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# Examining the Potential Impacts of Maintenance Investment and Capital Reinvestment in Vermont's Roadway Infrastructure Network

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## Executive Summary

The United States is facing a serious crisis with respect to transportation funding. Many infrastructure components, including roadways, bridges, and transit systems are dated, worn down and/or are functioning below baseline performance threshold levels. Traditional revenue sources such as gas taxes, vehicle tolls, and Highway Trust Fund (HTF) distributions are not providing adequate revenue streams to keep up with increasing infrastructure maintenance and repair costs. Even with the passage of the recent federal transportation funding bill in 2015, federal and state agencies are struggling to keep up with the increasing capital requirements needed to improve, replace, rehabilitate, and/or maintain aging and heavily used transportation assets. This funding crisis has put intense pressure on transportation agencies to come up with newer, more innovative funding strategies. One such innovative funding strategy is referred to as *strategic reinvestment / disinvestment*.

Conventional transportation investment alternatives are typically categorized as either maintenance, repair, replacement, or expansion. Conversely, disinvestment alternatives are categorized as deferment of action, modification of standards, decommissioning assets, or a change of jurisdiction. To fully evaluate all possible investment alternatives, decision-makers should consider both conventional investment strategies as well as disinvestment strategies. Strategic reinvestment / disinvestment generally involves: 1) clearly prioritizing transportation goals and objectives, 2) identifying the projects and/or assets that are most important with respect to obtaining various goals *as well* as projects and/or assets that are the least important or least critical in obtaining those goals, 3) and then consciously defunding or reducing funding allocated to lower priority transportation assets and ideally reinvesting those savings into higher-priority assets.

This report summarizes the current state of practice related to the implementation of different reinvestment / disinvestment strategies at the state level and examines how some of these strategies may be employed in the state of Vermont. In this report, we not only identify candidate corridors for disinvestment based on quantifiable measures of how critical or important the corridors are to traffic flow throughout the roadway network as a whole, but we also consider how disinvestments might impact access to critical services (i.e. access to hospitals and police / fire services), and whether or not the disinvestment might have a disproportionate impact on vulnerable populations in the state.

# 1 Introduction

Throughout the United States (U.S.), the organizations responsible for building and maintaining transportation infrastructure are faced with ever-growing fiscal constraints. Even with the 2015 transportation bill in place, the maintenance and rehabilitation of the nation's transportation infrastructure is underfunded and falls short of the baseline level of funding needed by over $170 billion (Herszenhorn 2015). Improvements in fuel economy and changing driving behaviors have led to decreasing revenues from gasoline and diesel sales taxes. In addition, revenues have not kept pace with inflation and the growing needs for rehabilitation of the nation's aging infrastructure. Consequently, a large and growing imbalance exists between the revenue raised from conventional transportation funding mechanisms and the capital requirements needed to improve, replace, rehabilitate, and maintain the nation's vast transportation assets.

In response to this imbalance, transportation investment strategies have shifted away from the capacity-expansion-based approaches to more innovative approaches focused on the most important or "most critical" infrastructure components. These investment strategies are fundamentally different from the traditional expansion-based strategies in that they shift investments away from assets that are not critical toward a targeted subset of the most important infrastructure assets.

Like many states in the U.S., Vermont faces challenges in determining how best to allocate its limited transportation budget to a growing list of infrastructure needs. For example, according to the 2012 Vermont Transportation Funding Options Report (CTF, 2012), a funding gap of approximately $240 million per year was forecast between 2014 and 2018. The gap is created by decreasing revenue and inflation coupled with a surge of future improvement needs, and represents the difference in funding that is needed to maintain, operate and administer the state's transportation system and revenue estimates for the same time period. Disinvestment is a strategy that could help the agency close this gap.

To better align transportation infrastructure investment decisions with the state's strategic priorities, the Vermont Long Range Transportation Business Plan specifically calls for the exploration of a policy of strategic disinvestment;

> *Consider development of a "strategic disinvestment" policy for transportation infrastructure and services whose maintenance, preservation, and/or operating costs*

*significantly exceed the value of their economic and social benefits (RSG 2009).*

As states like Vermont consider implementing disinvestment strategies with respect to prioritizing transportation infrastructure investment decisions, the possible negative consequences associated with those strategies should also be considered; particularly in the context of whether disinvestment decisions may disproportionately impact populations that are classified as "vulnerable". Vulnerable populations include the elderly, ethnic minorities, the mentally ill, the chronically ill, the physically disabled, and the economically disadvantaged (American Journal of Managed Care 2006). In this report, we identify candidate corridors for disinvestment in the state of Vermont based on four different disinvestment scenarios, and then evaluate whether or not disinvestment within each corridor is likely to disproportionably impact vulnerable populations. The specific objectives of this research effort are:

1. Review and document strategies for maintenance reinvestment and capital disinvestment that have been implemented throughout the U.S.

2. Develop a framework to help guide the Vermont Agency of Transportation (VAOT) with strategic reinvestment / disinvestment decisions.

3. Identify candidate corridors for strategic disinvestment using a comprehensive approach that incorporates two network-based performance measures: 1) the Network Robustness Index (NRI) (Novak et al. 2012; Sullivan et al. 2010; Scott et al. 2006), and 2) Critical Closeness Accessibility (CCA) (Novak and Sullivan 2014; Sullivan et al. 2013)) and a qualitative consideration of potential disinvestment savings.

4. Develop a vulnerability index to help identify populations that may be adversely impacted by disinvestment decisions. We then apply the index to the candidate corridors identified in Objective 3 to evaluate the potential relative impact of specific disinvestment scenarios on vulnerable populations in the state of Vermont as compared to non-vulnerable populations.

# 2 Background and Literature Review

To understand the concept of *disinvestment*, it is important to draw a distinction between underinvestment due to budget shortfalls and targeted (i.e. strategic) disinvestment. Underinvestment stems from not having enough money to fully fund all projects and / or assets that require or request funding (i.e. budget shortfalls). In some cases, underinvestment may be allocated equally across all assets and projects (i.e., reduce all operational area budgets in the state by 10%). In other cases, underinvestment may occur in a more ad hoc or reactionary manner. For example, once a specific budget threshold is hit, no more projects are funded, regardless of need or how "important" those projects might be. Whether underinvestment occurs in an equitable or ad hoc manner, the result is that assets that are due for maintenance or are in need of repair are not provided the funding needed to properly maintain or repair those assets due to budget shortfalls. This is not the same as disinvestment.

Strategic disinvestment involves the prioritization of assets or projects in terms of their strategic importance (or lack thereof), for the purpose of *deliberately* shifting investments away from the lowest priority assets and toward the highest priority assets. Thus, strategic disinvestment involves conscious, deliberate efforts to prepare for budget shortfalls by defunding targeted lower-priority assets. There is an intentionality to disinvestment that is lacking in the chronic underfunding that often plagues the nation's transportation system.

## 2.1 Current State of Practice

*Strategic reinvestment / disinvestment* is not an entirely new concept in managing and financing the maintenance, repair, and rehabilitation of transportation assets. In 2015, the National Cooperative Highway Research Program (NCHRP) released a research synthesis providing a road map to transportation disinvestment (Duncan and Weisbrod 2015). The synthesis defined the strategic disinvestment paradigm, provided background information on tools that can be used to evaluate disinvestment decisions, and discussed various case studies of disinvestment across federal, state, and local agencies. A substantial number of state departments of transportation were surveyed to assess their experiences with disinvestment decision-making as part of the synthesis. The state-level case studies provided real-world examples of how different states prioritized transportation funds for projects that best fit their strategic plans and goals.

About half of all the state DOTs surveyed reported struggling with infrastructure reinvestment / disinvestment decisions (Duncan and Weisbrod 2015). The majority of respondents noted that the state transportation improvement program (STIP) could serve as a suitable vehicle for examining disinvestment. Many respondents also noted that an important component of the strategic disinvestment process was the reinvestment of at least a portion of the funds saved through disinvestment to higher-priority projects or programs. Specifically, many state DOTs felt that the reinvestment (or transfer) of funds to high-priority projects was essential in justifying the disinvestment action. One of the findings of the survey was the stated need to develop evaluation methods specifically tailored to assess outcomes associated with different disinvestment scenarios.

## 2.2 Vermont's Strategic Investment Approach

In the state of Vermont, the project-prioritization component of the state's capital-project development process helps guide infrastructure investment decisions at the project level. The VAOT initially implemented a project prioritization process in 2006 (RSG 2009; VAOT 2009). The primary motivation behind this effort was to provide structured guidelines for evaluating and prioritizing the selection and funding of transportation infrastructure projects across different asset classes (i.e. paving, roadway, safety and operations, park-and-ride, etc.), given that the performance measures that are used to rank the various projects are not consistent across all the asset classes.

Table 1 provides an overview of the specific scoring metrics associated with each transportation asset class (VAOT, 2016a). Note that for the various highway asset classes, the prioritization process takes into account current conditions, cost/benefit ratios, regional priorities, project momentum, and other factors that may be specific to particular assets.

**Table 1. VAOT Project Prioritization Scoring**

| Project Category | Condition | Cost/ Benefit | Regional Priority | Project Momentum | Network Designation | Remaining Life | Functionality (meets standard) | Capacity / Demand | Designated Downtown | Safety | Multimodal / Transit Service | Waterway Adequacy / Scour Susceptibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving | 20 | 60 | 20 | | * | | | | | | | |
| Bridge | 30 | 10 | 15 | 5 | | 10 | 5 | 15 | | | | 10 |
| Roadway | 40 | 20 | 20 | 20 | * | | | | 10 | | | |
| Traffic Operations | | 20 | 20 | 10 | | | | 40 | | 20 | | |
| Park and Ride | 40 | 20 | 20 | 20 | * | | | * | | | * | |
| Bike/Ped | 20 | 20 | 20 | 20 | 10 | | | | 5 | | 5 | |

* Represents factors that are accounted for, but scored as a secondary consideration in another metric (e.g. network designation in paving projects accounted for by categorizing and allocating projects by designation interstate, national highway, state highway, town highway).

Significant opportunities for cost savings may also be achieved by renegotiating budget allocations between VAOT's capital programs (where the project-prioritization process is implemented) and its maintenance & operations sections. Although maintenance & operations decisions are not guided by the same structured project-prioritization as capital project decisions, they are being increasingly directed by performance measurement targets. Based on examples provided in the 2015 NCHRP synthesis, it would be possible for the VAOT to use performance measurement targets to help evaluate the impacts associated with disinvestment in maintenance & operations activities.

## 2.3 Potential Disinvestment Strategies

It is important to note that many of the scoring metrics presented in Table 1 (for the prioritization of capital projects) are project-based and evaluate each project in isolation, as opposed to evaluating the importance of each project in the context of its contribution to the entire transportation system or to the state's strategic goals. Using the scoring metrics in Table 1, it is possible that a project focused on a particular locality or corridor could rise to the top of the prioritization ranking for a specific asset class; however, there is no guarantee that the project is crucial to the performance of the state's transportation network, or that the project is critically important in achieving the state's overall transportation priorities. From a strategic standpoint, the prioritization and funding of transportation projects should be evaluated with respect to a project's value to the transportation network as a whole (Novak et al. 2012). A system-wide prioritization approach not only provides a more efficient use of resources, but ensures that investment decisions are strategically motivated.

Thus, the assets or projects that are most important to the functionality and safety of *the state's entire transportation network* should be prioritized. Conversely, the assets or projects that are not important to the functionality and safety of the transportation network represent possible candidates for disinvestment. Possible candidates for disinvestment might include: 1) assets or projects that address very specific or localized needs; 2) assets or projects that have decreased in importance over time, and 3) assets or projects that have outlived their original intended purpose or prescribed performance thresholds[1].

When evaluating investment alternatives, decision-makers should consider both conventional investment and disinvestment strategies, as these strategies may have very different or even conflicting focuses. Conventional transportation infrastructure investment strategies include:

- maintenance,
- repair,
- replacement,
- enhancement, and
- expansion;

whereas disinvestment strategies include:

- deferred action,
- modification of standards or performance thresholds,
- decommissioning,
- re-purposing, and
- jurisdictional change.

Figure 1 provides an overview of conventional investment strategies in contrast with disinvestment strategies on a relative scale of potential cost savings versus the change in responsibility, control, and/or obligation resulting from the action.

[1] It is important to note that the research team is not suggesting that all assets or projects that fall into one or more of these generalized classifications should automatically be targeted for disinvestment. Rather, that effective allocation of limited resources is best guided by longer-term, strategic decision-making keeping the state's overall mobility and safety goals in mind.

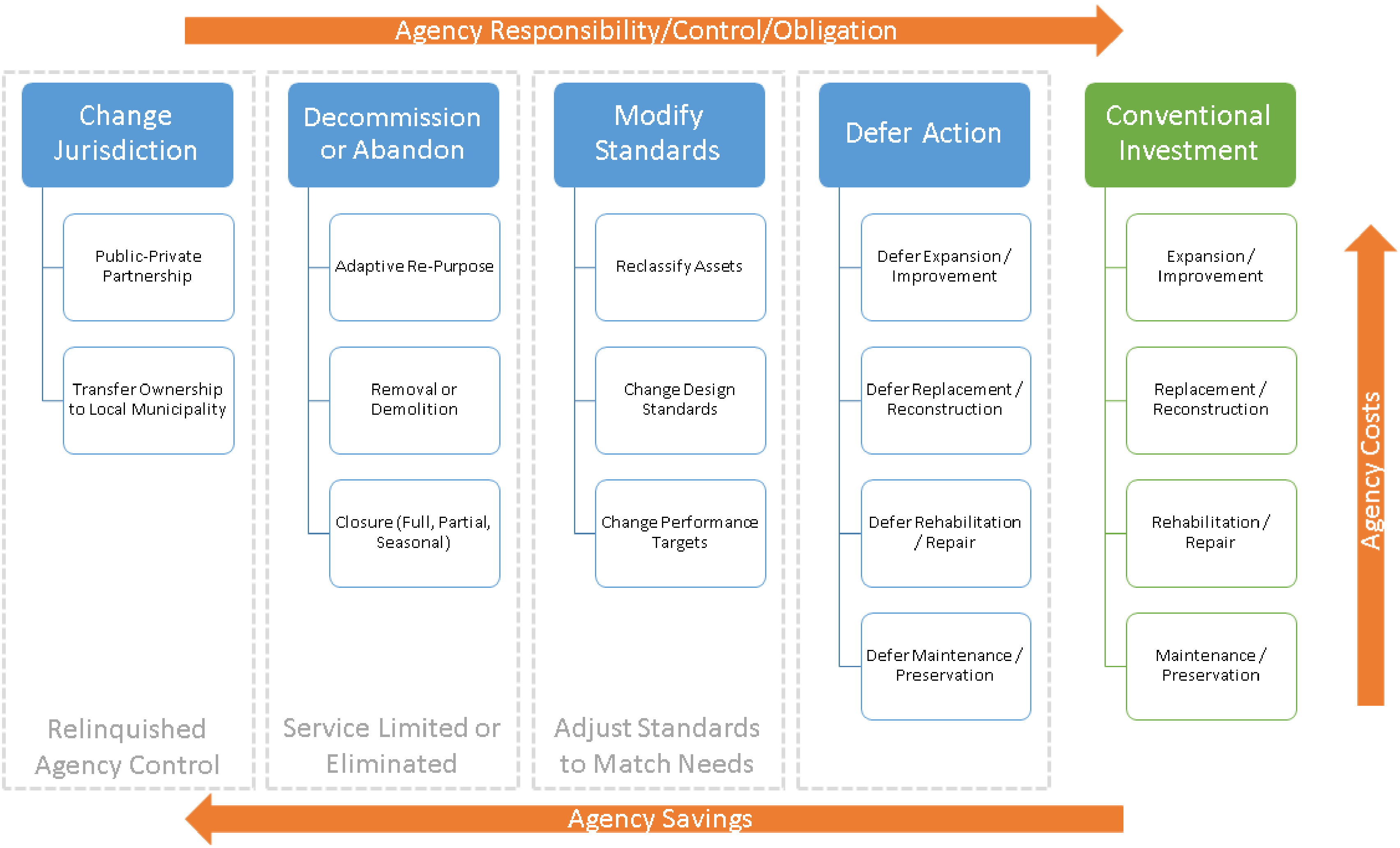


**Figure 1. Disinvestment strategies for transportation assets.**

Disinvestment decisions are not limited to “either/or” decisions, and it is important to note that different strategies may be used in conjunction with one another. It is also important to note that each strategy has a unique set of tradeoffs, and the impact of each disinvestment decision will vary on a case-by-case basis. For instance, accepting a new, lower *performance threshold* for a particular class of road may save VAOT money with respect to the short-term costs of maintenance and allow the agency to *defer rehabilitation* in the long-term; however, such a decision could potentially reduce public satisfaction and increase vehicle wear. Thus, the long-term effects of the decision could result in costs being transferred to individual travelers. These types of tradeoff should be evaluated carefully before any disinvestment decisions are made.

In an effort to better understand the concurrent application of different disinvestment strategies as well as the possible tradeoffs they pose, we examine a number of disinvestment scenarios and discuss the potential impacts associated with each. Table 2 provides a summary of the disinvestment scenarios included in the NCHRP research synthesis (Duncan and Weisbrod 2015), as well as additional cases found in the literature. The discussion is organized according to the framework provided in Figure 1.

**Table 2. Disinvestment Strategy Cases from NCHRP and Literature**

| Disinvestment Strategy | Specific Disinvestment Action | Examples from NCHRP & Other Sources | Example Agency |
|---|---|---|---|
| Change Jurisdiction | Public-Private Partnership | Public-Private Partnership (PPP) in Pennsylvania provided a contract for bridge design, replacement, and maintenance over a 25-year period. The PPP was projected save the agency 30% in costs and reduce the time necessary to address bridge deficiencies by 75% (Murphy 2014). | PennDOT |
| | Local Municipality Turnback | Louisiana established a program for the voluntary transfer of state highway assets to parish jurisdictions. For the 5,000 miles of eligible highway, the projected operations and maintenance reduction was $27M per year or $2.5B over the 40-year project lifetime (Paul 2015). | Louisiana DOTD |
| Decommission or Abandon | Adaptive Re-Purposing | Vermont installed (or is installing) the Beebe Spur, Delaware & Hudson, Lamoille Valley, and Missiquoi Valley Rail Trails on railbanked corridors. Previously used for rail, the repurposing of the corridors for active transportation purposes allows the state to maintain the right-of-way and the option to use it for other transportation functions in the future. | VAOT |
| | Disposal, Demolition, Restoration to Original Condition | The National Park Service developed an asset priority index and facility condition index to rank assets and flag low ranking assets for disposal (Duncan and Weisbrod 2015). Evaluation of the disposal options highlighted the need to project costs associated with disposal, which are not negligible and often overlooked. | National Park Service (NCHRP) |
| | Abandonment | On the Pennsylvania Turnpike, three tunnel bores were abandoned in favor of a highway realignment project as a result of demand for the corridor increasing beyond the capacity of the original tunnels (Longfellow 2015). | PennDOT |
| | Closure (Full, Partial, Seasonal) | Vermont and Colorado identified opportunities for disinvestment at several rest areas they were operating and managing along interstates. In Vermont, the cost savings were estimated at $1.4 million for the closure of 3 rest areas (VPR 2009). In Colorado, the cost savings associated with the closure of 5 rest areas were estimated at $300,000 annually (Howes 2013). | VAOT, CDOT |
| Modify Standards | Reclassify Assets | Washington State DOT reclassified the roadways eligible for chip sealing. The decision expanded eligibility for a lower-cost treatment to include roads with 2,000-10,000 AADT, not just roads with 2,000 AADT or less (Duncan and Weisbrod 2015). | WSDOT (NCHRP) |

| Disinvestment Strategy | Specific Disinvestment Action | Examples from NCHRP & Other Sources | Example Agency |
|---|---|---|---|
| | Change Design Standards | The 1997 codified Flexible Design Standards allowed the state of Vermont to adjust the standards for the National Highway System (NHS) passing through town and village centers. The original standards called for realignment of routes with wider lanes and higher speeds. Many of these realignment projects were met with significant local opposition, which resulted in subsequent delay. Adhering to NHS standards wound up costing the Agency time and money. VAOT's solution was to relax the NHS standards in downtown areas to be more flexible in terms of local needs and priorities. | VAOT |
| | Change Performance Targets | Minnesota disinvested in the state highway system to reinvest in the NHS based on the need to match federal funds (Duncan and Weisbrod 2015). The state lowered the minimum pavement condition of non-NHS class of roads. In the state of Connecticut, the highway that runs through Hartford is coming to the end of its useful life (Duncan and Weisbrod 2015). The Connecticut DOT is considering significant changes to performance targets for the highway. These changes primarily involve reclassifying the highway corridor as a boulevard in order to prioritize mobility, connectivity, and economic vitality in the neighborhoods it bisects. The previous classification as a highway corridor focused on providing a high speed thoroughfare through the city. | MinnDOT & ConnDOT (NCHRP) |
| Defer Action | Defer Rehabilitation / Repair | South Carolina disinvested in resurfacing and routine maintenance activities to reinvest limited funds into areas that are eligible to receive federal aid matches, highlighting the tradeoff between routine maintenance and increasing mobility (Duncan and Weisbrod 2015). | SCDOT (NCHRP) |

As shown in Table 2, VAOT has already implemented some actions that fall under the general umbrella of reinvestment / disinvestment. As the term "disinvestment" can be politically charged and may elicit unfavorable reactions from the general public, disinvestment decisions are often very low profile and the term "disinvestment" may not be explicitly used. Consequently, a limited number of "disinvestment" examples appear in the literature. Different disinvestment strategies and some illustrative examples are discussed in more detail below.

## Jurisdictional Change

Relinquishing control through *jurisdictional change* is one way in which state agencies are able to transfer the responsibility for maintaining an asset to another governing body. The agency gives up control of the asset in exchange for reprieve from maintenance and capital investment obligations. *Transferring ownership* of an asset or set of assets to local public entities is one way to accomplish jurisdictional change with *local municipality turnback*.

Recent efforts in Vermont to provide guidance to towns and local municipalities on the transfer of highway ownership from the state to town jurisdictions are summarized in a 2016 white paper (Gibson 2016). The paper provides a framework for identifying the maintenance activities that would become the responsibility of the town and the budget considerations that are typical for reclassification of state highways to Class I town highways. The paper also describes a cost analysis tool to assist towns in their assessments.

In the case of Louisiana, *reclassification* of nearly 5,000 miles of eligible state highway allowed the state to achieve its goal of owning 19% of the highway infrastructure mileage, which is consistent with the national average (LDOTD 2013). The state's mission is to maintain control of assets that provide the greatest interurban mobility in the state. The reclassification program allows the state to *turnback* jurisdiction of state highway assets to parishes and local municipalities. In turn, local municipalities are incentivized to take control of the assets by the state offering to repair or rehabilitate highway segments below fair condition prior to transfer and by providing a 40-year maintenance credit for the asset to be used as the municipality sees fit. The municipalities can use the maintenance credit to address transportation debts, finance other capital projects, or budget for assets to support the operation, maintenance, and construction needs of their systems. As currently budgeted, the program allows for the annual transfer of about 50 miles of highway and is projected to save the state approximately $2.5 billion in maintenance and operation over the 40-year program lifetime.

In *public-private partnerships* (PPP or P3), the state transportation agency maintains ownership of the asset, but shares the maintenance and improvement burden by providing incentives such as multi-project contracts for private firms. These arrangements can save the state money and save private firms' time, as well as providing the firms with increased contractual security by awarding multi-project contracts. A PPP approach that has been successfully implemented in Vermont is the design-build project, which awards both the design and build contracts to the same firm. This essentially eliminates the bidding process that typically occurs between the design and construction phases of a project, allows for improved coordination within the project, and allows for significantly quicker turnaround times on projects.

The Pennsylvania DOT utilized the design-build approach for a large rehabilitation / replacement project focused on deteriorating bridges throughout the state. The $899 million contract maintains PennDOT's ownership of the 558 bridges to be rehabilitated / replaced, but provides the contractual responsibility of designing, building, and maintaining the bridges to Plenary Walsh Keystone Partners for the next 25 years (Murphy 2014). The plan is estimated to save 30% of the overall costs to replace and maintain the deficient bridges, while cutting down the time of design and build by 75% (Murphy 2014).

### Decommissioning or Abandonment

There is a documented history of transportation disinvestment in terms of infrastructure or asset abandonment, decommissioning, disposal, and/or closure. These types of decisions can be spurred on by changes in usage and performance. For instance, decommissioning a bridge may come about based on the combination of low traffic volumes, structural deficiencies, and system redundancy changes (i.e. other bridges in close proximity over the same waterway), resulting in either reduction of allowable loads, closure, or demolition. In other cases, decommissioning may only be temporary, such as cases throughout Vermont where roads are seasonally closed due to safety concerns and/or the significant burden winter maintenance activities impose.

One way in which states can decommission an asset while retaining the right-of-way is through *adaptive re-purposing*. The most familiar example of adaptive re-purposing are rails-to-trails projects across the U.S. There are currently over 2,880 rail-trails totaling more than 31,000 miles (Rails-to-Trails Conservancy n.d.). In Vermont, the state owns the right-of-way for 145 miles of railbanked trail facilities (VAOT 2016b). Some of these are already converted to recreational walking and biking paths, like the Bebee Spur Trail ("Beebe Spur Rail Trail | Vermont Trails | TrailLink.com" n.d.), while others are in the process of becoming connected active transportation corridors, such as the Lamoille Valley Rail Trail ("Lamoille Valley Rail Trail" n.d.).

In Pennsylvania, stretches of the original Pennsylvania Turnpike, including three tunnel systems, were abandoned. The right-of-way associated with the tunnels was initially repurposed from a rail corridor to accommodate automobile and truck traffic as part of the Pennsylvania Turnpike in the mid-1900s. As traffic on the Turnpike increased over time, PennDOT officials determined the most cost effective strategy would be to completely close and abandon the three tunnel sections in favor of a newly built bypass. The tunnels were closed and were eventually repurposed as part of the rails-to-trails project.

Recently, many state maintained rest areas throughout the U.S. have faced closure or decommissioning in the face of tight budgets. For example, in 2009 VAOT closed three highway rest areas (Highgate I-89 southbound, Sharon I-89 southbound, Hartford I-91 northbound, and Randolph I-89 northbound), which accounted for savings of approximately $1.4 Million (VPR 2009). In fiscal year 2012, Colorado closed five of their 27 state owned and operated rest areas, which resulted in cost savings of approximately $300K a year. As an alternative to closing other rest areas, Colorado explored a variety of options such as: allowing commercial activities inside the rest areas including advertisement, sale of travel and tourism items or tickets, lottery sales, and vending machines, and / or encouraging commercial development adjacent to the interstate right-of-way such as fuel, retail, and food and beverage services through PPP.

## Modifying Standards

Disinvestment strategies that include *changing performance targets*, *altering design standards*, and/or *reclassifying assets* may also prove to be effective. Allowing state DOTs input into, and more flexibility in adhering to, certain design standards associated with the national highway system has allowed states to modify standards in certain situations. For example, in Vermont, new federal standards requiring wide, 12 foot lanes with wide, 8 foot shoulders on rural, two-lane highways were met with significant community resistance, particularly where the highway passed through small population centers. Costly delays and lack of public support were detrimental to many widening projects, and gave cause to VAOT to reevaluate their approach and to question the logic behind the federal standards. Concerns of safety were often cited in these corridors where pedestrian crossing and reducing traffic speeds were the priorities of the community. While widening and straightening two-lane highways made sense in some areas, many of the highways that passed through villages and towns required more context sensitive solutions. More flexible design standards established guidelines that can be adjusted for village, town, or urban areas. Specifically, the new flexible standards allowed lane widths between 10-12 feet (a narrowed design for lower speeds) and shoulder widths between 2-6 feet, which accounted for areas constrained by right-of-way or buildings.

As some components of the interstate highway system reach the end of their useful life, many localities across the country are re-evaluating the functionality of specific highway corridors. For example, many highway corridors in urban areas were originally designed to move high volumes of traffic into and through city centers from quickly expanding suburban areas. Accordingly, the design and performance targets for those highway segments were speed and capacity focused. In response to those design and performance goals, high speed thoroughfares were constructed that often bisected city neighborhoods by grade separated, viaduct structure highway systems. In some places these structures isolated neighborhoods from desirable areas, like the Embarcadero in San Francisco (Eckerson 2006). In other places, highway structures segregated neighborhoods, resulted in an increased exposure to noise and air pollution, and created undesirable areas with higher crime incidence, like I-81 through Syracuse, NY (NYSDOT 2015).

Given that different classes of assets are held to different performance standards, *reclassification* of a set of assets can be a useful disinvestment approach for some state agencies, especially in cases where activity patterns have, or are projected to shift. For instance, bridge load ratings for the interstate highway system are typically much different than bridge load ratings on local roads. Reclassification of a bridge corridor may allow deferment of action or change to performance targets for that particular asset, resulting in cost savings for the agency with the potential tradeoff of a change in the allowable load. Reclassification may also allow for a different set of treatments to be acceptable, like in the case of Washington State where reclassification of chip-sealing eligible roadways to include 2,000-10,000 AADT translated to significant cost savings based on the increased eligibility of roadways to a lower cost maintenance treatment (Duncan and Weisbrod 2015).

### Deferment of Action

*Deferment of action* is a disinvestment strategy that exploits the time element of investment decision-making. Delayed actions may be particularly effective in conjunction with other disinvestment strategies, such as modifying the performance targets of a corridor or asset to justify the deferred maintenance action taken by the agency.

In South Carolina, an intentional choice to delay resurfacing and other routine maintenance activities was motivated by the need to reinvest funds to meet match obligations for federal projects. The goal of improving mobility and targeting limited state funds for specific mobility-focused projects that received matching federal matching funds took precedence over pavement condition and routine maintenance projects that were not eligible for matching federal funds.

## 2.4 Implications of Disinvestment for Vulnerable Populations

Unlike existing literature that focusses exclusively on the economic implications of disinvestment decisions, this report also addresses the potential social impacts associated with those decisions. Of particular concern is the impact of disinvestment in areas with low-volume roads or limited alternative routes, to disproportionately affect demographically vulnerable populations. As one objective of VAOT is to provide reasonably equitable access and mobility to the population it serves, the potential impacts of disinvestment decisions on the population should also be considered to ensure this objective is achieved.

In public health, vulnerable populations are defined as those most prone to disease and/or illness and lacking access to health services; resulting in disparately poor health outcomes for these demographic groups (AJMC 2006). Similarly, the fields of emergency management and disaster preparedness explicitly identify populations that are acutely vulnerable to particular threats. Identifying highly vulnerable populations is critical in determining the areas that are likely need the most support in the face of a disaster (CDC 2015; CDC and ASTDR 2007). Demographics that help to distinguish vulnerable or disadvantaged populations include income, age (i.e. elderly), racial and ethnic status, chronic illness and disabilities, among others.

Institutions such as the Baltimore Metropolitan Council, have created vulnerability indices to assess the effectiveness of environmental justice programming and to help ensure they are fulfilling their duty to serve vulnerable populations equitably with federal dollars (Bridges and Kaminowitz 2015). The Center for Disease Control and Prevention has developed a social vulnerability index that considers four broad indicators:

- socioeconomic status;
- household composition and disability;
- minority status and language;
- housing and transportation.

Data resources that track changing demographics in time and space are the inputs needed in defining the factors or metrics of vulnerability. Therefore, much of the effort related to identifying and defining measures of vulnerability involves synthesizing relevant data from U.S. Census and the American Community Survey (ACS). These data sources provide the most comprehensive and accurately weighted demographic information. Table 3 provides a summary of the metrics relevant to the identification of vulnerable populations.

**Table 3. Metrics for Identifying Vulnerable Populations Defined from the Literature.**

| Factor Category | Baltimore Metropolitan Council (Bridges and Kaminowitz 2015) | Community Commons (Community Commons 2014) | Centers for Disease Control (CDC) (CDC 2015) | CDC & Agency for Toxic Substances and Disease Registry (ATSDR) (CDC and ASTDR 2007) | Goodwin et. al., 2014 (Goodwin et al. 2014) |
|---|---|---|---|---|---|
| **Income** | Poverty | Population Below Poverty Line >= 30% | Poverty | Per Capita or Family Income<br>Persons Living Below Poverty Line<br>Housing Value | % Persons Living Below Poverty Line |
| **Race / Ethnicity** | Non-Hispanic, Non-White Hispanic | | | African-American Female, African-American Head of Household | Minority Population (African-American, Native American, Asian, Hawaiian, and Hispanic, non-White) |
| **Housing Stock / Tenancy** | | | | Mobile Homes<br>Renters<br>Urban residents | |
| **Education / Language Proficiency** | Limited English Proficiency (LEP) | Population Less Than High School >=25% | Languages spoken at home<br>Country of origin | Language Spoken at Home Not English<br>Do Not Speak English Well | % of population 25+ years with no high school degree<br>% of population speaking English as a 2nd language |
| **Gender** | | | | | % of female heads of household |
| **Health / Medical** | Disabled | | Disabilities (mobility, mental, intellectual, or sensory) | Partial or Full Physical Disabilities<br>Cognitive Disabilities | |
| **Age** | Elderly | | 17 and Younger<br>66 and Older | 17 and Younger<br>65 and Older | % of the population 65 years and older |

| Factor Category | Baltimore Metropolitan Council (Bridges and Kaminowitz 2015) | Community Commons (Community Commons 2014) | Centers for Disease Control (CDC) (CDC 2015) | CDC & Agency for Toxic Substances and Disease Registry (ATSDR) (CDC and ASTDR 2007) | Goodwin et. al., 2014 (Goodwin et al. 2014) |
|---|---|---|---|---|---|
| **Transportation** | Car-less households | | Vehicle ownership (including car-less)<br>Night versus day populations | | % of households with no vehicle available |
| **Density** | | | Population density | Manufacturing or Commercial Establishment Density<br>Housing Density | |
| **Single-Sector Economic Dependence** | | | | % employed in extractive industries (fishing, farming, and mining)<br>% classified as "rural farm" | |
| **Infrastructure Dependence** | | | | Large debt-to-revenue ratio (by County)<br>% employed in public utilities, transportation, and communication | |

# 3 Description of Data

This section discusses the data resources used to inform the evaluation of potential disinvestment strategies and the identification of vulnerable populations for the state of Vermont.

## 3.1 American Community Survey

The American Community Survey (ACS) is administered annually by the U.S. Census Bureau to a sample of Americans to provide a detailed update of the demographics between decennial Census years. 5-year estimates are considered to be the most reliable as they represent the aggregation of five consecutive survey samples. Data used to develop the Vermont Vulnerability Index (VVI), which is explained in detail in the next section, were acquired from the ACS via the American FactFinder tool. The 5-year estimates spanning 2010 to 2014 for the following metrics were obtained for each town in Vermont:

- Per capita income ($)
- Percent of people whose income in the past 12 months is below the poverty level (%)
- Median housing value of owner-occupied units ($)
- Percent of Black or African American individuals (%)
- Percent of single Black or African American female householder (%)
- Percent of mobile homes (%)
- Percent of renter-occupied units (%)
- Percent of people with limited English proficiency (%)
- Percent of population with physical disability (%)
- Percent of population with cognitive disability (%)
- Percent of population 17 years and younger (%)
- Percent of population 65 years and over (%)

- Percent of households with no available vehicle (%)
- Percent of employees in agriculture, forestry, fishing and hunting, and mining (%)
- Percent of employees in transportation, warehousing, and utilities (%)

Most of these data were reported in the tables from the 5-year ACS. Metrics that were not directly reported for the entire 5-year time period were computed based on the average of two or more reported values. These include: percent of Black or African American individuals, percent of single Black or African American female householder, percent of people with limited English proficiency, and percent of population 17 years and younger. The tables, field labels, computations, and links to the American FactFinder downloads are further detailed in the Appendices.

## 3.2 VAOT Capital Investments

Each year, the VAOT releases the full transportation budget projection for the upcoming fiscal year. The forward of the budget outlines the considerations associated with the estimate of the federal and state funds that are allocated to specific capital programs and activities. Data used in evaluating the potential budget implications associated with the different disinvestment decisions was gathered from the VAOT website. The data included the most recent available transportation budget (FY 2017) and the STIP Report for 2016-2019. The data tables from these resources were translated into useable tables in Microsoft Excel.

## 3.3 Other Data Resources

Recent VAOT efforts to share data and information directly with the public has led the Agency to establish VTransparency, a website that serves as a data clearinghouse and information portal. The data shared on the portal is the same information used to support Agency decision-making. The intent of sharing data is in part to foster new and creative ways of utilizing the valuable data resources the Agency owns to help improve decision making. Additional data resources used in the research effort were obtained from the VTransparency site.

# 4 Methodology

In this section, we discuss the methodological approach used to identify the candidate corridors for disinvestment and to evaluate the effects of disinvestments on vulnerable populations in the state of Vermont. The team used the NRI and the CCA performance measures, coupled with generalized estimates of the potential cost savings associated with the different disinvestment scenarios to identify candidate corridors for disinvestment. Once the initial set of candidate corridors was identified using the NRI and CCA, we developed a new method of evaluating the potential impact different disinvestment decisions could have on vulnerable populations throughout the state. The evaluation process involves synthesizing indicators of vulnerability to catastrophic events from the Centers for Disease Control (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) (2007) into a novel, Vermont-specific vulnerability index, the VVI, which is applied at the town level using data from the ACS.

## 4.1 Identifying Candidate Corridors with the Network Robustness Index, the Critical Closeness Accessibility, and Budgets

The NRI is a performance measure that is used to evaluate the relative importance of a specific roadway component (i.e., a link, corridor, or bridge) with respect to the component's contribution to the overall performance of the roadway network (Scott et al. 2006). The NRI has been used to evaluate link criticality in the context of short-duration (e.g. construction) or long-term (e.g. facility closure) disruptions in both actual and hypothetical transportation networks (Novak et al. 2012; Scott et al. 2006; Sullivan et al. 2013, 2010). The NRI algorithm enumerates the system-wide increase in vehicle-hours of travel on the entire network as a consequence of a change in capacity on a single roadway component. Thus, components with high NRI values are more critical to the overall performance of the network as compared to components with low NRI values. Components with an NRI value of zero are not critical to network performance, and components with a negative NRI value suggest that network-wide VHTs would actually improve if capacity on the component were reduced (or the component was removed) (Sullivan et al. 2010). In this research study, we identify components with very low, zero, or negative NRI values as ideal candidates for disinvestment, as their overall contribution to the performance of the road network is non-existent or negligible.

The CCA index is a link-focused performance measure that quantifies the "accessibility" to critical services on a link-by-link (or component-by-component) basis, where *accessibility* is defined as the ease with which services and facilities can be reached while using the road network (Novak and Sullivan 2014). This definition forms the basis for the CCA measure, and "ease of reach" is quantified via travel time. Many existing accessibility measures only evaluate access to a specific node or set of nodes (or zones). The CCA index assigns a quantified accessibility value directly to the individual components in the roadway network with respect to each component's contribution to moving travelers to and from critical locations. In previous work, the research team has used the CCA to evaluate the Vermont statewide highway network with respect to emergency services including police stations, fire houses, ambulance houses, hospitals, and other critical health care facilities (Novak and Sullivan 2014; Sullivan et al. 2013).

The CCA metric is static and will not change without significant changes to the location of critical services and/or the topology of the entire roadway network. Consequently, the CCA values associated with the state of Vermont roadway network calculated from previous research were used in this study (Novak and Sullivan 2014; Sullivan et al. 2013).

The use of the NRI and the CCA in the selection of candidate corridors for disinvestment was guided by estimates of cost savings from VAOT's capital and/or maintenance and operations budgets. The potential cost savings associated with disinvestment decisions are linked to the specific disinvestment strategy (see Table 2), so each disinvestment decision should be evaluated on a case-by-case basis. Generally, projects or maintenance activities that are higher in costs but are intended for a link or corridor that is not critical to the statewide network should be prioritized for disinvestment. We used current projects from VTransparency as a method to assess possibilities for disinvestment. Links or corridors where relatively costly projects are proposed for the upcoming construction season were considered to be the best candidates. Once the initial budgetary screening was performed, the selection of candidate corridors was further guided by NRI and CCA results. Existing CCA values for each roadway segment were used directly, without modification. However, a new approach for calculating the NRI was implemented in which both capacity and travel speed were reduced in tandem and the NRI values were re-calculated for each roadway component in the network so that the capacity and speed reduction on each corridor accurately reflected the specific disinvestment strategy being considered. Four generalized disinvestment scenarios (A, B, C, and D) were evaluated. The four scenarios and the associated capacity and speed reduction values are shown in **Error! Reference source not found.**.

**Table 4. Capacity Reduction and Travel Time Increase for Each Disinvestment Strategy**

| Scenario | Capacity Reduction | Travel Time Increase | Disinvestment Type |
|---|---|---|---|
| Disinvestment A | 25% | 25% | Defer Action or Modify Standards |
| Disinvestment B | 50% | 50% | |
| Disinvestment C | 75% | 75% | |
| Disinvestment D | 100% | Not Applicable | Decommission |

The generalized Disinvestment Scenarios A, B, and C, which consist of deferred action and/or modification of standards, are likely to range from fairly minor capacity reductions and travel time increases (i.e., 25% capacity reduction and 25% travel time increase in Disinvestment Scenario A) to much more dramatic reductions in capacity and travel time increases (i.e., 75% capacity reduction and 75% travel time increase in Disinvestment Scenario C). Generalized Disinvestment Scenario D is modeled using a capacity reduction of 100%, which effectively makes the corridor impassible. Thus, the travel time increase is not applicable. The full closure of a link or corridor is associated with decommissioning disinvestment strategies. The removal of a link could represent the closure of a bridge, closure of a road link, or re-use of a corridor for a purpose that no longer supports highway travel.

## 4.2 Evaluating Vulnerability of Vermont Populations

To evaluate the potential impacts associated with each of the disinvestment scenarios on vulnerable populations in Vermont, we first adopted a subset of vulnerability metrics from the CDC and ASTDR (2007) data. We then used these metrics to develop the VVI, which was applied to each of the towns in Vermont. Town level demographic data was collected from the Census portal and American FactFinder. The research team focused on selecting a subset of vulnerability metrics that were specifically relevant to transportation and mobility related to catastrophic disruption. Furthermore, the metrics were selected to minimize potential urban or rural biases. To avoid potential aggregation biases, the use of vulnerability thresholds from the national literature was avoided. We used a normalized ranking of the individual metrics based only on towns in Vermont. The vulnerability data set is therefore bounded by, and specifically targeted to, a range of vulnerabilities that would be "most typical" in the state of Vermont. Vermont towns are ranked alongside other non-Vermont towns using the same set of vulnerability metrics as a baseline for comparison. Thus, the VVI is specifically designed for use in Vermont, which has vulnerable populations in both urban and rural communities. The vulnerability metrics used to create the VVI are shown in Table 5.

**Table 4. Subset of Vulnerability Metrics Considered for Vermont**

| Metric | Magnitude Relationship to Vulnerability | Unit | Metric Category |
|---|---|---|---|
| Income Per Capita | ↓ | $ | Income |
| People Living in Poverty | ↑ | % of all people | Income |
| 17 Years and Under | ↑ | % of total population | Age |
| 65 Years and Over | ↑ | % of total population | Age |
| Housing Value | ↓ | $ of owner-occupied units | Housing Stock / Tenancy |
| Mobile Homes | ↑ | % of all housing units | Housing Stock / Tenancy |
| Renter-occupied Homes | ↑ | % of all occupied housing units | Housing Stock / Tenancy |
| Households without Access to Vehicle | ↑ | % of all occupied housing units | Transportation |
| Cognitive Difficulty | ↑ | % of civilian non-institutionalized population | Health / Medical |
| Ambulatory Difficulty | ↑ | % of civilian non-institutionalized population | Health / Medical |
| Employed in Extractive Industries (agriculture, forestry, fishing and hunting, and mining) | ↑ | % of all workers | Single-Sector Economic Dependence |
| Employed in transportation and warehousing, and utilities | ↑ | % of all workers | Infrastructure Dependence |

| Metric | Magnitude Relationship to Vulnerability | Unit | Metric Category |
|---|---|---|---|
| Limited English Proficiency | ↑ | % of all people 5 years and over | Education / Language Proficiency |
| Black or African American | ↑ | % of total population | Race / Ethnicity |
| Black or African American Female Householder | ↑ | % of all families | Race / Ethnicity |

In developing the VVI, the individual vulnerability metrics or factors ( $f_{ia}$) for each town are weighed against the median value of the same factor for all towns in Vermont ( $\tilde{f}_a$), where the town is $i$ and the factor is $a$. All factors associated with increased vulnerability were retained, whereas factors that were associated with decreased vulnerability (as noted with a ↓ above in Table 45) were discarded. The individual factors were summed to create a single, generalized vulnerability index for each town, $VVI_i$, as shown in Equation 1.

$$VVI_i = \sum_a \left( \frac{f_{ia} - \tilde{f}_a}{\max\ f_a - \tilde{f}_a} \right) \quad (1)$$

We then created a binary variable to measure vulnerability, $I_{VVI_i}$ where a value of one implies that the town is "vulnerable" and a value of zero implies that the town is "not vulnerable". The vulnerability of each town is compared to a threshold median vulnerability index across all towns, $\widetilde{VVI}$, to determine whether a town is vulnerable or not, according to Equation 2. Towns with a $VVI$ value greater than or equal to the threshold median vulnerability value represent populations with an increased level of vulnerability.

$$\begin{aligned} VVI_i \geq \widetilde{VVI} \rightarrow I_{VVI_i} = 1 \\ VVI_i < \widetilde{VVI} \rightarrow I_{VVI_i} = 0 \end{aligned} \quad (2)$$

## 4.3 Determining the Effect of Disinvestment on Vulnerable Populations

Once the vulnerability index for each town in the state was calculated, we identified the towns that would be disproportionately affected by the different disinvest scenarios for each candidate corridor. We used the candidate disinvestment corridors to develop an impact forecast scenario for each disinvestment strategy.

For each impact forecast scenario, we examined the estimated traffic flow as measured in vehicles per day (vpd), between all sets of town pairs in Vermont. This examination was conducted using the Vermont Travel Model. The Vermont Travel Model includes the road network topology in Vermont in a geospatial interface in the TransCAD software platform. The Model uses land use and travel behavior patterns, along with network characteristics, to estimate a typical day of travel in the state (Sullivan and Sentoff 2015). If the traffic flow between any two towns amounted to greater than 0.50% of the total traffic flow along the selected disinvestment corridor, those towns were considered to be affected by the disinvestment and the town was added to the set X for corridor c ($X_c$), as shown in Equation 3.

$$\frac{Q_{c_{jk}}}{\sum_{jk} Q_c} \geq 0.005 * Q_c \rightarrow X_c \cup \{x_j, x_k\} \qquad (3)$$

Where $Q_{cj\text{-}k}$ is the flow between towns j and k using corridor c, and $Q_c$ is the total flow on corridor c.

We then compiled a comprehensive list of all the towns throughout the state that were likely to be affected by disinvestment and estimated the potential impact of the disinvestment on vulnerable populations by weighing the number of vulnerable towns in the set against the total number of towns affected, as shown in Equation 4. A higher value of $E_c$ is indicative of a more vulnerable population. An important consideration in developing the vulnerability index was to include the full spectrum of populations and land uses without bias towards more or less densely populated areas. The existing vulnerability literature tends to focus on either rural or urban areas in isolation, while the vulnerability index developed as part of this research addresses both urban and rural populations.

$$E_c = \frac{\sum_i I_{VVI}}{|X_c|} \qquad (4)$$

Two steps are required to develop a forecast scenario to evaluate the impact of disinvestment along a single candidate corridor:

1. Identify the set of all affected towns, $X_c$, based on all trips to and from those towns ($Q_{c_{jk}}$) according to Equation 3.
2. Estimate the effect ($E_c$) of the disinvestment scenario on vulnerable populations according to Equation 4.

In cases where there is extremely low traffic volume along a candidate disinvestment corridor, the impact of disinvestment is likely to be experienced only in a localized context. Consequently, we do not conduct a select link analysis for candidate disinvestment corridors with very low daily traffic volume assignments (<100 vpd). A manual check was performed to identify the towns that would potentially utilize the candidate corridor in these low traffic cases. The vulnerability of the town(s) where the candidate corridor is located dictated whether the disinvestment would disproportionately affect vulnerable persons.

# 5 Results

The results are from an initial screening of thousands of miles of state and some local roads in Vermont to identify opportunities where disinvestment *may be* justified and demonstrate how the CCA, NRI, and VVI metrics can be used to develop a set of possible candidate disinvestment corridors. It is important to stress that specific disinvestment decisions require a thorough evaluation of the local and regional impacts and involve collaboration with municipalities, RPCs, residents, businesses and other stakeholders that would be directly affected.

## 5.1 Candidate Disinvestment Corridors

As discussed previously, strategic decisions related to disinvestment should consider an asset's importance within the context of the roadway network as a whole. Thus, the research goal is to identify disinvestment opportunities in low importance, non-critical corridors. The research team used both the NRI and CCA performance measures to identify relatively low importance corridors in Vermont based on illustrative threshold values for the NRI and CCA[2]. The candidate disinvestment corridors associated with the threshold NRI and CCA values used in this study are shown in Figure 2. The corridors that are identified include all four disinvestment strategies, A, B, C, and D. Broadening the acceptable thresholds for defining "low" NRI and CCA target values would obviously increase the number of corridors and miles of roadway that are identified as candidate corridors for disinvestment. The candidate disinvestment corridors are distributed across the entire state, and occur in both rural and urban areas. Recall that high levels of redundancy and/or low traffic volumes are consistent with a low NRI value being associated with a specific corridor. Likewise, low CCA values imply that the corridor is not important in terms of providing accessibility to critical services.

[2] Threshold values for the NRI and CCA can be changed depending on agency objectives. For example, the value of either or both performance measures can be raised or lowered to provide a larger or smaller sample of potential disinvestment corridors.

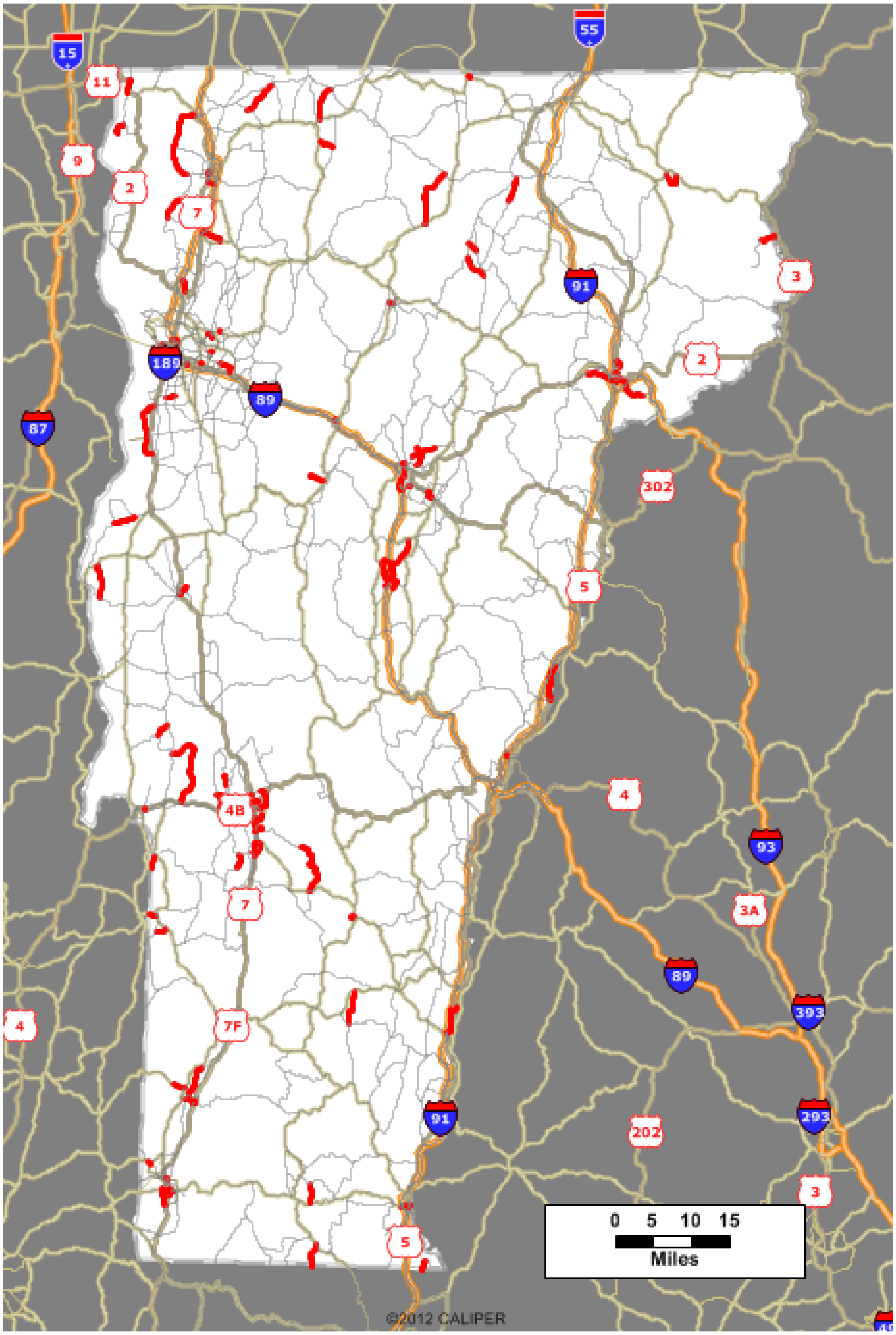


**Figure 2. Candidate Corridors for Disinvestment across the State of Vermont.**

All of the four classes of roadway represented in the statewide travel model (interstate, US highway, state highway, and some town highways[3]) appear as potential candidate disinvestment corridors. It is important to note that the model is a representation of the highway network in Vermont, and while all interstate, US, and state highways are included in the model, the list of town highways represented in the model is not exhaustive. Although roadways that are maintained by VAOT (i.e. state, US, and interstate highways) are typically viewed as more critical, a number of corridors containing state, US or interstate highway segments are identified as candidates for disinvestment.

The state maintained roadway links identified as potential candidates for disinvestment are listed in Table 5. Table 6 includes 36 links that equate to nearly 35 miles of roadway. Note that the specific disinvestment scenario is indicated in the far right column. For example, based on the NRI and CCA results, the Interstate 89 Highway entrance/exit into Norwich (Exit 5) is a candidate for disinvestment scenarios A and B, but not for scenarios C and D (first row of Table 6).

**Table 5. Candidate Disinvestment Corridors (State, US, and Interstate Highways)**

| | | | | | | Disinvestment Scenarios | | | |
|---|---|---|---|---|---|---|---|---|---|
| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | A | B | C | D |
| I-91N ON-RAMP EXIT 13 VT10A W | Interstate | 0.21 | 1600 | 30 | Norwich | ✓ | ✓ | | |
| I-89S OFF-RAMP EXIT 14E US2 E | Interstate | 0.28 | 1600 | 30 | South Burlington | ✓ | ✓ | ✓ | ✓ |
| I-89S ON-RAMP EXIT 10 VT100 W | Interstate | 0.20 | 1600 | 30 | Waterbury | ✓ | ✓ | ✓ | ✓ |
| I-89N ON-RAMP EXIT 10 VT100 E | Interstate | 0.19 | 1600 | 30 | Waterbury | ✓ | ✓ | ✓ | ✓ |
| N MAIN ST / US HIGHWAY 2 | US Highway | 0.85 | 1200 | 45 | Alburgh | | | | ✓ |
| S MAIN ST / US HIGHWAY 2 | US Highway | 0.80 | 1200 | 30 | Alburgh | | | | ✓ |
| ROUTE 7 | US Highway | 0.20 | 1600 | 30 | Manchester | | | ✓ | |
| ROUTE 7 | US Highway | 0.24 | 1600 | 30 | Manchester | ✓ | ✓ | ✓ | ✓ |
| MISSING LINK RD / US HIGHWAY 5 | US Highway | 4.66 | 1200 | 40 | Rockingham | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 2B | US Highway | 0.01 | 1200 | 35 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7 | US Highway | 0.32 | 1600 | 30 | Sunderland | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7 | US Highway | 0.18 | 1600 | 30 | Sunderland | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7 | US Highway | 0.18 | 1600 | 30 | Sunderland | ✓ | ✓ | ✓ | ✓ |
| US HIGHWAY 5 | US Highway | 4.97 | 1200 | 40 | Thetford | ✓ | ✓ | ✓ | ✓ |
| BATTEN KILL RD / STATE ROUTE 313 | State Highway | 1.66 | 1200 | 35 | Arlington | | | | ✓ |
| STATE ROUTE 313 | State Highway | 1.29 | 1200 | 40 | Arlington | ✓ | ✓ | ✓ | ✓ |
| PHYLIS LN / VT-279 ON RAMP | State Highway | 0.01 | 1100 | 40 | Bennington | ✓ | ✓ | ✓ | ✓ |

[3] The statewide model does not include an exhaustive set of all town highways throughout the state.

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| VT-279 BENNINGTON BYPASS | State Highway | 0.93 | 3520 | 55 | Bennington | ✓ | ✓ | ✓ | ✓ |
| AIRPORT RD | State Highway | 0.08 | 1200 | 30 | Berlin | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 65 | State Highway | 0.22 | 1200 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 65 | State Highway | 0.56 | 1000 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 65 | State Highway | 0.60 | 1000 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 65 | State Highway | 2.44 | 850 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7B CENTRAL | State Highway | 1.97 | 1200 | 45 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7B NORTH EXT | State Highway | 0.09 | 1200 | 40 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| ROUTE 7B S EXT | State Highway | 0.01 | 1200 | 35 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| VERMONT ROUTE 7B | State Highway | 0.01 | 1200 | 45 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| VERMONT ROUTE 7B | State Highway | 0.46 | 1200 | 35 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| VERMONT ROUTE 7B | State Highway | 0.05 | 1200 | 35 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| STATE ROUTE 14 | State Highway | 3.66 | 1200 | 40 | Craftsbury | ✓ | ✓ | ✓ | ✓ |
| ENT/EXT RAMP STATE HWY | State Highway | 0.24 | 1600 | 35 | Essex | ✓ | | | |
| UPPER MAIN ST / STATE ROUTE 15 | State Highway | 0.06 | 800 | 45 | Essex | ✓ | | | |
| DUTTON AVE | State Highway | 0.19 | 1200 | 40 | Fair Haven | | | | ✓ |
| STATE ROUTE 149 | State Highway | 1.05 | 1200 | 40 | Pawlet | | | | ✓ |
| STATE ROUTE 31 | State Highway | 1.65 | 1200 | 40 | Poultney | | | | ✓ |
| ROUTE 2B | State Highway | 3.45 | 1200 | 40 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |

Table 6 lists the 152 links and nearly 180 miles of town highway roadway identified as potential candidates for disinvestment.

**Table 6. Disinvestment Scenarios for Town Highway Candidate Corridors**

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| S PLEASANT ST / US HIGHWAY 7 | TH Class 1 Divided | 0.03 | 1100 | 40 | Middlebury | ✓ | ✓ | ✓ | ✓ |
| BANK ST / STATE ROUTE 67 | TH Class 1 | 0.17 | 1100 | 40 | Bennington | | | | ✓ |
| HIGH ST | TH Class 1 | 0.05 | 1100 | 25 | Brattleboro | ✓ | ✓ | ✓ | ✓ |
| RAILROAD ST / STATE ROUTE 243 | TH Class 1 | 0.20 | 1200 | 40 | Troy | | | | ✓ |
| ENT/EXT RAMP TOWN HWY | TH Class 2 Divided | 0.05 | 800 | 30 | Burlington | ✓ | ✓ | ✓ | ✓ |
| ENT/EXT RAMP STATE HWY | TH Class 2 Divided | 0.05 | 1100 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| ENT/EXT RAMP STATE HWY | TH Class 2 Divided | 0.03 | 1200 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| SPEAR ST | TH Class 2 Divided | 0.05 | 800 | 30 | South Burlington | ✓ | ✓ | ✓ | ✓ |
| JERSEY ST S | TH Class 2 | 4.74 | 1200 | 30 | Addison | ✓ | ✓ | ✓ | ✓ |
| CARPENTER HILL RD | TH Class 2 | 0.01 | 1200 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| ELM ST | TH Class 2 | 0.16 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| MONUMENT AVE | TH Class 2 | 1.07 | 1200 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| MONUMENT AVE | TH Class 2 | 1.27 | 1200 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| WATER TOWER RD | TH Class 2 | 4.87 | 1200 | 25 | Berkshire | ✓ | ✓ | ✓ | ✓ |
| CROSSTOWN RD | TH Class 2 | 0.38 | 1200 | 30 | Berlin | ✓ | ✓ | ✓ | ✓ |
| LAKESHORE DR | TH Class 2 | 3.15 | 1200 | 30 | Brighton | ✓ | ✓ | ✓ | ✓ |
| NORTHFIELD RD | TH Class 2 | 2.82 | 850 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| RIDGE RD | TH Class 2 | 1.13 | 1200 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| STONE RD | TH Class 2 | 0.96 | 1200 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| WEST ST | TH Class 2 | 1.28 | 1000 | 30 | Brookfield | ✓ | ✓ | ✓ | ✓ |
| BATTERY ST | TH Class 2 | 0.03 | 825 | 30 | Burlington |  | ✓ |  |  |
| PEARL ST | TH Class 2 | 0.05 | 700 | 30 | Burlington |  |  | ✓ |  |
| GREENBUSH RD | TH Class 2 | 1.87 | 1200 | 35 | Charlotte | ✓ | ✓ | ✓ | ✓ |
| GREENBUSH RD | TH Class 2 | 4.41 | 1200 | 35 | Charlotte | ✓ | ✓ | ✓ | ✓ |
| MIDDLE RD | TH Class 2 | 1.42 | 1200 | 40 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| N SHREWSBURY RD | TH Class 2 | 0.85 | 1200 | 30 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| N CRAFTSBURY RD | TH Class 2 | 1.48 | 1200 | 40 | Craftsbury | ✓ | ✓ | ✓ | ✓ |
| CENTER RD | TH Class 2 | 1.30 | 1050 | 30 | East Montpelier | ✓ | ✓ | ✓ | ✓ |
| TYLER BRANCH RD | TH Class 2 | 2.10 | 1200 | 50 | Enosburg | ✓ | ✓ | ✓ | ✓ |
| N FAYSTON RD | TH Class 2 | 1.97 | 1200 | 30 | Fayston |  |  |  | ✓ |
| GEORGIA SHORE RD | TH Class 2 | 3.38 | 1200 | 30 | Georgia | ✓ | ✓ | ✓ | ✓ |
| MONUMENT HILL RD / EAST HUBBARDTON RD | TH Class 2 | 11.85 | 1200 | 30 | Hubbardton | ✓ | ✓ | ✓ | ✓ |
| CREEK RD | TH Class 2 | 3.31 | 1200 | 30 | Irasburg | ✓ | ✓ | ✓ | ✓ |
| MAIN ST / STATE ROUTE 129 | TH Class 2 | 1.84 | 1200 | 40 | Isle La Motte |  |  |  | ✓ |
| MINES RD | TH Class 2 | 8.43 | 700 | 30 | Lowell | ✓ | ✓ | ✓ | ✓ |
| OKEMO MOUNTAIN RD | TH Class 2 | 0.55 | 1050 | 40 | Ludlow |  |  |  | ✓ |
| WASHINGTON ST | TH Class 2 | 1.03 | 1200 | 30 | Middlebury |  |  |  | ✓ |
| BRIDGE ST | TH Class 2 | 0.61 | 1200 | 40 | Morristown | ✓ | ✓ | ✓ | ✓ |
| PANTON RD | TH Class 2 | 2.88 | 1200 | 40 | Panton | ✓ | ✓ | ✓ | ✓ |
| RIVER RD | TH Class 2 | 1.60 | 1200 | 40 | Pawlet | ✓ | ✓ | ✓ | ✓ |
| COLD RIVER RD | TH Class 2 | 0.92 | 1200 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| TOWN LINE RD | TH Class 2 | 2.08 | 1200 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| WHITE CREEK RD / BANK ST | TH Class 2 | 0.45 | 825 | 30 | Shaftsbury |  |  |  | ✓ |
| BOSTWICK RD | TH Class 2 | 0.65 | 1200 | 35 | Shelburne | ✓ | ✓ | ✓ | ✓ |
| SHELBURNE RD | TH Class 2 | 0.11 | 700 | 35 | Shelburne |  | ✓ | ✓ | ✓ |
| EASTHAM RD | TH Class 2 | 8.66 | 1000 | 30 | Shrewsbury | ✓ | ✓ | ✓ | ✓ |

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| FAIRFAX ST | TH Class 2 | 0.96 | 1200 | 35 | St. Albans Town | ✓ | ✓ | ✓ | ✓ |
| MAQUAM SHORE RD / STATE ROUTE 36 | TH Class 2 | 2.24 | 1200 | 30 | St. Albans Town | ✓ | ✓ | ✓ | ✓ |
| MAQUAM SHORE RD / STATE ROUTE 36 | TH Class 2 | 4.49 | 1200 | 35 | St. Albans Town | ✓ | ✓ | ✓ | ✓ |
| BREEZY HILL RD | TH Class 2 | 1.18 | 1200 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| LAKE HORTONIA RD | TH Class 2 | 2.09 | 1200 | 30 | Sudbury | ✓ | ✓ | ✓ | ✓ |
| DUNHAM RD | TH Class 2 | 4.39 | 1200 | 40 | Sunderland | ✓ | ✓ | ✓ | ✓ |
| MAQUAM SHORE RD / STATE ROUTE 36 | TH Class 2 | 3.61 | 1200 | 30 | Swanton | ✓ | ✓ | ✓ | ✓ |
| HUCKLE HILL RD | TH Class 2 | 1.43 | 1200 | 30 | Vernon | | | | ✓ |
| DANIELS FARM RD | TH Class 2 | 4.68 | 1200 | 30 | Waterford | ✓ | ✓ | ✓ | ✓ |
| MARBLE ST | TH Class 2 | 1.47 | 1200 | 30 | West Rutland | ✓ | ✓ | ✓ | ✓ |
| PLEASANT ST | TH Class 2 | 0.40 | 1200 | 30 | West Rutland | ✓ | ✓ | ✓ | ✓ |
| STAGE RD / STATE ROUTE 8A | TH Class 2 | 3.27 | 1000 | 40 | Whitingham | | | | ✓ |
| ROOD POND RD | TH Class 2 | 5.39 | 1000 | 30 | Williamstown | ✓ | ✓ | ✓ | ✓ |
| LAKE RAPONDA RD | TH Class 2 | 2.86 | 1000 | 30 | Wilmington | ✓ | ✓ | ✓ | ✓ |
| LA FOUNTAIN ST | TH Class 2 | 0.19 | 700 | 25 | Winooski | ✓ | ✓ | ✓ | ✓ |
| WEST CENTER ST | TH Class 2 | 0.04 | 1200 | 25 | Winooski | ✓ | | | |
| BROOK ST | TH Class 3 | 0.08 | 825 | 30 | Barre City | ✓ | ✓ | ✓ | ✓ |
| N SEMINARY ST | TH Class 3 | 0.15 | 825 | 30 | Barre City | ✓ | ✓ | ✓ | ✓ |
| RIVER ST | TH Class 3 | 0.72 | 825 | 30 | Barre City | ✓ | ✓ | ✓ | ✓ |
| S SEMINARY ST | TH Class 3 | 0.08 | 825 | 35 | Barre City | ✓ | ✓ | ✓ | ✓ |
| SMITH ST | TH Class 3 | 0.21 | 825 | 30 | Barre City | ✓ | ✓ | ✓ | ✓ |
| WEST ST | TH Class 3 | 0.10 | 825 | 25 | Barre City | ✓ | ✓ | ✓ | ✓ |
| COOLIDGE AVE | TH Class 3 | 0.26 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| DEWEY ST | TH Class 3 | 0.63 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| GAGE ST | TH Class 3 | 0.11 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| GAGE ST | TH Class 3 | 0.36 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| PLEASANT ST | TH Class 3 | 0.22 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| PLEASANT ST | TH Class 3 | 0.11 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| PLEASANT ST | TH Class 3 | 0.13 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| SCHOOL ST | TH Class 3 | 0.07 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| SCHOOL ST | TH Class 3 | 0.17 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| SCHOOL ST | TH Class 3 | 0.19 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| SILVER ST | TH Class 3 | 0.06 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| SILVER ST | TH Class 3 | 0.15 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| UNION ST | TH Class 3 | 0.17 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| UNION ST | TH Class 3 | 0.13 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| VALENTINE ST | TH Class 3 | 0.08 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| WASHINGTON AVE | TH Class 3 | 0.18 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| WESTSIDE DR | TH Class 3 | 0.33 | 825 | 30 | Bennington | ✓ | ✓ | ✓ | ✓ |
| HILL ST EXT | TH Class 3 | 2.06 | 1200 | 30 | Berlin | ✓ | ✓ | ✓ | ✓ |
| FLAT ST | TH Class 3 | 0.22 | 825 | 30 | Brattleboro | ✓ | ✓ | ✓ | ✓ |
| GREEN ST | TH Class 3 | 0.20 | 1100 | 25 | Brattleboro | ✓ | ✓ | ✓ | ✓ |
| WILLIAMS ST | TH Class 3 | 1.04 | 825 | 30 | Brattleboro | ✓ | ✓ | ✓ | ✓ |
| COLLEGE ST | TH Class 3 | 0.07 | 825 | 30 | Burlington | | | ✓ | ✓ |
| COLLEGE ST | TH Class 3 | 0.05 | 825 | 30 | Burlington | | | ✓ | |
| CRESCENT RD | TH Class 3 | 0.29 | 700 | 30 | Burlington | ✓ | ✓ | ✓ | ✓ |
| ELMWOOD AVE | TH Class 3 | 0.20 | 700 | 30 | Burlington | ✓ | ✓ | ✓ | |
| FLYNN AVE | TH Class 3 | 0.48 | 700 | 30 | Burlington | | | | ✓ |
| HOME AVE | TH Class 3 | 0.10 | 700 | 30 | Burlington | | | | ✓ |
| KING ST | TH Class 3 | 0.04 | 700 | 30 | Burlington | ✓ | ✓ | ✓ | ✓ |
| KING ST | TH Class 3 | 0.04 | 700 | 30 | Burlington | ✓ | ✓ | ✓ | ✓ |
| KING ST | TH Class 3 | 0.07 | 700 | 30 | Burlington | | | | ✓ |
| LAKE ST | TH Class 3 | 0.18 | 500 | 20 | Burlington | | | | ✓ |
| LAKE ST | TH Class 3 | 0.13 | 500 | 20 | Burlington | | | | ✓ |
| LAKESIDE AVE | TH Class 3 | 0.11 | 700 | 30 | Burlington | | | | ✓ |
| LAKESIDE AVE | TH Class 3 | 0.08 | 700 | 30 | Burlington | | | | ✓ |
| N CHAMPLAIN ST | TH Class 3 | 0.08 | 2400 | 25 | Burlington | | | | ✓ |
| N UNION ST | TH Class 3 | 0.12 | 1200 | 30 | Burlington | ✓ | | | |
| S UNION ST | TH Class 3 | 0.05 | 1200 | 30 | Burlington | | | ✓ | |
| S UNION ST | TH Class 3 | 0.05 | 1200 | 30 | Burlington | | ✓ | | |
| E THOMPSONS POINT RD | TH Class 3 | 1.19 | 1200 | 45 | Charlotte | ✓ | ✓ | ✓ | ✓ |
| E TINMOUTH RD | TH Class 3 | 1.86 | 1200 | 30 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| SQUIRES RD | TH Class 3 | 0.60 | 1100 | 30 | Clarendon | ✓ | ✓ | ✓ | ✓ |
| ROUTE 2B | TH Class 3 | 0.01 | 1200 | 40 | Danville | ✓ | ✓ | ✓ | ✓ |
| BARNES RD | TH Class 3 | 0.73 | 1200 | 30 | East Montpelier | ✓ | ✓ | ✓ | ✓ |
| BLISS RD | TH Class 3 | 2.04 | 1200 | 30 | East Montpelier | ✓ | ✓ | ✓ | ✓ |
| DODGE RD | TH Class 3 | 2.11 | 1200 | 30 | East Montpelier | ✓ | ✓ | ✓ | ✓ |
| ESSEX WAY | TH Class 3 | 0.37 | 1600 | 35 | Essex | | | | ✓ |
| TOWERS RD | TH Class 3 | 0.19 | 700 | 25 | Essex | | | ✓ | |
| SKUNK HILL RD | TH Class 3 | 2.94 | 1200 | 30 | Georgia | ✓ | ✓ | ✓ | ✓ |
| HANNA RD | TH Class 3 | 4.61 | 1100 | 30 | Highgate | ✓ | ✓ | ✓ | ✓ |
| S PLEASANT ST | TH Class 3 | 0.27 | 825 | 30 | Middlebury | ✓ | ✓ | ✓ | ✓ |

| Road Name | Road Type | Length (miles) | Capacity (vphpl) | Speed Limit (mph) | Primary Town | Disinvestment Scenarios A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| HILL ST | TH Class 3 | 1.33 | 1200 | 30 | Montpelier | ✓ | ✓ | ✓ | ✓ |
| LANGDON ST | TH Class 3 | 0.08 | 825 | 30 | Montpelier | ✓ | ✓ | ✓ | ✓ |
| SCHOOL ST | TH Class 3 | 0.06 | 825 | 30 | Montpelier | ✓ | ✓ | ✓ | ✓ |
| BEAVER POND RD | TH Class 3 | 1.24 | 1200 | 30 | Proctor | ✓ | ✓ | ✓ | ✓ |
| LUNT PL | TH Class 3 | 1.00 | 1200 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| STRATTON RD | TH Class 3 | 0.67 | 1200 | 30 | Rutland | ✓ | ✓ | ✓ | ✓ |
| LINCOLN AVE | TH Class 3 | 0.39 | 825 | 30 | Rutland City | ✓ | ✓ | ✓ | ✓ |
| NORTH ST | TH Class 3 | 1.03 | 825 | 30 | Rutland City | ✓ | ✓ | ✓ | ✓ |
| UPLAND DR | TH Class 3 | 0.74 | 1200 | 30 | Rutland City | ✓ | ✓ | ✓ | ✓ |
| BISHOP RD | TH Class 3 | 1.25 | 1200 | 35 | Shelburne | ✓ | ✓ | ✓ | ✓ |
| COMMUNITY DR | TH Class 3 | 0.12 | 825 | 35 | South Burlington | ✓ | | | |
| EAST AVE | TH Class 3 | 0.02 | 1650 | 30 | South Burlington | ✓ | ✓ | ✓ | ✓ |
| FARRELL ST | TH Class 3 | 0.10 | 500 | 25 | South Burlington | | | | ✓ |
| HOLMES RD | TH Class 3 | 0.19 | 1650 | 30 | South Burlington | | | | ✓ |
| PINE ST | TH Class 3 | 0.42 | 825 | 30 | St. Albans City | ✓ | ✓ | ✓ | ✓ |
| UPPER NEWTON ST | TH Class 3 | 0.12 | 825 | 25 | St. Albans City | ✓ | ✓ | ✓ | ✓ |
| BAY ST | TH Class 3 | 0.12 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| CENTRAL ST | TH Class 3 | 0.10 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| CHERRY ST | TH Class 3 | 0.16 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| CHURCH ST | TH Class 3 | 0.10 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| DEPOT SQ | TH Class 3 | 0.16 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| PEARL ST | TH Class 3 | 0.16 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| ST JOHN ST | TH Class 3 | 0.34 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| WINTER ST | TH Class 3 | 0.10 | 825 | 30 | St. Johnsbury | ✓ | ✓ | ✓ | ✓ |
| PLEASANT ST | TH Class 3 | 2.11 | 1200 | 30 | West Rutland | ✓ | ✓ | ✓ | ✓ |
| WATER ST | TH Class 3 | 0.28 | 1200 | 30 | West Rutland | ✓ | ✓ | ✓ | ✓ |
| GOVERNOR CHITTENDEN RD | TH Class 3 | 2.61 | 1200 | 30 | Williston | ✓ | ✓ | ✓ | ✓ |
| REDMOND RD | TH Class 3 | 0.35 | 1200 | 35 | Williston | | | | ✓ |
| ZEPHYR RD | TH Class 3 | 0.20 | 800 | 40 | Williston | ✓ | ✓ | ✓ | ✓ |
| HOWARD HILL RD | TH Class 3 | 4.81 | 800 | 30 | Windham | ✓ | ✓ | ✓ | ✓ |
| FLORIDA AVE | TH Class 3 | 0.53 | 700 | 25 | Winooski | ✓ | ✓ | ✓ | ✓ |
| VALLEY RD | Other | 0.10 | 825 | 35 | South Burlington | | | | ✓ |
| MAIDSTONE LAKE ACCESS RD | Other | 2.07 | 1200 | 35 | Brunswick | | | | ✓ |
| PETTY BROOK RD | Other | 1.74 | 1200 | 30 | Milton | ✓ | ✓ | ✓ | ✓ |

Using the candidate corridors shown in Tables 6 and 7, the research team selected a subset of bridges from these corridors as disinvestment candidates using existing VAOT bridge performance measures. In the case of disinvestment in bridge assets, the impacts associated with the specific disinvestment scenario is extremely important (i.e., whether it is scenario A, B, C, D) and warrants careful consideration, as decommissioning bridge structures could potentially isolate residences, industries, or other locations that rely on those structures for access. Table 8 lists 33 candidate disinvestment corridors that contain at least one bridge.

**Table 7. Selection of Candidate Corridors with One or More Bridges**

| Road Name | No. of Bridges | Road Type | VT Town or State | Length |
|---|---|---|---|---|
| ROUTE 2B | 4 | State Highway | St. Johnsbury | 3.45 |
| FROG HOLLOW RD | 4 | TH Class 2 | Hubbardton | 11.85 |
| MISSING LINK RD / US HIGHWAY 5 | 2 | US Highway | Rockingham | 4.66 |
| DUTTON AVE | 2 | State Highway | Fair Haven | 0.19 |
| STATE ROUTE 65 | 2 | State Highway | Brookfield | 0.60 |
| DUNHAM RD | 2 | TH Class 2 | Sunderland | 4.39 |
| BRIDGE ST | 2 | TH Class 2 | Morristown | 0.61 |
| CROSSTOWN RD | 2 | TH Class 2 | Berlin | 0.38 |
| GREENBUSH RD | 2 | TH Class 2 | Charlotte | 4.41 |
| WILLIAMS ST | 2 | TH Class 3 | Brattleboro | 1.04 |
| LAKESIDE AVE | 2 | TH Class 3 | Burlington | 0.08 |
| FLORIDA AVE | 2 | TH Class 3 | Winooski | 0.53 |
| US HIGHWAY 5 | 1 | US Highway | Thetford | 4.97 |
| STATE ROUTE 31 | 1 | State Highway | Poultney | 1.65 |
| BATTEN KILL RD / STATE ROUTE 313 | 1 | State Highway | Arlington | 1.66 |
| STATE ROUTE 149 | 1 | State Highway | Pawlet | 1.05 |
| VERMONT ROUTE 7B | 1 | State Highway | Clarendon | 0.46 |
| UPPER MAIN ST / STATE ROUTE 15 | 1 | State Highway | Essex | 0.06 |
| VT-279 BENNINGTON BYPASS | 1 | State Highway | Bennington | 0.93 |
| LAKE RAPONDA RD | 1 | TH Class 2 | Wilmington | 2.86 |
| PANTON RD | 1 | TH Class 2 | Panton | 2.88 |
| MAIN ST / STATE ROUTE 129 | 1 | TH Class 2 | Isle La Motte | 1.84 |
| MAQUAM SHORE RD / STATE ROUTE 36 | 1 | TH Class 2 | St. Albans Town | 4.49 |
| N FAYSTON RD | 1 | TH Class 2 | Fayston | 1.97 |
| N CRAFTSBURY RD | 1 | TH Class 2 | Craftsbury | 1.48 |
| CREEK RD | 1 | TH Class 2 | Irasburg | 3.31 |
| DANIELS FARM RD | 1 | TH Class 2 | Waterford | 4.68 |
| SCHOOL ST | 1 | TH Class 3 | Bennington | 0.17 |

| | | | | |
|---|---|---|---|---|
| WATER ST | 1 | TH Class 3 | West Rutland | 0.28 |
| HOWARD HILL RD | 1 | TH Class 3 | Windham | 4.81 |
| SCHOOL ST | 1 | TH Class 3 | Montpelier | 0.06 |
| LANGDON ST | 1 | TH Class 3 | Montpelier | 0.08 |
| HILL ST EXT | 1 | TH Class 3 | Berlin | 2.06 |

## 5.2 Identifying Locations in the State with the most Vulnerable Populations

Part of VAOT's mission is to serve the Vermonter's in a reasonably equitable manner; therefore, identifying vulnerable populations that may be disproportionately impacted by disinvestment decisions is crucial in evaluating the overall impact of these decisions. The potential impacts associated with various disinvestment scenarios on vulnerable populations was determined by assessing whether or not disinvestment in a candidate corridor was likely to have a large impact on the vulnerable populations in the area. The vulnerability index discussed in Section 3.3 was used as the primary metric to evaluate these impacts.

Figure 3 provides a color-coded "vulnerability" map of the state, where more vulnerable populations are indicated by a darker shading on the map (i.e., larger values of $E_c$). Highly vulnerable locations are distributed throughout the state and involve both urban and rural towns. Note that the extreme north-central region of the state including portions of Orleans and Franklin counties appear to contain vulnerable populations that may be more negatively impacted by disinvestment decisions relative to other areas in the state.

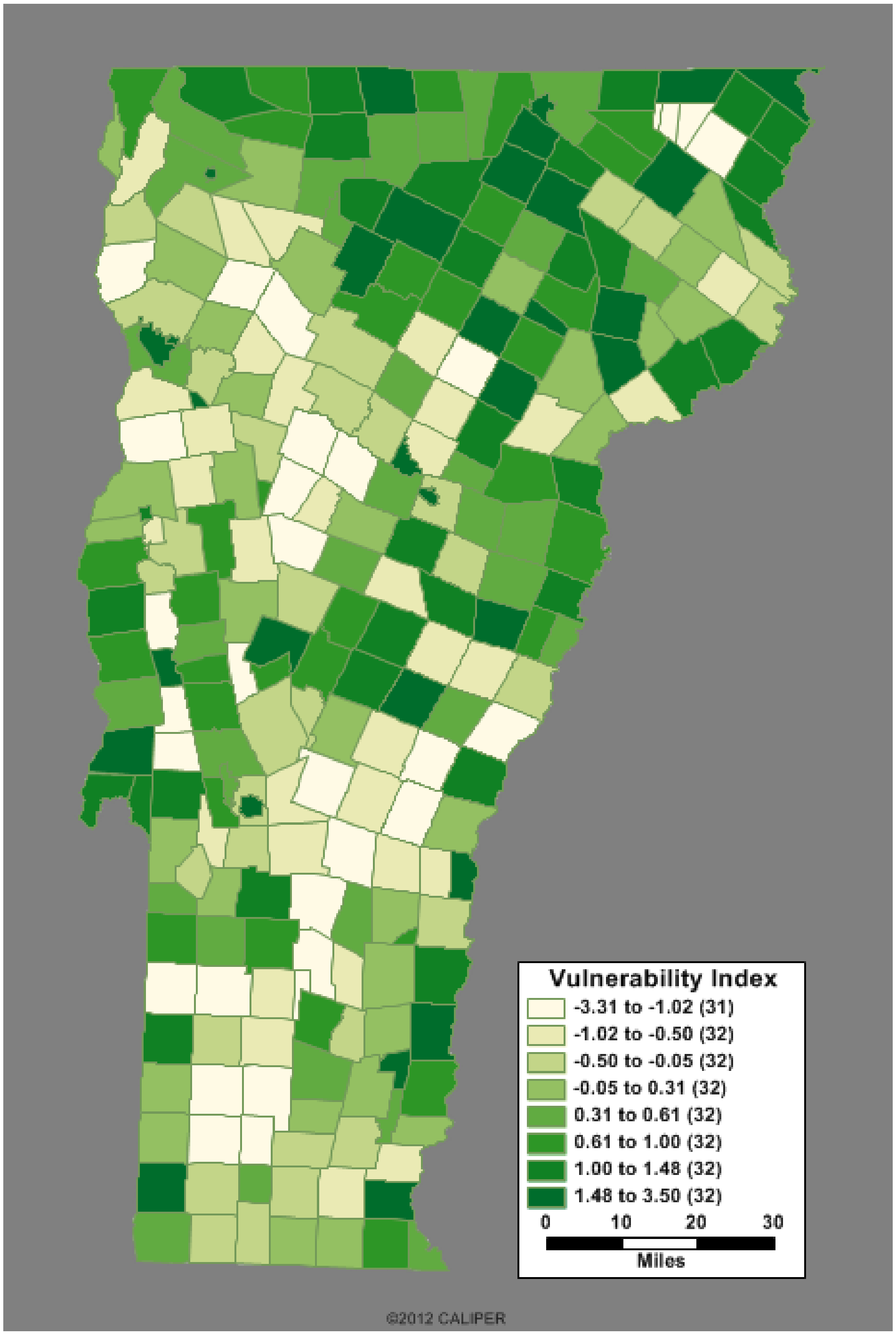


**Figure 3. Locations with Highly Vulnerable Populations across the State of Vermont.**

Overall, about 40% of the state-owned candidate disinvestment links identified in this analysis have the potential to disproportionately affect vulnerable populations. Table 8 provides a summary of the vulnerability assessments for the candidate disinvestment corridors with interstate, US highway, and state highway designations. The number of towns most directly impacted by the disinvestment ($NX_c$), the Vermont Vulnerability Index value ($VVI_i$), the effect on vulnerable populations (the binary variable $E_c$), the method used to identify the towns affected, and the primary town in which the candidate corridor is located are all provided.

**Table 8. Vulnerability Assessment of Candidate Corridors for State Roadways**

| Road Name | Road Type | $VVI_i$ | $N X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| I-91N ON-RAMP EXIT 13 VT10A W | Interstate | 0.82 | 11 | Vulnerable | SLA | Norwich |
| I-89S OFF-RAMP EXIT 14E US2 E | Interstate | 0.38 | 13 | Not Vulnerable | SLA | South Burlington |
| I-89S ON-RAMP EXIT 10 VT100 W | Interstate | 0.00 | 2 | Not Vulnerable | Manual | Waterbury |
| I-89N ON-RAMP EXIT 10 VT100 E | Interstate | 0.00 | 2 | Not Vulnerable | Manual | Waterbury |
| N MAIN ST / US HIGHWAY 2 | US Highway | 0.78 | 9 | Vulnerable | SLA | Alburgh |
| S MAIN ST / US HIGHWAY 2 | US Highway | 0.89 | 9 | Vulnerable | SLA | Alburgh |
| ROUTE 7 | US Highway | 0.33 | 9 | Not Vulnerable | SLA | Manchester |
| ROUTE 7 | US Highway | 0.25 | 4 | Not Vulnerable | Manual | Manchester |
| MISSING LINK RD / US HIGHWAY 5 | US Highway | 1.00 | 3 | Vulnerable | Manual | Rockingham |
| STATE ROUTE 2B | US Highway | 0.50 | 2 | Vulnerable | Manual | St. Johnsbury |
| ROUTE 7 | US Highway | 0.00 | 2 | Not Vulnerable | Manual | Sunderland |
| ROUTE 7 | US Highway | 0.00 | 2 | Not Vulnerable | Manual | Sunderland |
| ROUTE 7 | US Highway | 0.00 | 2 | Not Vulnerable | Manual | Sunderland |
| US HIGHWAY 5 | US Highway | 0.50 | 2 | Vulnerable | Manual | Thetford |
| BATTEN KILL RD / STATE ROUTE 313 | State Highway | 0.29 | 7 | Not Vulnerable | SLA | Arlington |
| STATE ROUTE 313 | State Highway | 0.00 | 2 | Not Vulnerable | Manual | Arlington |
| PHYLIS LN / VT-279 ON RAMP | State Highway | 1.00 | 1 | Vulnerable | Manual | Bennington |
| VT-279 BENNINGTON BYPASS | State Highway | 1.00 | 1 | Vulnerable | Manual | Bennington |
| AIRPORT RD | State Highway | 1.00 | 1 | Vulnerable | Manual | Berlin |
| STATE ROUTE 65 | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| STATE ROUTE 65 | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| STATE ROUTE 65 | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| STATE ROUTE 65 | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| ROUTE 7B CENTRAL | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| ROUTE 7B NORTH EXT | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| RTE 7B S EXT | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| VERMONT ROUTE 7B | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| VERMONT ROUTE 7B | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |

| Road Name | Road Type | $VVI_i$ | N $X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| VERMONT ROUTE 7B | State Highway | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| STATE ROUTE 14 | State Highway | 1.00 | 1 | Vulnerable | Manual | Craftsbury |
| ENT/EXT RAMP STATE HWY | State Highway | 0.17 | 6 | Not Vulnerable | SLA | Essex |
| UPPER MAIN ST / STATE ROUTE 15 | State Highway | 0.25 | 12 | Not Vulnerable | SLA | Essex |
| DUTTON AVE | State Highway | 0.56 | 9 | Vulnerable | SLA | Fair Haven |
| STATE ROUTE 149 | State Highway | 0.50 | 12 | Vulnerable | SLA | Pawlet |
| STATE ROUTE 31 | State Highway | 0.50 | 6 | Vulnerable | SLA | Poultney |
| ROUTE 2B | State Highway | 0.50 | 2 | Vulnerable | Manual | St. Johnsbury |

Table 8 provides a summary of the vulnerability assessments for the candidate disinvestment corridors with town highway designation. Over 60% of links that are candidate disinvestment corridors were identified as having the potential to affect vulnerable populations.

**Table 9. Vulnerability Assessments for Candidates with Town Highway Designations**

| Road Name | Road Type | $VVI_i$ | N $X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| S PLEASANT ST | TH Class 1 Divided | 1.00 | 1 | Vulnerable | Manual | Middlebury |
| BANK ST | TH Class 1 | 0.38 | 8 | Not Vulnerable | SLA | Bennington |
| HIGH ST | TH Class 1 | 1.00 | 1 | Vulnerable | Manual | Brattleboro |
| RAILROAD ST | TH Class 1 | 0.89 | 9 | Vulnerable | SLA | Troy |
| ENT/EXT RAMP TOWN HWY | TH Class 2 Divided | 1.00 | 2 | Vulnerable | Manual | Burlington |
| ENT/EXT RAMP STATE HWY | TH Class 2 Divided | 0.33 | 3 | Not Vulnerable | Manual | Rutland |
| ENT/EXT RAMP STATE HWY | TH Class 2 Divided | 0.33 | 3 | Not Vulnerable | Manual | Rutland |
| SPEAR ST | TH Class 2 Divided | 1.00 | 2 | Vulnerable | Manual | South Burlington |
| JERSEY ST S | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Addison |
| CARPENTER HILL RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Bennington |
| ELM ST | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| MONUMENT AVE | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Bennington |
| MONUMENT AVE | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Bennington |
| WATER TOWER RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Berkshire |
| CROSSTOWN RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Berlin |
| LAKESHORE DR | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | Brighton |
| NORTHFIELD RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| RIDGE RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| STONE RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| WEST ST | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Brookfield |
| BATTERY ST | TH Class 2 | 0.40 | 5 | Not Vulnerable | SLA | Burlington |
| PEARL ST | TH Class 2 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| GREENBUSH RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Charlotte |

| Road Name | Road Type | $VVI_i$ | $N X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| GREENBUSH RD | TH Class 2 | 0.00 | 2 | Not Vulnerable | Manual | Charlotte |
| MIDDLE RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| N SHREWSBURY RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| N CRAFTSBURY RD | TH Class 2 | 0.65 | 17 | Vulnerable | SLA | Craftsbury |
| CENTER RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | East Montpelier |
| TYLER BRANCH RD | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | Enosburg |
| N FAYSTON RD | TH Class 2 | 0.25 | 16 | Not Vulnerable | SLA | Fayston |
| GEORGIA SHORE RD | TH Class 2 | 0.33 | 3 | Not Vulnerable | Manual | Georgia |
| FROG HOLLOW RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | Hubbardton |
| CREEK RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Irasburg |
| MAIN ST | TH Class 2 | 0.58 | 12 | Vulnerable | SLA | Isle La Motte |
| MINES RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Lowell |
| OKEMO MOUNTAIN RD | TH Class 2 | 0.40 | 15 | Not Vulnerable | SLA | Ludlow |
| WASHINGTON ST | TH Class 2 | 0.67 | 12 | Vulnerable | SLA | Middlebury |
| BRIDGE ST | TH Class 2 | 0.82 | 11 | Vulnerable | SLA | Morristown |
| PANTON RD | TH Class 2 | 0.50 | 4 | Vulnerable | Manual | Panton |
| RIVER RD | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | Pawlet |
| COLD RIVER RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | Rutland |
| TOWN LINE RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | Rutland |
| WHITE CREEK RD | TH Class 2 | 0.38 | 8 | Not Vulnerable | SLA | Shaftsbury |
| BOSTWICK RD | TH Class 2 | 0.00 | 2 | Not Vulnerable | Manual | Shelburne |
| SHELBURNE RD | TH Class 2 | 0.43 | 7 | Not Vulnerable | SLA | Shelburne |
| EASTHAM RD | TH Class 2 | 0.00 | 2 | Not Vulnerable | Manual | Shrewsbury |
| FAIRFAX ST | TH Class 2 | 0.00 | 2 | Not Vulnerable | SLA | St. Albans Town |
| GIROUX RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | St. Albans Town |
| MAQUAM SHORE RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | St. Albans Town |
| BREEZY HILL RD | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| LAKE HORTONIA RD | TH Class 2 | 0.33 | 3 | Not Vulnerable | Manual | Sudbury |
| DUNHAM RD | TH Class 2 | 0.00 | 3 | Not Vulnerable | Manual | Sunderland |
| MAQUAM SHORE RD | TH Class 2 | 1.00 | 2 | Vulnerable | Manual | Swanton |
| HUCKLE HILL RD | TH Class 2 | 1.00 | 6 | Vulnerable | SLA | Vernon |
| DANIELS FARM RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | Waterford |
| MARBLE ST | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | West Rutland |
| PLEASANT ST | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | West Rutland |
| STAGE RD | TH Class 2 | 0.31 | 13 | Not Vulnerable | SLA | Whitingham |
| ROOD POND RD | TH Class 2 | 0.50 | 2 | Vulnerable | Manual | Williamstown |
| LAKE RAPONDA RD | TH Class 2 | 0.00 | 1 | Not Vulnerable | Manual | Wilmington |
| LA FOUNTAIN ST | TH Class 2 | 1.00 | 1 | Vulnerable | Manual | Winooski |
| W. Center St. | TH Class 2 | 0.75 | 4 | Vulnerable | SLA | Winooski |

| Road Name | Road Type | $VVI_i$ | N $X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| BROOK ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| N SEMINARY ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| RIVER ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| S SEMINARY ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| SMITH ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| WEST ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Barre City |
| COOLIDGE AVE | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| DEWEY ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| GAGE ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| GAGE ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| PLEASANT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| PLEASANT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| PLEASANT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| SCHOOL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| SCHOOL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| SCHOOL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| SILVER ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| SILVER ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| UNION ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| UNION ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| VALENTINE ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| WASHINGTON AVE | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| WESTSIDE DR | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Bennington |
| Hill Street | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | Berlin |
| FLAT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Brattleboro |
| GREEN ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Brattleboro |
| WILLIAMS ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Brattleboro |
| COLLEGE ST | TH Class 3 | 0.27 | 11 | Not Vulnerable | SLA | Burlington |
| COLLEGE ST | TH Class 3 | 0.27 | 11 | Not Vulnerable | SLA | Burlington |
| CRESCENT RD | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Burlington |
| ELMWOOD AVE | TH Class 3 | 0.33 | 6 | Not Vulnerable | SLA | Burlington |
| FLYNN AVE | TH Class 3 | 0.27 | 11 | Not Vulnerable | SLA | Burlington |
| HOME AVE | TH Class 3 | 0.27 | 11 | Not Vulnerable | SLA | Burlington |
| KING ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| KING ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| KING ST | TH Class 3 | 1.00 | 1 | Vulnerable | SLA | Burlington |
| LAKE ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| LAKE ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| LAKESIDE AVE | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |

| Road Name | Road Type | $VVI_i$ | N $X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| LAKESIDE AVE | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| N CHAMPLAIN ST | TH Class 3 | 0.60 | 5 | Vulnerable | SLA | Burlington |
| N UNION ST | TH Class 3 | 0.43 | 7 | Not Vulnerable | SLA | Burlington |
| S UNION ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| S UNION ST | TH Class 3 | 0.38 | 8 | Not Vulnerable | SLA | Burlington |
| E THOMPSONS POINT RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Charlotte |
| E TINMOUTH RD | TH Class 3 | 0.00 | 2 | Not Vulnerable | Manual | Clarendon |
| SQUIRES RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Clarendon |
| ROUTE 2B | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Danville |
| BARNES RD | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | East Montpelier |
| BLISS RD | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | East Montpelier |
| DODGE RD | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | East Montpelier |
| ESSEX WAY | TH Class 3 | 0.23 | 13 | Not Vulnerable | SLA | Essex |
| TOWERS RD | TH Class 3 | 0.23 | 13 | Not Vulnerable | SLA | Essex |
| SKUNK HILL RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Georgia |
| HANNA RD | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | Highgate |
| S PLEASANT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Middlebury |
| HILL ST | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | Montpelier |
| LANGDON ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Montpelier |
| SCHOOL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Montpelier |
| BEAVER POND RD | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Proctor |
| LUNT PL | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | Rutland |
| STRATTON RD | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | Rutland |
| LINCOLN AVE | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | Rutland City |
| NORTH ST | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | Rutland City |
| UPLAND DR | TH Class 3 | 0.50 | 2 | Vulnerable | Manual | Rutland City |
| BISHOP RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Shelburne |
| COMMUNITY DR | TH Class 3 | 0.27 | 11 | Not Vulnerable | SLA | South Burlington |
| EAST AVE | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | South Burlington |
| FARRELL ST | TH Class 3 | 0.31 | 13 | Not Vulnerable | SLA | South Burlington |
| HOLMES RD | TH Class 3 | 0.31 | 13 | Not Vulnerable | SLA | South Burlington |
| PINE ST | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | St. Albans City |
| UPPER NEWTON ST | TH Class 3 | 1.00 | 2 | Vulnerable | Manual | St. Albans City |
| BAY ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| CENTRAL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| CHERRY ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| CHURCH ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| DEPOT SQ | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| PEARL ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |

| Road Name | Road Type | $VVI_i$ | N $X_c$ | $E_c$ | Method | Primary Town |
|---|---|---|---|---|---|---|
| ST JOHN ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| WINTER ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | St. Johnsbury |
| PLEASANT ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | West Rutland |
| WATER ST | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | West Rutland |
| GOVERNOR CHITTENDEN RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Williston |
| REDMOND RD | TH Class 3 | 0.25 | 12 | Not Vulnerable | SLA | Williston |
| ZEPHYR RD | TH Class 3 | 0.00 | 1 | Not Vulnerable | Manual | Williston |
| HOWARD HILL RD | TH Class 3 | 0.00 | 2 | Not Vulnerable | Manual | Windham |
| FLORIDA AVE | TH Class 3 | 1.00 | 1 | Vulnerable | Manual | Winooski |
| VALLEY RD | Private Road | 0.31 | 13 | Not Vulnerable | SLA | South Burlington |
| MAIDSTONE LAKE ACCESS RD | State Forest | 0.83 | 12 | Vulnerable | SLA | Brunswick |
| PETTY BROOK RD | Unknown | 0.00 | 2 | Not Vulnerable | Manual | Milton |

# 6 Disinvestment Corridor Case Studies

To illustrate the importance in considering the potential impacts on vulnerable populations, we examine three candidate disinvestment corridors in detail in Sections 6.1, 6.2, and 6.3 respectively: 1) Route 7B, 2) Route 65, and 3) US 2.

## 6.1 Candidate Disinvestment Corridor: Route 7B

This particular case highlights that the use of disinvestment strategies by state agencies has occurred with more frequency than is broadly advertised. In the late 1980s Route 7B and Cold River Bridge were bypassed in the realignment of Route 7 south of Rutland. Given the new Route 7 alignment and the redundancy provided by bridge structures just to the east on Route 7 and just to the west on Middle Road across the Cold River, as well as the deteriorating condition of the historic Vermont Route 7B Cold River bridge, it was closed in 1989. Our initial analysis identified sections of Route 7B as having low NRI and CCA values, and thus Route 7B became a candidate corridor for disinvestment. The corridor also has a relatively low vulnerability score. With the demolition of the Cold River Bridge on Route 7B in 1995, the opportunity to disinvest in adjacent infrastructure components exists. The loss of connectivity along Route 7B does not significantly affect the surrounding community, as 7B has become a local road that only provides access to few residences and commercial locations.

## 6.2 Candidate Disinvestment Corridor: Route 65

Another candidate corridor that was identified as an opportunity for disinvestment and received a low vulnerability score (i.e. does not support highly vulnerable populations) is the nearly 5 miles of the Route 65 corridor located in Brookfield, VT. VT 65 begins at an intersection with Route 12 and then runs east through Brookfield, connecting to Route 14. In 2015, the historic Sunset Lake Floating Bridge was reopened after being closed in 2008. The bridge replacement project cost $2.4 million with a 80/20 federal/state split (Rathke 2015). This particular project is an example of local champions garnering community support for a project that has historical significance, but has little to no strategic value in terms of the overall roadway infrastructure network.

## 6.3 Candidate Disinvestment Corridor: US 2

Approximately two miles of US 2 in Alburgh were identified as a candidate for disinvestment. US Highway 2 travels through the town center of Alburgh, where the speed limit along the highway drops to between 25 and 35 MPH to reflect the local land use pattern. Based on low NRI and CCA values, the portion of US 2 running through Alburgh would appear to be a candidate for reclassification or municipal turnback. However, it is important to note that the corridor serves a vulnerable population and disinvestment along the US corridor may place undue burden on the town of Alburgh and transfer the costs of disinvestment onto already vulnerable users.

# 7 Conclusions and Recommendations

A transportation infrastructure investment approach that more aggressively employs disinvestment / reinvestment strategies will require VAOT to refine the decision-making tools and methods of analysis that are already used in evaluating project prioritization and asset investment opportunities throughout the state. These tools and methods should include various measures of system-wide performance as well as considering how specific disinvestment decisions may affect vulnerable populations.

This report addresses the evaluation of a variety of generalized disinvestment scenarios in the state of Vermont. The specific objectives of this research are:

1. Review and document strategies for maintenance reinvestment and capital disinvestment that have been implemented throughout the U.S.

2. Develop a framework to help guide the Vermont Agency of Transportation (VAOT) with strategic reinvestment / disinvestment decisions.

3. Identify candidate corridors for strategic disinvestment using a comprehensive evaluation approach that incorporates network-based performance measures. Candidate corridors for disinvestment were identified using two network-based performance measures: 1) corridors that have little to no impact on system-wide performance when the speed and capacity reductions as measured by the NRI, and 2) corridors that are not important in accessing critical locations / services as measured by the CCA.

4. Develop a vulnerability index to help identify populations that may be impacted by disinvestment decisions.

Based on a system-wide strategic investment approach, the research team offers the following recommendations:

- Improve select link analyses for low volume roads to enhance the vulnerability assessment process and upgrade the candidate corridors currently requiring manual methods;
- Operationalize the vulnerability metric in TransCAD script as a standard output of the select link analysis scenario testing;
- Consider and evaluate other possible disinvestment strategies;

- Evaluate disinvestment strategies using different baseline levels for the NRI and CCA;
- Incorporate upcoming project and pavement condition data from VTransparency into the evaluation of strategic disinvestment and reinvestment;
- Investigate the temporal component of disinvestment using time-based performance metrics such as life-cycle and cost/benefit analyses.

The research presented here illustrates a range of disinvestment strategies that might be used to guide transportation investment decisions. Four general categories of disinvestment strategies were suggested using specific examples of disinvestment that are used by state transportation agencies throughout the U.S. The four generalized disinvestment categories are: 1) jurisdictional change, 2) decommissioning, 3) modification of standards, and 4) deferment of action. The four disinvestment strategies offer different opportunities for cost savings and are associated with varying levels of reduced state-level responsibility and/or obligation.

The four generalized disinvestment scenarios were evaluated using both the NRI and CCA to identify corridors that are viable candidates for disinvestment. Each scenario is modeled by disrupting roadway components by varying degrees, where each disruption scenario is associated directly with a specific capacity and speed reduction percentage that reflects the "most likely" impact associated with a specific disinvestment scenario. Once the initial candidate corridors for disinvestment were selected, each corridor was vetted according to the potential impact the disinvestment decision may have on vulnerable populations, as measured by a vulnerability index. Results from the analysis are presented in a tabular form within the report for clarity.

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# Appendices

## Appendix A. ACS Detailed Data Resources

| Parameters | Units | Table | Attribute Labels and Computations | Attribute Labels and Computations | Link |
|---|---|---|---|---|---|
| Per capita income ($) | dollars | DP03 | HC01_VC118 | INCOME AND BENEFITS - Per capita income (dollars) | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/DP03/0400000US50.06000 |
| Percent of people whose income in the past 12 months is below the poverty level (%) | percent of all people | DP03 | HC03_VC171 | PERCENTAGE OF FAMILIES AND PEOPLE WHOSE INCOME IN THE PAST 12 MONTHS IS BELOW THE POVERTY LEVEL - All people | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/DP03/0400000US50.06000 |
| Median housing value of owner-occupied units ($) | dollars | DP04 | HC01_VC127 | VALUE - Owner-occupied units - Median (dollars) | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/DP04/0400000US50.06000 |
| Percent of Black or African American individuals (%) | percent of all people | S02001 | HD01_VD03 / HD01_VD01 | Black or African American alone / Total number of people | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/B02001/0400000US50.06000 |
| Percent of single Black or African American female householder (%) | percent of all families | B02001 | HD01_VD06 / HC01_VC103 | Female householder, no husband present / Total number of families | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/B02001/0400000US50.06000 |
| Percent of mobile homes (%) | percent of all housing units | DP04 | HC03_VC21 | UNITS IN STRUCTURE - Total housing units - Mobile home | http://factfinder.census.gov/bkmk/table/1.0/ |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | en/ACS/14_5YR/DP04/0400000US50.06000 |
| Percent of renter-occupied units (%) | percent of all housing units | DP04 | HC03_VC65 | HOUSING TENURE - Occupied housing units - Renter-occupied | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/DP04/0400000US50.06000 |
| Percent of people with limited English proficiency (%) | percent of all people | S1601 | HC01_EST_VC03 * HC03_EST_VC03 | Speak a language other than English * Percent of specified language speakers - Speak English less than "very well" | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S1601/0400000US50.06000 |
| Percent of population with physical disability (%) | percent of all people | S1810 | HC01_EST_VC52 | PERCENT IMPUTED - Ambulatory difficulty | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S1810/0400000US50.06000 |
| Percent of population with cognitive disability (%) | percent of all people | S1810 | HC01_EST_VC51 | PERCENT IMPUTED - Cognitive difficulty | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S1810/0400000US50.06000 |
| Percent of population 17 years and younger (%) | percent of all people | S0101 | HC01_EST_VC03 + HC01_EST_VC23 + HC01_EST_VC24 | AGE - Under 5 years + SELECTED AGE CATEGORIES - 5 to 14 years + SELECTED AGE CATEGORIES - 15 to 17 years | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S0101/0400000US50.06000 |
| Percent of population 65 years and over (%) | percent of all people | S0101 | HC01_EST_VC31 | SELECTED AGE CATEGORIES - 65 years and over | http://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S0101/0400000US50.06000 |
| Percent of households with no available vehicle (%) | percent of all housing units | DP04 | HC03_VC84 | VEHICLES AVAILABLE - Occupied housing units - No vehicles available | http://factfinder.census.gov/bkmk/table/1.0/ |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | en/ACS/14_5YR/DP04/ 0400000US50.06000 |
| Percent of employees in agriculture, forestry, fishing and hunting, and mining (%) | percent of civilian employed population | DP03 | HC03_VC50 | INDUSTRY - Civilian employed population 16 years and over - Agriculture, forestry, fishing and hunting, and mining | http://factfinder.census.gov/bkmk/table/1.0/ en/ACS/14_5YR/DP03/ 0400000US50.06000 |
| Percent of employees in transportation, warehousing, and utilities (%) | percent of civilian employed population | DP03 | HC03_VC55 | INDUSTRY - Civilian employed population 16 years and over - Transportation and warehousing, and utilities | http://factfinder.census.gov/bkmk/table/1.0/ en/ACS/14_5YR/DP03/ 0400000US50.06000 |