Property Values

Several states were contacted to inquire how their program of purchase of rights-of-way and access rights impacted property values. None of the states responding have formally tracked the impact of access acquisition activities on property values. However, the states surveyed have not observed that the purchase of access rights have clearly devalued or increased the value of adjacent properties. In fact, acquisitions have been associated with both increases and decreases in property values, indicating that the importance of access to property value is very variable and dependent upon many factors. The following observations are relevant to this issue:

- Factors influencing changes in property values include the functional classification of the abutting roadway, property location relative to other developments, zoning controls, and growth trends in the geographic area.

- An appraisal is prepared for each property where access rights are to be acquired in some way. These appraisal reports do not usually identify of the value of access as a distinct part of the overall property value, but rely on traditional appraisal techniques. Such techniques include examining property sales in the surrounding area and value of improvements on the property.

- Florida usually only purchases access rights around interchanges. FDOT reports that the result in urban and suburban areas is often the enhancement of property values. However, this is not due to the purchase of access rights per se, but to the anticipated increase in access created by the new interchange.

- WisDOT notes in its *Corridor Preservation and Access Management Guidance* report that they at times purchase a property before it is actually needed for a project in order to fairly compensate a landowner, because knowledge that the land will be required for a future roadway project has had a negative affect on the property's marketability. This process is referred to as hardship acquisition.

References

1. National Transportation Library web site – http://ntl.bts.gov/data/policy-plan/access.

2. Corridor Preservation and Access Management Guidance; Guidelines to Assist Metropolitan Planning Organizations in Addressing Corridor Preservation and Access Management Concerns in their Communities, Wisconsin Department of Transportation, January 1994.

3. Corridor Capacity Preservation Policy, Delaware Department of Transportation, 2002, http://www.deldot.net/static/pubs_forms/manuals/corr_cap/toc.html.

4. Survey of Purchase of Development and/or Access Rights, AASHTO, 2002 (http://www.transportation.org/community/right-of-way).

Appendix D

Glossary

Glossary

Term	Definition
Access Management	A process for providing access to land development, while preserving the safety and capacity of the transportation system.
Act 250	The 1970 Vermont Land Use and Development Law. The objective of this law was to ensure that new development would occur in a well-planned, controlled fashion that was sensitive to environmental and natural resource considerations.
Arterial	A street or highway that is primarily designed to accommodate through traffic.
Average Daily Traffic (ADT)	The average number of vehicles using a roadway over a 24-hour period.
Bridge Management System (BMS)	A database and analytical tool that allows the State Agency of Transportation to track bridge conditions; identify needs for maintenance, rehabilitation, and replacement; and analyze future bridge conditions under different investment scenarios.
Class 1 Town Highways	Town-maintained highways which form the extension of a state highway route and which carry a state highway route number.
Class 2 Town Highways	Town-maintained highways selected as the most important highways in each town (in addition to Class 1 highways).
Class 3 Town Highways	Other town-maintained highways negotiable under normal conditions all seasons of the year by a standard manufactured passenger car.

Term	Definition
Collector	A road or street that provides an intermediate function between providing access to abutting land and accommodating through traffic.
Commercial Vehicle Network	Highways for which no permit is required for trucks less than 72 feet in length.
Corridor	A broad geographical band connecting major population and employment centers within which passenger and freight travel, land use, topography, environment and other characteristics are evaluated for transportation purposes.
Engineered Flexible Pavement	Asphalt pavement for which the type and placement of fill underneath the surface is known and was designed to meet engineering specifications or criteria.
Equivalent Single-Axle Loadings (ESALs)	An approach for converting wheel loads from a mix of vehicle types to an equivalent number of "standard" or "equivalent" loads based on the amount of damage the vehicles do to the pavement.
Functional Class	The grouping of streets and highways into classes, or systems, according to the character of service they are intended to provide.
Goal	A general statement of an outcome that the Agency strives to achieve over the long term.
Health Index (Bridge)	A number between zero and 100, used in Vermont's Bridge Management System, that defines the overall condition or "remaining value" of a bridge.
Highway Economic Requirements System (HERS)	A model developed by the Federal Highway Administration to predict future conditions and performance levels on the highway system, given current network conditions and future highway improvement funds.

Term	**Definition**
Intelligent Transportation Systems (ITS)	The use of advanced technology to improve the efficiency and safety of the surface transportation system.
Level of Improvement (LOI)	A state policy and set of criteria to target roadway investments to locations and strategies of greatest need and benefit, based on functional class and level of usage.
Local Road	A road or street with the primary function of providing access to abutting land.
Long-Range Transportation Plan (LRTP)	A collection of transportation goals, policies, and planned projects for a state or metropolitan area, covering at least a 20-year time horizon.
Metropolitan Planning Organization (MPO)	The Federally designated transportation planning agency for a metropolitan area.
National Highway System (NHS)	A system of Federally designated roadways, including the Interstate Highway System and other major roadways considered important to the nation's economy, defense, and mobility.
Performance Category	A classification for a related set of desired outcomes.
Pavement Condition Index	Composite index from 0 (worst) to 100 (best) reflecting the extent and severity of pavement cracking, roughness and rutting.
Pavement Condition Category	Very Good – pavement condition index between 80 to 100 Good – pavement condition index between 65 to 79 Fair -pavement condition index between 40 to 64 Poor – pavement condition index less than 40
Pavement Management System (PMS)	A database and analytical tool that allows the State Agency of Transportation to track pavement conditions; identify needs for maintenance, rehabilitation, and replacement; and analyze future pavement conditions under different investment scenarios.

Term	Definition
Performance measure	An indicator that is used to track how well the transportation system is performing at achieving some desired outcome. Examples include number of structurally deficient bridges, vehicle-hours of delay, crashes, and tons of air pollutant emissions, percent change in poor lane miles.
Performance Target	A specific value of a performance measure that the agency intends to achieve within a specified amount of time, and against which actual results will be compared.
Present Serviceability Rating (PSR)	A subjective measure of pavement condition, ranging from 0 to 5, with 0 being the worst and 5 the best.
Preservation	Investments that serve the purpose of maintaining the physical integrity and the originally intended function of the existing system elements, including pavements, bridges and other highway system elements.
Primary Network	A state-designated network of roads that provide an essential set of links for statewide passenger and goods movement between primary population centers.
Regional Planning Commission (RPC)	A planning agency for a non-metropolitan area, which provides input to the state transportation planning process as well as conducting other planning functions.
Safety Management System (SMS)	A set of goals, performance measures, programmatic procedures, and analysis methods designed to reduce the severity and frequency of crashes on the State Highway System.
State Highway System	The set of highways maintained exclusively by the State Agency of Transportation.
State Transportation Improvement Program (STIP)	A short-term list of all transportation projects to be funded and undertaken within the state.
Strategy	An implementation step taken to achieve a goal; e.g., "undertake safety improvements at high-crash locations."

Term	Definition
Structurally Deficient	A bridge that has a poor condition rating for one of their major structural components (deck, superstructure, substructure, culvert) or if the structure's appraisal rating and waterway adequacy (where appropriate) is poor.
Sufficiency Rating (Bridge)	A number between zero and 100 indicating the sufficiency of a bridge to remain in service, based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use.
Traffic Analysis Zone (TAZ)	A geographic unit for summarizing population and employment data for use in travel demand models and for other transportation planning purposes.
Transportation Improvement Program (TIP)	A short-term list of all transportation projects to be funded and undertaken within a metropolitan area.
Transportation Planning Initiative (TPI)	A State initiative designed to include all segments of the public in planning improvements to Vermont's transportation system.
Volume/Capacity (V/C) Ratio	The ratio of the traffic volume on a roadway to the capacity of the roadway over a given time period.