

# *Pavement Management Update*

Westminster, Massachusetts

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Prepared for Town of Westminster  
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# 1

## Introduction

The Town of Westminster, Massachusetts retained the firm of Vanasse Hangen Brustlin, Inc (VHB) to perform pavement management services. A comprehensive study was undertaken to evaluate pavement conditions in Westminster and to allow for the analysis of various funding scenarios.

Under the scope of this project, VHB performed a detailed inspection of the condition of the pavement on all Town maintained roads, and updated the towns pavement management database with this information which can be viewed, edited and analyzed using VHB's RoadManager™ software. VHB has delivered this software to staff in the Public Works and Engineering department, and trained them on its use. This report describes the steps taken in this project, the results of the field evaluations, and also compares the results of potential roadway funding scenarios.

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### Theory of Pavement Management

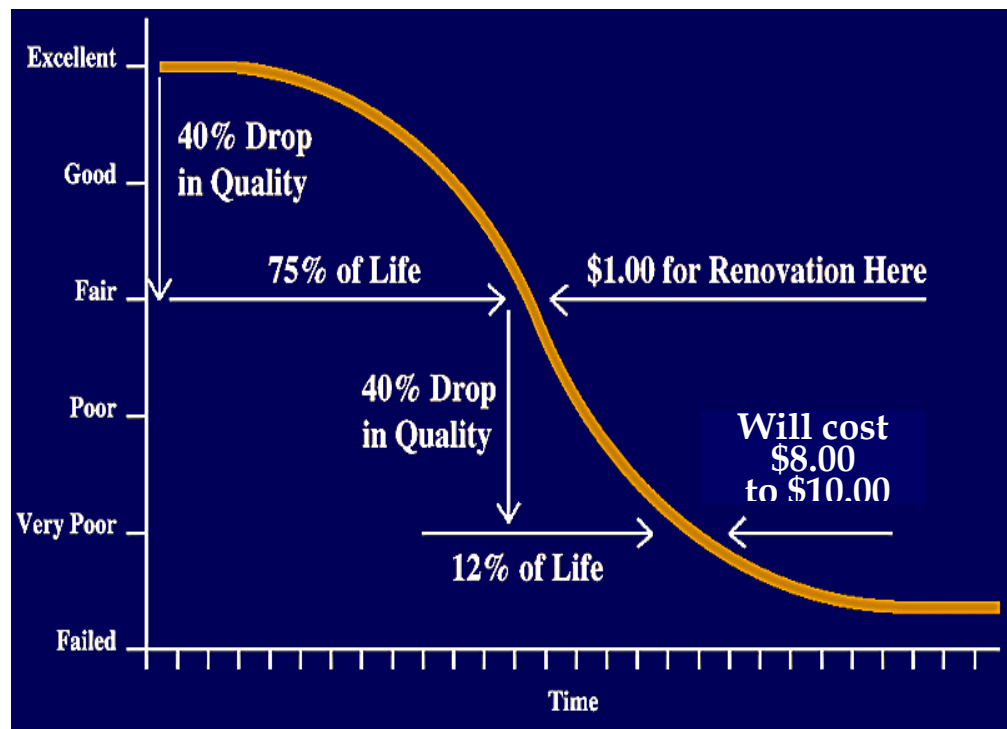
Pavement management is the practice of planning for pavement repairs and maintenance with the goal of maximizing the value and life of a pavement network.

To accomplish this, a community needs to have several repair techniques in its arsenal and the knowledge of when to apply them. This is where pavement management comes into play. With a comprehensive database of road conditions, the RoadManager™ software can model when to perform which repairs on a road network. Of course, engineering judgment is required to finalize any list of street repairs, as no computer model can take every variable analyzed in making a repair decision into account. The computer system is a great springboard to help a community start its repair program for each year and is an excellent method of storing the repair data.

## The Pavement Deterioration Curve

Below is a model of how a street's pavement deteriorates over time. Interpreting the curve, a street starts out in excellent condition when it is newly constructed. Midway through its life, a low cost repair such as crack seal and patch will cost approximately a dollar a square yard. It takes only a few years for the window of opportunity to perform this low cost maintenance to pass after which the road would need an overlay costing \$8 - \$10 per square yard. By performing timely maintenance, road conditions can be improved today thereby extending the life of the road.

Figure 1 - Typical Pavement Deterioration Curve



To expand a bit on the theory described in the chart above; a typical, low traffic, hot-mix asphalt road has a useful life span of 20 years before needing to be rebuilt, if no preventative maintenance is performed. As will be discussed later in this report, it costs the Town of Westminster approximately \$18.00 per square yard to reclaim a road. However, it costs the Town an average of \$1.50 to seal cracks and do some local base repairs, which can add about 5 years of life to a road. It would cost Westminster about \$5.00 per square yard to put a preventative maintenance surface treatment on a road, which can extend the life of a road by about 8 years.

# 2

## Methodology

VHB performed a detailed condition evaluation on Westminster's 88.4 miles of Town maintained roads to build the pavement management system. The first step was to identify the Town accepted streets, thereby comprising the roadway network. The second step was to further break each street in the roadway network into pavement management sections. The third step was to carefully categorize, measure, and record the individual pavement distresses within each pavement management section. Finally, the fourth step was to customize the road repair unit costs within the RoadManager™ software through discussions with Town officials. All these steps were performed prior to the study of future funding scenarios.

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### Network Identification

Network Identification builds an inventory of streets that describe the municipality's complete roadway network. The direction of travel, street length, width, ownership, classification, zone and pavement type are among the items identified at this initial phase in the pavement management process. This integral step ensures the streets surveyed are the definitive set to be analyzed.

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### Pavement Management Section Identification

Once the Network Identification is complete, the field work begins. Each street contains one or more pavement management sections. A pavement management section defines the limits of previous construction or maintenance activities within each street. Sections are defined by having the same width, typical distresses, functional class, etc. The goal is to set up homogenous areas of pavement to aid in assigning the appropriate repair. A street may be one section, or it may be comprised of several pavement management sections, depending on its construction history.

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## Surface Distress Assessment

For each pavement management section, the severity and extent of nine major pavement distresses are recorded, then entered into a weighted formula to arrive at a Pavement Condition Index (PCI). The distresses are categorized as base related or surface related distresses. Base related distresses indicate that the subsurface soil strength is inadequate for the existing traffic load. Streets that show significant base related distresses may need to have the subsurface soils fortified with stone to strengthen the structure and/or the street may need a significantly thicker layer of pavement. Surface related distresses are caused by age and weathering of the pavement. Streets that have predominantly surface related distresses are excellent candidates for maintenance sealing to inhibit further pavement oxidization (the main effect of aging). Streets with more of the base related distresses will most likely need some full depth patching, structural overlays or reclamation/reconstruction.

The four base related distresses are:

- potholing or non-utility patching
- alligator cracking
- distortion
- rutting

The five surface related distresses are:

- block cracking
- transverse or longitudinal cracking
- bleeding or polished aggregate
- surface wear or raveling
- shoving, slippage or corrugation

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### PCI Defined

A PCI was generated for each inventoried pavement management section in Westminster using the surface distress data collected by VHB. PCI is measured on a scale of zero to one hundred, with one hundred representing a pavement in perfect condition and zero describing a road in impassable condition. Each type of observed pavement distress is assigned a deduct value based on the type, severity and extent of the distress.

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### PCI Calculation

A weighted sum of the deduct points is subtracted from the perfect “one hundred” road in order to generate a PCI for each pavement management section. In general, base related (pavement foundation) distresses are weighted more heavily than surface related distresses. For example, if 15% of a road section had medium severity “Alligator Cracking” it would received a deduct of 40 points. Where as the same area of “Block Cracking” would only receive a deduct of 15 points. The actual PCI calculation follows:

$$\text{PCI} = 100 - (\text{Highest Deduct Value}) - (25\% \text{ of remaining base related deduct values}) - (10\% \text{ of remaining surface related deduct values})$$

## The Five Treatment Bands

VHB's RoadManager™ software uses broad ranges to group the individual repair types into five major treatment bands. Treatment bands are a useful tool to summarize data on a Town-wide basis. An individual road segment will fall into a particular category based on the strategy table's output of repair types and will vary due to functional classification. The goal is to gain a broad understanding of the existing conditions in simple yet meaningful terms.

**Table 1 - Treatment Band Descriptions**

TREATMENT BAND	PCI*	Description
DO NOTHING	93-100	Excellent condition - in need of no maintenance.
ROUTINE MAINTENANCE	86-92	Good condition - may be in need of crack sealing or minor localized repair.
PREVENTIVE MAINTENANCE	78-85	Fair condition - pavement surface may be in need of surface sealing, full depth patch and/or crack sealing.
STRUCTURAL IMPROVEMENT	61-77	Deficient condition - pavement surface structure in need of added strength for existing traffic. Typical repairs are overlay with or without milling.
BASE REHABILITATION	0-60	Poor condition - in need of base improvement. Typical repairs are reclamation or full depth reconstruction.

\*These are only general PCI ranges for reference purposes, and represent only one pavement type. There are several fields considered by the strategy table when assigning repair types to each individual street.

## General Roadway Indices

In addition to the pavement distress survey, each pavement management section was characterized by a series of general roadway indices that describe a number of roadway attributes and are also factors in the decision making process. Each index is based on a scale of 0 to 100 with 100 indicating an ideal condition. Definitions of each index can be found in Appendix D. They include:

- Rideability Index (RI)
- Drainage Condition Index (DCI)
- Utility Condition Index (UCI)
- Sidewalk Condition Index (SCI)
- Traffic Control Index (TCI)
- Traffic Safety Index (TSI)
- Roadside Maintenance Index (RMI)



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## Customizing Repair Strategies

VHB met with Town officials to review VHB's typical repair strategies, and to learn how to customize these strategies to meet the Town's specific needs. VHB also refined repair unit costs. VHB's goal was to understand Westminster's decision-making process and simulate that process in the budget analysis software based on the pavement condition and other criteria of each pavement section.

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## Preparing Budget Scenarios

Once the roadway conditions are inventoried and analyzed, and the repair strategies are defined, the impact of various spending programs on the roadway network is assessed. These studies can range from 1 to 20 years; however, for the purpose of this report 10-year studies are used. The purpose of the budget planning process is to determine the impact of various spending levels to find a funding level that will best meet Westminster's needs. The budget module uses deterioration curves, unit costs, and the strategy tables developed in the repair strategy definition phase to assign each street a repair type and associated cost for each year of the study. The module also assigns each street a benefit value that is used to prioritize which streets the software will select for repair each year.

The results of the budget analysis are two-fold. Pavement management deals with the life cycle of pavement structures and the various repair treatments to maintain the condition of the pavement. The pavement management system and the various repair types utilized in the study do not directly address other physical improvements associated with a roadway. Some of the items, which might be encountered on a roadway project, include the storm drainage system, traffic signals, sidewalks and utility adjustments. In an attempt to develop a reasonable cost of various improvements, the overall scope of a typical project associated with the various repair types was estimated to develop a network level unit cost for the work.



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## Deterioration Curves

In order to properly plan for future repairs, the budget analysis feature of RoadManager™ utilizes deterioration curves. The deterioration curves estimate the rate at which the pavement condition decreases over time. These pavement deterioration curves depict two major categories of functional class - arterials and collectors in one curve and local roads in the other.



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## Strategy Table

RoadManager™ uses a table of repair strategies to assign specific road repair types to individual roadway segments. The repair strategy table incorporates PCI ranges as well as functional class and pavement type to simulate decisions consistent with Westminster's repair practices and procedures.



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## Project Prioritization

The Budget Analysis module prioritizes needed system repairs based on the estimated "Benefit Value". The Benefit Value formula is calculated using variables representing traffic volume, repair service life, PCI, and unit repair costs for each pavement management section. For each plan year, the software prepares a future roadway condition projection, exhausts the assigned budget, and then produces an annual list of roads included in the repair program. The system also allows the user to enter an inflation rate to account for estimated increases in future year construction costs. A 4% inflation rate was used for Westminster.

The Benefit Value prioritization process generally favors cost effective maintenance alternatives. Repair actions are typically delayed on those sections that require reconstruction or major rehabilitation because the benefits for dollars spent are generally lower than maintenance candidates. After the relatively good roads are "saved", improvements are directed towards the poorer arterial and collector roads, and then to the local roads in need of major rehabilitation.

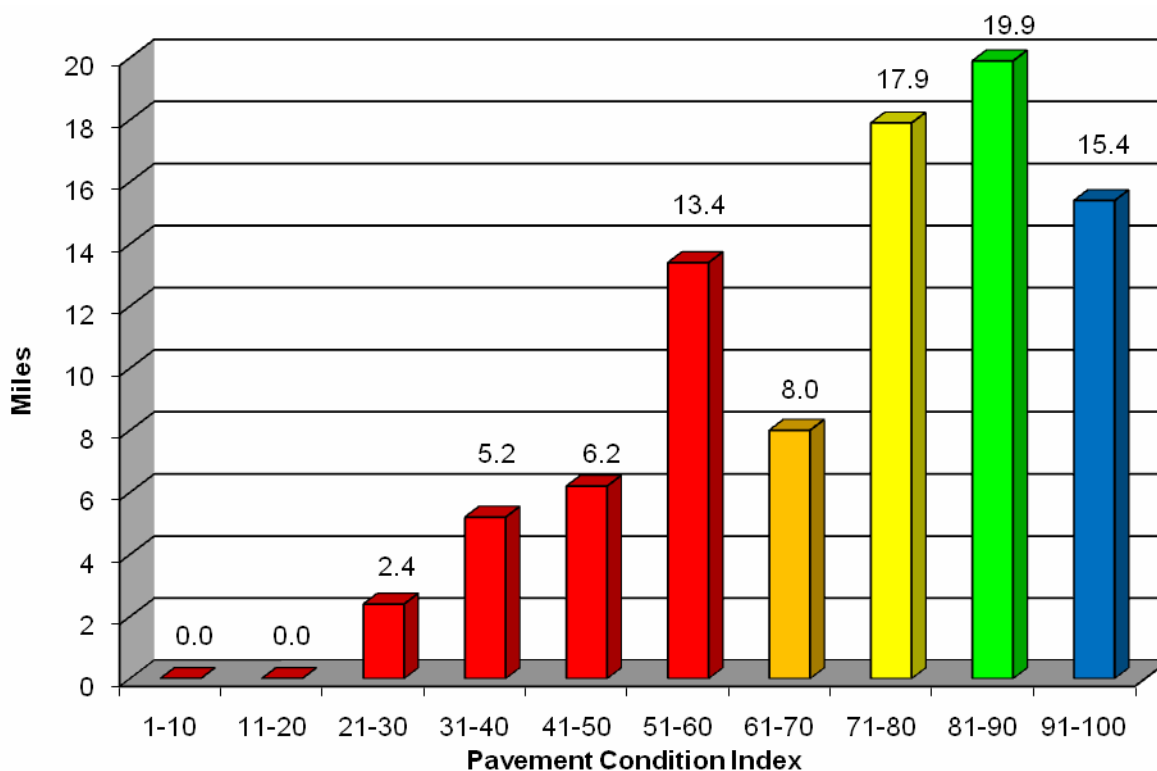
## 3

## Existing Conditions

### Accepted Streets Pavement Conditions

VHB conducted the field evaluation of pavement conditions in the summer of 2007. The average PCI for Westminster's road network at the time of the survey was a **71**. The wide dispersal of conditions on Figure 2 shows the Town's immediate need for an aggressive maintenance program as well as a budget for capital improvements. Continued low-cost maintenance on the roads in better condition will be critical to prevent them from deteriorating into a condition that will require expensive capital repairs.

Figure 2 - PCI Distribution of All Town Streets



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## Backlog of Work

Applying the five treatment bands shown in Table 1 and unit costs to Westminster's road network, a summary of outstanding work was developed. The following table gives the miles and dollars associated with each treatment band for the conditions at the time of the evaluation.

**Table 2 - Summary of Miles and Dollars of Outstanding Work**

Treatment band	All Roads (Miles)	All Roads (Cost)
Do Nothing	14.0	
Routine Maintenance	22.4	\$156,000
Preventive Maintenance	14.8	\$835,000
Structural Improvement	6.9	\$1,152,000
Base Rehabilitation	30.4	\$6,409,000
<b>Totals:</b>	<b>88.4</b>	<b>\$8,553,000</b>

The charts on the following pages present the information from Table 2 graphically. They show how smaller percentages of funds put towards maintenance will have an effect on a larger percentage of mileage, emphasizing the importance of preventative maintenance.

Figure 3- Miles of Outstanding Work

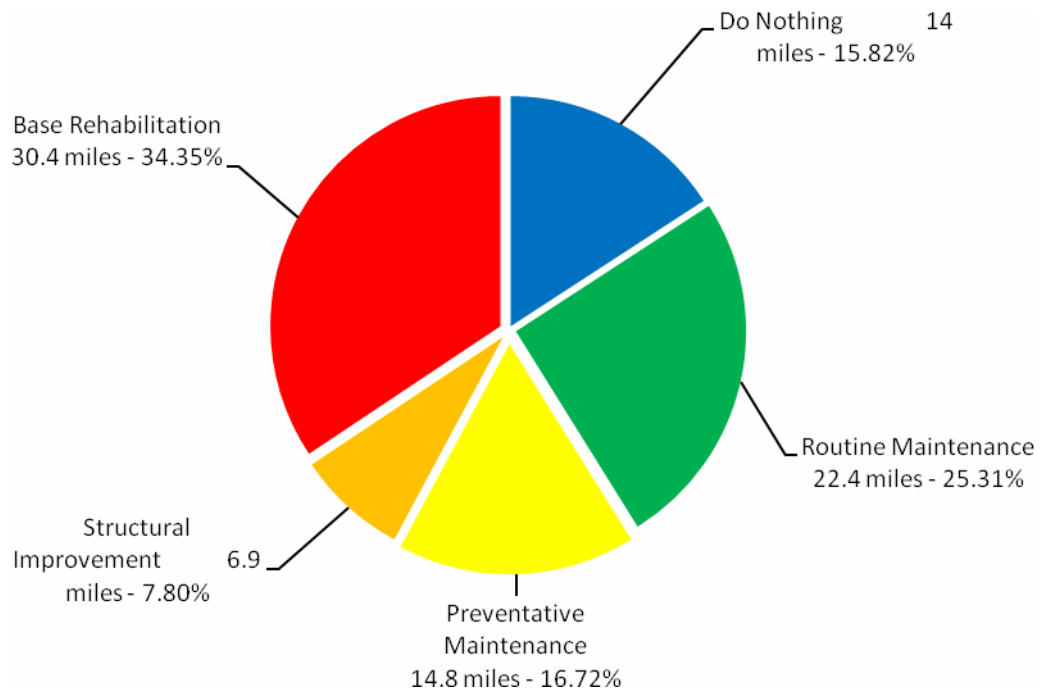
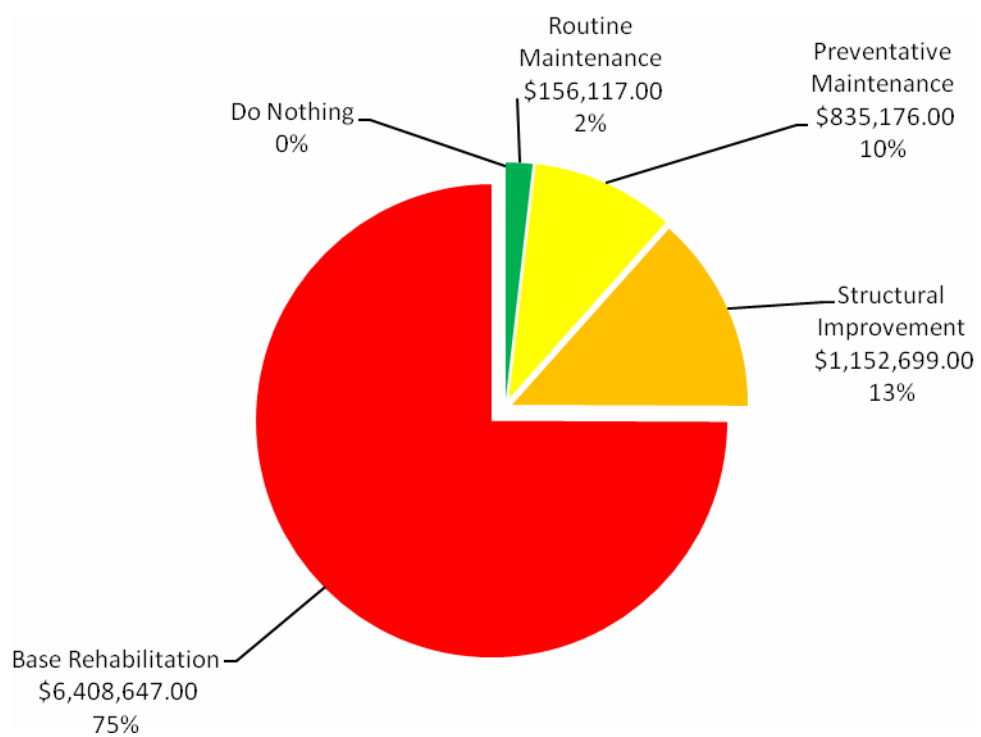


Figure 4 - Dollars of Outstanding Work



# 4

## Budget Analysis

Westminster has a major investment in its 88 miles of Town-maintained roads. It is easy to forget that roadways are a community's single largest investment. Based on the unit cost established for reconstruction of Westminster's roads, without considering signs, signals, curbing, or sidewalks, it would cost Westminster at least 40 million in today's dollars to replace the existing Town accepted roadway infrastructure. The final phase of the pavement management process that VHB undertook for this report was the examination of various annual spending levels.

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### Scenarios Explored

VHB projected the PCI and dollar backlog for four funding scenarios that accounted for all town-maintained roads. These scenarios explored the possibility of applying four different levels over a period of 10 years.



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### Scenario Detail

This section will outline the specific annual funding levels used in the budget scenarios and will compare their results.

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**\$500 Thousand/Year**

This scenario shows the results of spending no money on Westminster's road program for 10 years. If this is the only funding the Town-wide average PCI will deteriorate quickly.

<b>Plan Date</b>	<b>Budget Amount</b>	<b>PCI</b>	<b>Backlog</b>
Surveyed		71	\$8,553,000
2008	\$500,000	71	\$9,400,000
2009	\$500,000	69	\$10,834,000
2010	\$500,000	66	\$11,081,000
2011	\$500,000	64	\$11,801,000
2012	\$500,000	61	\$12,847,000
2013	\$500,000	60	\$13,768,000
2014	\$500,000	59	\$13,978,000
2015	\$500,000	58	\$14,413,000
2016	\$500,000	57	\$15,276,000
2017	\$500,000	56	\$15,408,000

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**\$750 Thousand/Year**

This scenario shows the potential results of continuing to spend \$750,000 annually on Westminster's road program. This is still not an adequate funding level.

<b>Plan Date</b>	<b>Budget Amount</b>	<b>PCI</b>	<b>Backlog</b>
Surveyed		71	\$8,553,000
2008	\$750,000	72	\$9,400,000
2009	\$750,000	71	\$10,306,000
2010	\$750,000	69	\$10,283,000
2011	\$750,000	67	\$10,602,000
2012	\$750,000	67	\$11,368,000
2013	\$750,000	67	\$11,945,000
2014	\$750,000	67	\$11,980,000
2015	\$750,000	67	\$12,071,000
2016	\$750,000	67	\$12,328,000
2017	\$750,000	67	\$12,111,000

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**\$1 Million/Year**

This plan shows the cost of improving the Town's average PCI by 7 points over the ten year analysis period.

<b>Plan Date</b>	<b>Budget Amount</b>	<b>PCI</b>	<b>Backlog</b>
Surveyed		71	\$8,553,000
2008	\$1,000,000	73	\$9,400,000
2009	\$1,000,000	72	\$10,070,000
2010	\$1,000,000	71	\$9,657,000
2011	\$1,000,000	71	\$9,513,000
2012	\$1,000,000	71	\$9,530,000
2013	\$1,000,000	72	\$9,613,000
2014	\$1,000,000	74	\$9,174,000
2015	\$1,000,000	74	\$8,695,000
2016	\$1,000,000	76	\$8,442,000
2017	\$1,000,000	78	\$7,853,000

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**Varying Funding/Year**

This scenario show the necessary annual expenditure to gradually increase the PCI 6 points over the ten year period.

<b>Plan Date</b>	<b>Budget Amount</b>	<b>PCI</b>	<b>Backlog</b>
Surveyed		71	\$8,553,000
2008	\$1,000,000	73	\$9,400,000
2009	\$1,500,000	73	\$10,070,000
2010	\$1,200,000	73	\$9,137,000
2011	\$1,200,000	73	\$8,732,000
2012	\$1,000,000	74	\$8,456,000
2013	\$700,000	74	\$8,511,000
2014	\$700,000	75	\$8,350,000
2015	\$700,000	76	\$8,154,000
2016	\$700,000	76	\$8,212,000
2017	\$500,000	77	\$7,909,000



## Budget Summary

Figure 5 and 6 show the effects of the four funding levels analyzed on Westminster's road network over the next 10 years. Either of the last two funding levels will maintain or improve today's condition while keeping the outstanding backlog of work from increasing.

Figure 5 – Projected PCI Summary

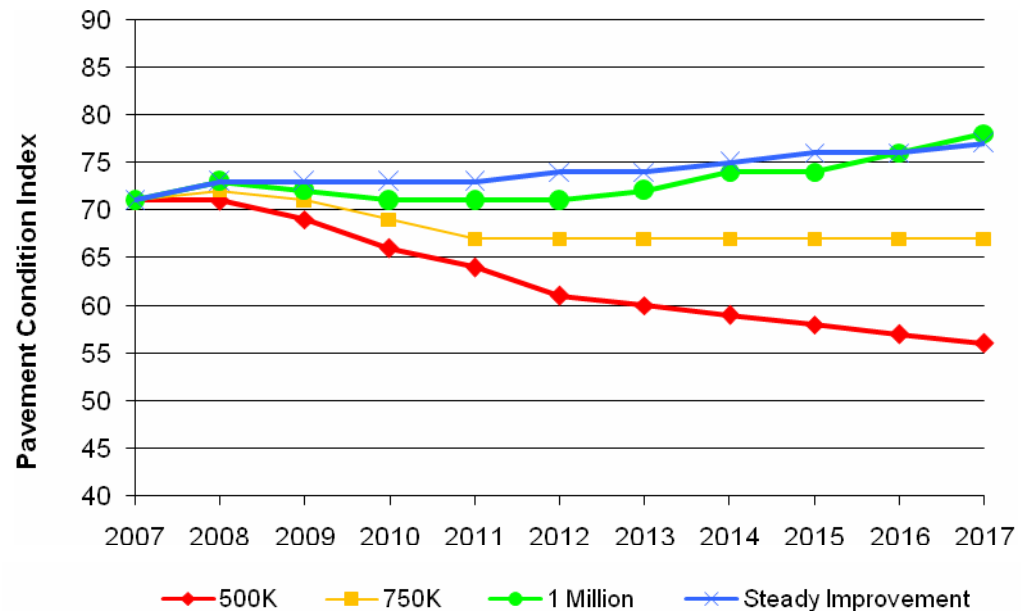
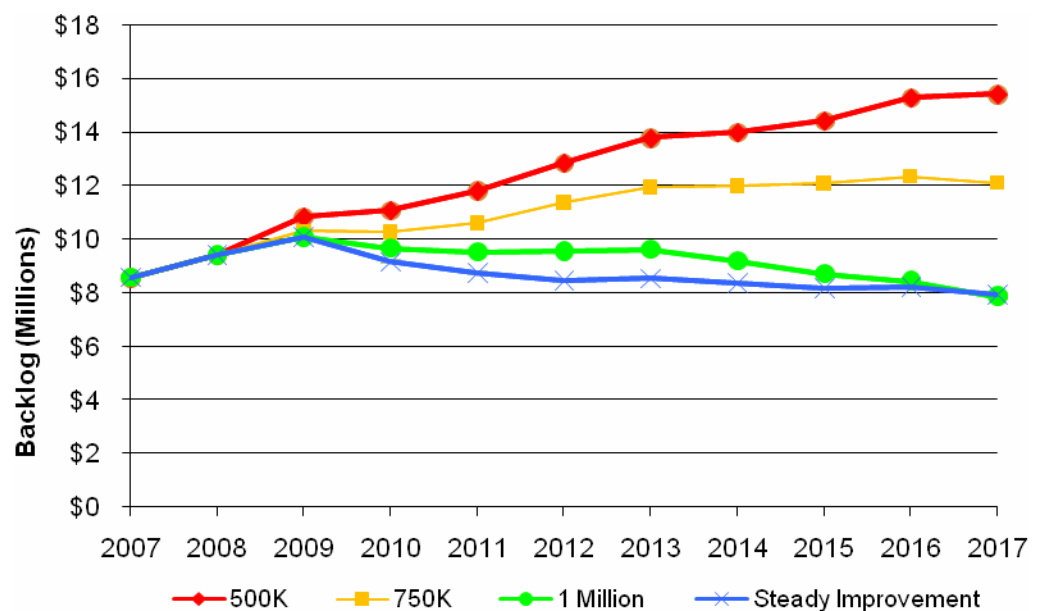


Figure 6 – Projected Dollar Backlog Summary



# 5

## Concluding Remarks

The Town of Westminster now has a pavement management system based on road condition data and descriptive information collected in 2007. The Town is urged to fully utilize the considerable volume of data it now possesses. The Westminster pavement management system gives Town decision-makers a picture of existing roadway infrastructure conditions and **a dollar estimate to improve streets in poor condition while protecting those pavements already in good condition.**

The findings of this study reveal a street network in fair condition, however, there is still a significant backlog of work. **Westminster needs to continue performing maintenance on the roads in fair condition, while rehabilitating the roads in poor condition as funds are available. Westminster will benefit most from a balanced attack of maintenance, overlays, and reclamation.**

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### Recommendations – Pavement Management

- Make timely maintenance repairs
- Repair localized base problems before overlaying
- Address major rehabilitation needs as funding allows
- **Provide staff or hire consultants for construction inspection at the plant and in the field to ensure quality material is provided and quality work is being performed.**

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### Recommendations – *RoadManager*™

- Update system to reflect work that has been done  
*(important to maintain accuracy of system)*
- Track specific and overall conditions periodically
- Evaluate funding levels periodically
- Develop multi-year road programs
- Update pavement condition ratings at a minimum of every 4 years

# Appendix A

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Pavement Inventory Report ■

Road	From	To	PCI	Repair
ACADEMY HILL RD	LEOMINSTER ST	327' E OF LEOMINSTER ST	65	Struct Imprmt LO
ACADEMY HILL RD	327' E OF LEOMINSTER ST	FOSTER ST	53	BaseRehab w/Sidewalk
ACADEMY HILL RD	FOSTER ST	WORCESTER RD	47	BaseRehab Local
ADAMS ST	MAIN ST	DEAD END	44	BaseRehab Local
AMBER RD	WOODLAND DR	1ST CUL-DE-SAC	99	Do Nothing
AMBER RD	1ST CUL-DE-SAC	2ND CUL-DE-SAC	99	Do Nothing
ANDREA LN	WORCESTER RD	WORCESTER RD	39	BaseRehab Local
BACON ST	MAIN ST	100' N OF ELLIOTT ST	46	BaseRehab w/Sidewalk
BACON ST	100' N OF ELLIOTT ST	2006' N OF ELLIOTT ST	54	BaseRehab w/Sidewalk
BACON ST	2006' N OF ELLIOTT ST	NORTH COMMON RD	51	BaseRehab A/C
BARREL RD	SOUTH ASHBURNHAM RD	733' W OF BRAGG HILL RD	36	BaseRehab Local
BARREL RD	733' W OF BRAGG HILL RD	BRAGG HILL RD	73	Gravel blading & Routine Drain
BATHERICK RD	STATE RD EAST	600' N STATE RD EAST	94	Do Nothing
BATHERICK RD	600' N STATE RD EAST	NEWCOMB RD	87	RoutineMaint CrSl or Patch
BATHERICK RD	NEWCOMB RD	HOWARD RD	18	BaseRehab Local
BATHERICK RD	HOWARD RD	TOWN FARM RD	69	Gravel blading & Routine Drain
BATTLES RD	STATE RD EAST	CUL DE SAC	53	BaseRehab Local
BEAN PORRIDGE HILL R	SOUTH ASHBURNHAM RD	1920' N OF S ASHBURNHAM R	87	RoutineMaint CrSl or Patch
BEAN PORRIDGE HILL R	1920' N OF S ASHBURNHAM R	2362' N OF S ASHBURNHAM R	88	RoutineMaint CrSl or Patch
BEAN PORRIDGE HILL R	2362' N OF S ASHBURNHAM R	3451' N OF S ASHBURNHAM R	100	Do Nothing
BEAN PORRIDGE HILL R	3451' N OF S ASHBURNHAM R	400' S OF POTATOE HILL RD	46	BaseRehab A/C
BEAN PORRIDGE HILL R	400' S OF POTATOE HILL RD	100' N OF POTATOE HILL RD	100	Do Nothing
BEAN PORRIDGE HILL R	100' N OF POTATOE HILL RD	3463' S OF ASHBURNHAM RD	93	RoutineMaint CrSl or Patch
BEAN PORRIDGE HILL R	3463' S OF ASHBURNHAM RD	ASHBURNHAM RD	88	RoutineMaint CrSl or Patch
BEECH HILL RD	SARGENT RD	300' N OF SARGENT RD	87	Gravel blading & Routine Drain
BEECH HILL RD	300' N OF SARGENT RD	DEAD END	87	Gravel blading & Routine Drain
BETTY SPRING RD (NB)	415' S OF WEST MAIN ST	WEST MAIN ST	95	Do Nothing
BETTY SPRING RD (SB)	WEST MAIN ST	415' S OF WEST MAIN ST	99	Do Nothing
BETTY SPRING RD (SB)	415' S OF WEST MAIN ST	GARDNER TOWN LINE	95	Do Nothing
BLUEBERRY HILL LN	NORTH COMMON RD	CUL-DE-SAC	88	RoutineMaint CrSl or Patch
BOLTON RD	WEST PRINCETON RD	495' W OF MILE HILL RD	73	PrevMaint Prep/Dblchip
BOLTON RD	495' W OF MILE HILL RD	MILE HILL RD	86	RoutineMaint CrSl or Patch
BRAGG HILL RD	SOUTH ASHBURNHAM RD	3500' N OF S ASHBURNHAM R	66	Struct Imprmt LO
BRAGG HILL RD	3500' N OF S ASHBURNHAM R	BARREL RD	64	Struct Imprmt LO
BRAGG HILL RD	BARREL RD	1835' S OF ASHBURNHAM TL	69	Gravel blading & Routine Drain
BRAGG HILL RD	1835' S OF ASHBURNHAM TL	ASHBURNHAM TOWN LINE	34	BaseRehab Local
BROOKS AV	MAIN ST	DEAD END	58	BaseRehab Local
CARPENTER LN	FENNO DR	SCENIC DR	94	Do Nothing
CARTER RD	ELLIS RD	KNOWER RD	87	RoutineMaint CrSl or Patch
CARTER RD	KNOWER RD	#64 or 1785' W KNOWER RD	88	RoutineMaint CrSl or Patch
CARTER RD	#64 or 1785' W KNOWER RD	SOUTH STREET	88	RoutineMaint CrSl or Patch
CHURCH ST	MAIN ST	CUL DE SAC	60	BaseRehab Local
CODY RD	NOTOWN RD	760' E OF NOTOWN RD	73	Gravel blading & Routine Drain
CODY RD	760' E OF NOTOWN RD	FITCHBURG RD	68	Gravel blading & Routine Drain
COLONY RD	DEAD END	GARDNER TOWN LINE	54	BaseRehab Local
CROSS RD	KNOWER RD	MINOTT RD	27	BaseRehab Local
CUDAK CT	TOMMY FRANCIS RD	CUL-DE-SAC	100	Do Nothing
CURTIS RD	DEPOT RD	231' N OF TURNPIKE RD	69	Gravel blading & Routine Drain
CURTIS RD	231' N OF TURNPIKE RD	TURNPIKE RD	100	Do Nothing
DAVIS RD	WEST PRINCETON RD	260' S OF WEST PRINCETON	48	BaseRehab Local
DAVIS RD	260' S OF WEST PRINCETON	1370' N OF SPRUCE ST	82	Gravel blading & Routine Drain
DAVIS RD	1370' N OF SPRUCE ST	SPRUCE ST	35	BaseRehab Local
DAVIS RD	SPRUCE ST	1143' S OF SPRUCE ST	86	RoutineMaint CrSl or Patch

DAVIS RD	1143' S OF SPRUCE ST	HARRINGTON RD	78	PrevMaint Chipseal
DAVIS RD	HARRINGTON RD	1725' N OF LANES RD	88	RoutineMaint CrSl or Patch
DAVIS RD	1725' N OF LANES RD	LANES RD	86	RoutineMaint CrSl and Patch
DAWLEY RD	ACADEMY HILL RD	SOUTH ST	48	BaseRehab Local
DEAN HILL RD	ASHBURNHAM RD	LAWS RD	33	BaseRehab Local
DEAN HILL RD	LAWS RD	1823' E OF LAWS RD	26	BaseRehab Local
DEAN HILL RD	1823' E OF LAWS RD	FITCHBURG TOWN LINE	52	BaseRehab Local
DEPOT RD	RT 2	TURNPIKE RD	73	PrevMaint Prep/Dbchchip
DEPOT RD	TURNPIKE RD	STATE RD EAST	39	BaseRehab A/C
EAST GARDNER RD	NORTH COMMON RD	OAKMONT AV	77	PrevMaint Chipseal
EAST GARDNER RD	OAKMONT AV	GATE ENTRANCE	74	PrevMaint Chipseal
EAST RD	NARROWS RD	1078' S OF NARROWS RD	88	RoutineMaint CrSl or Patch
EAST RD	1078' S OF NARROWS RD	49' N OF STONE HILL RD	88	RoutineMaint CrSl or Patch
EAST RD	49' N OF STONE HILL RD	LAUREL LA	77	PrevMaint Prep/Dbchchip
EAST RD	LAUREL LA	95' S OF GATEHOUSE RD	87	RoutineMaint CrSl or Patch
EAST RD	95' S OF GATEHOUSE RD	WORCESTER RD	60	Base Rehab - Gravel
EATON ST	MAIN ST	DEAD END	63	Struct Imprmt LO
EDRO ISLE	LAURIE LANE	END	94	Do Nothing
ELLIOT ST	MAIN ST	BACON ST	86	RoutineMaint CrSl or Patch
ELLIS RD	KNOWER RD	550' W OF CARTER RD	77	PrevMaint Prep/Dbchchip
ELLIS RD	550' W OF CARTER RD	LAKE DR WEST	76	PrevMaint Prep/Dbchchip
ELLIS RD	LAKE DR WEST	400' W OF LAKE DR WEST	86	RoutineMaint CrSl or Patch
ELLIS RD	400' W OF LAKE DR WEST	PARTRIDGE HILL RD	77	PrevMaint Prep/Dbchchip
ELLIS RD	PARTRIDGE HILL RD	1712' W OF PARTRIDGE HILL	51	BaseRehab Local
ELLIS RD	1712' W OF PARTRIDGE HILL	940' E OF MINOTT RD	56	BaseRehab Local
ELLIS RD	940' E OF MINOTT RD	MINOTT RD	54	BaseRehab Local
ELM ST	LOVELL ST	HOWARD AV	54	BaseRehab Local
FENNO DR	WEST MAIN ST	CUL-DE-SAC	90	RoutineMaint CrSl or Patch
FITCHBURG RD	PRINCETON TOWN LINE	NOTOWN RD	89	RoutineMaint CrSl or Patch
FITCHBURG RD	NOTOWN RD	FITCHBURG TOWN LINE	88	RoutineMaint CrSl or Patch
FOSTER ST	DAWLEY RD	ACADEMY HILL RD	54	BaseRehab Local
FRED SMITH RD	ASHBURNHAM RD	2151' E OF ASHBURNHAM RD	35	BaseRehab Local
FRED SMITH RD	2151' E OF ASHBURNHAM RD	3000' E OF ASHBURNHAM RD	50	Base Rehab - Gravel
FRED SMITH RD	3000' E OF ASHBURNHAM RD	DEAN HILL RD	83	Gravel blading & Routine Drain
FROG HOLLOW RD	CARTER RD	625' S OF CARTER RD	88	RoutineMaint CrSl or Patch
FROG HOLLOW RD	625' S OF CARTER RD	1350' N OF SOUTH ST	50	Base Rehab - Gravel
FROG HOLLOW RD	1350' N OF SOUTH ST	SOUTH ST	83	Gravel blading & Routine Drain
GATEHOUSE RD	EAST RD	WORCESTER RD	88	RoutineMaint CrSl or Patch
GOODRIDGE DR	SHADY AV	DEAD END	88	RoutineMaint CrSl or Patch
HAGER PARK RD	STATE RD EAST	NARROWS RD	65	Struct Imprmt A/C w/ mill
HAGER PARK RD	NARROWS RD	WORCESTER RD	89	RoutineMaint CrSl or Patch
HANKS HILL RD	STONEHILL RD	DEAD END	52	BaseRehab Local
HARRINGTON RD	SOUTH ST	350' W OF DAVIS ST	51	BaseRehab Local
HARRINGTON RD	350' W OF DAVIS ST	DAVIS ST	88	RoutineMaint CrSl or Patch
HOWARD AV	SMITH AV	DEAD END	60	BaseRehab Local
HOWARD RD	BATHERICK RD	DEAD END	44	Base Rehab - Gravel
HY RD	EAST RD	VAL RD	88	RoutineMaint CrSl or Patch
HY RD	VAL RD	CUL DE SAC	84	PrevMaint Chipseal
KENDALL CT	FENNO DR	FENNO DR	100	Do Nothing
KENT RD	GATEHOUSE RD	DEAD END	88	RoutineMaint CrSl or Patch
KIRALI CT	SOUTH ASHBURNHAM RD	CUL-DE-SAC	95	Do Nothing
KNOWER RD	ELLIS RD	CARTER RD	78	PrevMaint Chipseal
KNOWER RD	CARTER RD	1915' S OF CARTER RD	51	BaseRehab Local
KNOWER RD	1915' S OF CARTER RD	CROSS RD	41	BaseRehab Local
KNOWER RD	CROSS RD	MINOTT RD	63	Struct Imprmt LO
KNOWER RD	MINOTT RD	HUBBARDSTON TOWN LINE	48	BaseRehab Local
KURIKKA RD	MINOTT RD	DEAD END	44	BaseRehab Local

LANES RD	WEST PRINCETON RD	400' E OF DAVIS RD	55	BaseRehab Local
LANES RD	400' E OF DAVIS RD	DAVIS RD	98	Do Nothing
LANES RD	DAVIS RD	HUBBARDSTON TOWN LINE	100	Do Nothing
LAURIE LN	PATRICIA RD	CUL-DE-SAC	95	Do Nothing
LAWS RD	ASHBURNHAM RD	DEAN HILL RD	36	BaseRehab Local
LEOMINSTER ST	MAIN ST	MAIN ST	90	RoutineMaint CrSl or Patch
LOVELL ST	MAIN ST	DEAD END	65	Struct Imprmt LO
MAIN ST	WEST MAIN ST	SOUTH ST	78	PrevMaint Chipseal
MAIN ST	SOUTH ST	STATE RD EAST	77	PrevMaint Chipseal
MARK NEWTON RD	NEWTON RD	CUL DE SAC	88	RoutineMaint CrSl or Patch
MARSHALL HILL RD	LEOMINSTER STREET	167' E OF LEOMINSTER ST	100	Do Nothing
MARSHALL HILL RD	167' E OF LEOMINSTER ST	HOUSE #17	34	BaseRehab Local
MARSHALL HILL RD	HOUSE #17	WORCESTER RD	52	BaseRehab Local
MEETINGHOUSE RD	SOUTH ST	CUL-DE-SAC	65	Struct Imprmt LO
MERRIAM RD	STATE RD EAST	STATE RD EAST	53	BaseRehab Local
MILE HILL RD	PRINCETON TOWN LINE	BOLTON RD	74	PrevMaint Chipseal
MILE HILL RD	BOLTON RD	WORCESTER RD	84	PrevMaint Chipseal
MILES AV	RIDGE ST	NORWOOD ST	99	Do Nothing
MINOTT RD	SOUTH ST	KNOWER RD	50	BaseRehab A/C
MINOTT RD	KNOWER RD	3000' W OF KNOWER RD	56	BaseRehab A/C
MINOTT RD	3000' W OF KNOWER RD	NEWTON RD	67	Struct Imprmt A/C
MINOTT RD	NEWTON RD	1988' W OF NEWTON RD	54	BaseRehab A/C
MINOTT RD	1988' W OF NEWTON RD	2117' W NEWTON RD	88	RoutineMaint CrSl or Patch
MINOTT RD	2117' W NEWTON RD	WHITNEY ST	77	PrevMaint Chipseal
MINOTT RD	WHITNEY ST	GARDNER TOWN LINE	76	PrevMaint Prep/Dbldchip
MOSSMAN RD	OAKMONT AV	EAST GARDNER RD	100	Do Nothing
NARROWS RD	HAGER PARK RD	1033' E OF HAGER PARK RD	56	BaseRehab A/C
NARROWS RD	1033' E OF HAGER PARK RD	840' W OF WYMAN RD	57	BaseRehab A/C
NARROWS RD	840' W OF WYMAN RD	EAST RD	55	BaseRehab A/C
NARROWS RD	EAST RD	340' W OF STONEHILL RD	32	BaseRehab A/C
NARROWS RD	340' W OF STONEHILL RD	1313' S OF RT 2	50	BaseRehab A/C
NARROWS RD	1313' S OF RT 2	RT 2	85	PrevMaint Chipseal
NEEDHAM RD	SOUTH ASHBURNHAM RD	ASHBURNHAM TOWN LINE	52	BaseRehab Local
NEWCOMB RD	STATE RD EAST	#33 or 2100' N STATE RD E	66	Struct Imprmt LO
NEWCOMB RD	#33 or 2100' N STATE RD E	BATHERICK RD	45	BaseRehab Local
NEWTON RD	MINOTT RD	HUBBARDSTON TOWN LINE	56	BaseRehab Local
NICHOLS ST	MAIN ST	SMITH ST	61	Struct Imprmt LO w/ mill
NICHOLS ST	SMITH ST	KNOWER RD	52	BaseRehab Local
NORTH COMMON RD	OVERLOOK RD	OAKMONT AV	52	BaseRehab A/C
NORTH COMMON RD	OAKMONT AV	TOWN FARM RD	76	PrevMaint Prep/Dbldchip
NORTH COMMON RD	TOWN FARM RD	EAST GARDNER RD	88	RoutineMaint CrSl or Patch
NORTH COMMON RD	EAST GARDNER RD	OAKMONT AV	23	BaseRehab Local
NORWOOD ST	MILES AV	RIDGE ST	99	Do Nothing
NOTOWN RD	NARROWS RD	2500' E OF NARROWS RD	60	BaseRehab Local
NOTOWN RD	2500' E OF NARROWS RD	FITCHBURG RD	60	BaseRehab Local
OAKMONT AV	NORTH COMMON RD	325' N OF NORTH COMMON RD	51	BaseRehab A/C
OAKMONT AV	325' N OF NORTH COMMON RD	928' N OF NORTH COMMON RD	78	PrevMaint Prep/Dbldchip
OAKMONT AV	928' N OF NORTH COMMON RD	EAST GARDNER RD	78	PrevMaint Prep/Dbldchip
OAKMONT AV	EAST GARDNER RD	MOSSMAN RD	87	RoutineMaint CrSl or Patch
OAKMONT AV	MOSSMAN RD	SOUTH ASHBURNHAM RD	75	PrevMaint Prep/Dbldchip
OAKWOOD CT	WOODLAND DR	CUL-DE-SAC	95	Do Nothing
OLD COUNTY RD	ELLIS RD	1025' N OF ELLIS RD	52	BaseRehab Local
OLD COUNTY RD	1025' N OF ELLIS RD	DEAD END	98	Do Nothing
OLD GARDNER RD	WHITMANVILLE RD	CUL DE SAC	63	BaseRehab Local
OLD HUBBARDSTON RD	SOUTH ST	SPRUCE ST	55	BaseRehab Local
OLD TOWN FARM RD	TOWN FARM RD	100' N OF CUL DE SAC	88	RoutineMaint CrSl or Patch
OLD TOWN FARM RD	100' N OF CUL DE SAC	CUL DE SAC	56	BaseRehab Local

OLD WORCESTER RD	MARSHALL HILL RD	WORCESTER RD	39	BaseRehab Local
OVERLOOK RD	NORTH COMMON RD	25' N OF SIMPLEX DR	43	BaseRehab Local
OVERLOOK RD	25' N OF SIMPLEX DR	2250' N OF SIMPLEX DR	53	BaseRehab Local
OVERLOOK RD	2250' N OF SIMPLEX DR	3410' N OF SIMPLEX DR	62	Struct Imprmt LO
OVERLOOK RD	3410' N OF SIMPLEX DR	4955' N OF SIMPLEX DR	47	BaseRehab Local
OVERLOOK RD	4955' N OF SIMPLEX DR	GATE ENTRANCE	30	BaseRehab Local
PARK ST	MILES AV	DEAD END	99	Do Nothing
PARTRIDGE HILL RD	ELLIS RD	CUL-DE-SAC	73	PrevMaint Prep/Dbldchip
PATRICIA RD	WORCESTER RD	LAURIE LN	95	Do Nothing
PIERCE RD	SOUTH ASHBURNHAM RD	SOUTH ASHBURNHAM RD	69	Gravel blading & Routine Drain
PLEASANT ST	MAIN ST	BACON ST	42	BaseRehab Local
POTATO HILL RD	ASHBURNHAM RD	376' W OF ASHBURNHAM RD	100	Do Nothing
POTATO HILL RD	376' W OF ASHBURNHAM RD	BEAN PORRIDGE HILL RD	100	Do Nothing
RAYMOND RD	NEWCOMB RD	DEAD END	83	Gravel blading & Routine Drain
RIDGE ST	STATE RD WEST	NORWOOD ST	100	Do Nothing
RIPLEY RD	NICHOLS ST	DEAD END	53	BaseRehab Local
ROPER RD	SOUTH ASHBURNHAM RD	25' E OF WEST HILL DR	77	PrevMaint Chipseal
ROPER RD	25' E OF WEST HILL DR	459' W OF FITCHBURG TN LN	29	BaseRehab Local
ROPER RD	459' W OF FITCHBURG TN LN	FITCHBURG TOWN LINE	83	Gravel blading & Routine Drain
SARGENT RD	CUL-DE-SAC	BEECH HILL RD	100	Do Nothing
SARGENT RD	BEECH HILL RD	COLONY RD	100	Do Nothing
SARGENT RD	COLONY RD	250' S OF WEST MAIN ST	49	BaseRehab Local
SARGENT RD	250' S OF WEST MAIN ST	COLONY RD	100	Do Nothing
SCENIC DR	WEST MAIN ST	CUL-DE-SAC	86	RoutineMaint CrSl and Patch
SEAVER ST	LEOMINSTER ST	MAIN ST	94	Do Nothing
SHADY AV	STATE RD WEST (W)	767' W OF GOODRIDGE DR	72	Struct Imprmt LO
SHADY AV	767' W OF GOODRIDGE DR	STATE RD WEST (E)	53	BaseRehab Local
SIMPLEX DR	WEST MAIN ST	160' N OF WEST MAIN ST	98	Do Nothing
SIMPLEX DR	160' N OF WEST MAINST	525' N OF WEST MAINST	51	BaseRehab Local
SIMPLEX DR	525' N OF WEST MAIN ST	SIMPLEX PROPERTY	69	Struct Imprmt LO
SMITH AV	NICHOLS ST	LOVELL ST	56	BaseRehab Local
SOUTH ASHBURNHAM RD	STATE RD EAST	BEAN PORRIDGE HILL RD	89	RoutineMaint CrSl or Patch
SOUTH ASHBURNHAM RD	WEST HILL DR	WOODLAND DR	76	PrevMaint Chipseal
SOUTH ASHBURNHAM RD	WOODLAND DR	BEAN PORRIDGE HILL RD	94	Do Nothing
SOUTH ASHBURNHAM RD	BEAN PORRIDGE HILL RD	WHITMANVILLE RD	76	PrevMaint Chipseal
SOUTH ASHBURNHAM RD	WHITMANVILLE RD	ASHBURNHAM TOWN LINE	94	Do Nothing
SOUTH ST	LEOMINSTER ST	705' S OF CARTER RD	47	BaseRehab A/C
SOUTH ST	705' S OF CARTER RD	2660' N OF SPRUCE ST	87	RoutineMaint CrSl or Patch
SOUTH ST	2660' N OF SPRUCE ST	OLD HUBBARDSTON RD	51	BaseRehab A/C
SOUTH ST	OLD HUBBARDSTON RD	MINNOTT RD	64	Struct Imprmt A/C
SOUTH ST	MINNOTT RD	5691' N OF HUBBARDSTON TL	88	RoutineMaint CrSl or Patch
SOUTH ST	5691' N OF HUBBARDSTON TL	HUBBARDSTON TOWN LINE	87	RoutineMaint CrSl or Patch
SPRING ST	STATE RD WEST	RIDGE ST	95	Do Nothing
SPRUCE ST	SOUTH ST	DAVIS RD	63	BaseRehab Local
STONEHILL RD	NARROWS RD	EAST RD	75	PrevMaint Prep/Dbldchip
SUNSET RD	SHADY AV	CUL-DE-SAC	57	BaseRehab Local
SYD SMITH RD	NORTH COMMON RD	DEAD END	34	BaseRehab Local
TAYMAX RD	WOODLAND DR	CUL-DE-SAC	98	Do Nothing
TOMMY FRANCIS RD	SOUTH ASHBURNHAM RD	SOUTH ASHBURNHAM RD	100	Do Nothing
TOWN FARM RD	STATE RD EAST	BATHERICK RD	33	BaseRehab Local
TOWN FARM RD	BATHERICK RD	518' S OF NORTH COMMON RD	27	BaseRehab Local
TOWN FARM RD	518' S OF NORTH COMMON RD	NORTH COMMON RD	56	BaseRehab Local
TURNPIKE RD	WILLARD RD	925' E OF WILLARD RD	94	Do Nothing
TURNPIKE RD	925' E OF WILLARD RD	DEPOT RD	99	Do Nothing
TURNPIKE RD	DEPOT RD	585' E OF CURTIS RD	89	RoutineMaint CrSl or Patch
TURNPIKE RD	585' E OF CURTIS RD	FITCHBURG TOWN LINE	37	BaseRehab Local
VAL RD	EAST RD	HY RD	55	BaseRehab Local

VILLAGE INN RD	WYMAN RD	800' W OF RT 2 RAMPS	83	PrevMaint Chipseal
VILLAGE INN RD	800' W OF RT 2 RAMPS	NARROWS RD	74	PrevMaint Prep/Dbldchip
VIRGINIA AVE	EDRO ISLE	EDRO ISLE	80	Gravel blading & Routine Drain
WACHUSETT DR	EAST RD	CUL-DE-SAC	69	Struct Imprmt LO
WASHINGTON DR	PATRICIA RD	CUL-DE-SAC	66	Struct Imprmt LO
WEST MAIN ST	MAIN ST	860' E OF WILSON DR	87	RoutineMaint CrSl or Patch
WEST MAIN ST	860' E OF WILSON DR	111' W OF FENNO DR	94	Do Nothing
WEST MAIN ST	111' W OF FENNO DR	57' W OF SCENIC DR	99	Do Nothing
WEST MAIN ST (EB)	GARDNER TOWN LINE	BETTY SPRING RD	100	Do Nothing
WEST MAIN ST (EB)	BETTY SPRING RD	228' W OF SIMPLEX DR	100	Do Nothing
WEST MAIN ST (EB)	228' W OF SIMPLEX DR	1144' E OF SIMPLEX DR	100	Do Nothing
WEST MAIN ST (WB)	57' W OF SCENIC DR	228' W OF SIMPLEX DR	100	Do Nothing
WEST MAIN ST (WB)	228' W OF SIMPLEX DR	GARDNER TOWN LINE	100	Do Nothing
WEST PRINCETON RD	WORCESTER RD	DAVIS RD	85	PrevMaint Chipseal
WEST PRINCETON RD	DAVIS RD	1100' S OF DAVIS RD	77	PrevMaint Prep/Dbldchip
WEST PRINCETON RD	1100' S OF DAVIS RD	2800' N OF BOLTON RD	86	RoutineMaint CrSl or Patch
WEST PRINCETON RD	2800' N OF BOLTON RD	31' S OF BOLTON RD	74	PrevMaint Prep/Dbldchip
WEST PRINCETON RD	31' S OF BOLTON RD	180' S OF LANES RD	66	Struct Imprmt LO
WEST PRINCETON RD	180' S OF LANES RD	600' N OF NORTH LA	38	Base Rehab - Gravel
WEST PRINCETON RD	600' N OF NORTH LA	2178' N OF PRINCETON TL	70	Gravel blading & Routine Drain
WEST PRINCETON RD	2178' N OF PRINCETON TL	1539' N OF PRINCETON TL	53	Base Rehab - Gravel
WEST PRINCETON RD	1539' N OF PRINCETON TL	PRINCETON TOWN LINE	70	Gravel blading & Routine Drain
WHITMAN TRAIL	TOMMY FRANCIS RD	CUL-DE-SAC	100	Do Nothing
WHITMANVILLE RD	SOUTH ASHBURNHAM RD	DEAD END	30	BaseRehab Local
WHITNEY ST	MINOTT RD	GARDNER TOWN LINE	87	RoutineMaint CrSl or Patch
WILLARD RD	CUL-DE-SAC	100' N OF WYMAN RD	80	PrevMaint Chipseal
WILLARD RD	100' N OF WYMAN RD	600' W OF DEPOT RD	36	BaseRehab Local
WILLARD RD	600' W OF DEPOT RD	DEPOT RD	81	PrevMaint Chipseal
WILSON DR	WEST MAIN ST	CUL-DE-SAC	77	PrevMaint Chipseal
WOODLAND DR	SOUTH ASHBURNHAM RD	SOUTH ASHBURNHAM RD	94	Do Nothing
WOODS RD	BARREL RD	ASHBURNHAM TOWN LINE	34	Base Rehab - Gravel
WORCESTER RD	LEOMINSTER ST	HAGER PARK RD	95	Do Nothing
WORCESTER RD	HAGER PARK RD	700' S OF PATRICIA RD	88	RoutineMaint CrSl or Patch
WORCESTER RD	700' S OF PATRICIA RD	PRINCETON TOWN LINE	71	Struct Imprmt A/C
WYMAN RD	NARROWS RD	RT 2	87	RoutineMaint CrSl or Patch
WYMAN RD	RT 2	WILLARD RD	88	RoutineMaint CrSl or Patch



# Appendix B

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Glossary ■

# Glossary of Terms

**BASE INDEX (BI):** an index derived from controlled measurements and evaluations of condition survey distresses attributed to the underlying unbound base and subbase materials, and is manifested as potholes & non-utility patching, alligator cracking, distortions, and rutting. It is a rating established as an indicator of asphalt materials quality and performance on a scale from 0 to 100, with 100 being excellent.

**BENEFIT VALUE (BV):** a value computed by RoadManager™ at the time it determines the most beneficial recommended repair for a particular road section. The benefit value formula is:

$$BV = \frac{ADT \times \text{Estimated Repair Life}}{\text{Repair Unit Cost} \times \text{Condition Index}}$$

Where BV = benefit value, ADT = average daily traffic, and Condition Index = the condition index for the particular road section for the type of work being done (PCI, DCI, UCI).

**CAPITAL REPAIRS:** capital repairs are extensive and costly repairs such as Structural Improvement and Base Rehabilitation work.

**DEDUCT VALUES:** a value representing the penalty assessed for each identified distress used in the calculation of the Pavement Condition Index. Each distress has multiple severity and extent levels, with a specific deduct value at each level. Deduct values may be modified for all nine pavement distress types. The deduct value is ultimately subtracted from a perfect pavement condition of 100.

**DEFICIENCY:** an indication of poor or unfavorable pavement performance or signs of impending failure; or any unsatisfactory performance of a pavement short of failure.

**DETERIORATION RATE:** a rate that predicts of the anticipated change in a roadway's condition over time.

**DISTRESS:** a physical defect in a pavement system which can be observed and quantified through visual inspection of the roadway surface. Broad categories include cracking, patching, depressions, and surface wear.

**DRAINAGE CONDITION INDEX (DCI):** an index derived from controlled measurements and evaluations of pavement surface drainage deficiencies and conditions. It is a serviceability rating established for determining the present stature or performance of the drainage features on a scale from 0 to 100, with 100 being excellent.

**FAILURE:** the unsatisfactory performance of a pavement or portion such that it can no longer serve its intended purpose.

**FUNCTIONAL CLASSIFICATION:** road functional classification places all streets and roads in the network into one of three general categories - arterial, collector, or local - according to vehicular volume, roadway geometry, and traffic characteristics.

**GRADE:** a measure of the steepness of a slope, expressed as a percentage. One percent slope has one foot of elevation change in one hundred feet of horizontal distance.

**MAINTENANCE:** anything done to the pavement after original construction short of complete reconstruction, excluding shoulders and bridges.

**NETWORK LEVEL:** an assessment of conditions and/or program needs across the entire roadway system encompassed by the roadway management study.

**PAVEMENT CONDITION INDEX (PCI):** an index derived from established measurements of pavement surface condition distress or deficiencies. It is a serviceability rating established under controlled conditions having a scale of 0 to 100, with 100 being excellent.

**PAVEMENT MANAGEMENT (PM):** is the effective and efficient directing of the various activities involved in providing and sustaining pavements in a condition acceptable to the traveling public at the lowest life-cycle cost.

**PAVEMENT MANAGEMENT SYSTEM (PMS):** an established, documented procedure treating many or all of the Pavement Management activities in a systematic and coordinated manner. It consists of five essential elements structured to serve decision-making responsibilities at various management levels.

1. Pavement surveys related to condition and serviceability;
2. Database containing all pavement-related information;
3. Analysis scheme;
4. Decision criteria;
5. Implementation procedures.

**PAVEMENT PERFORMANCE:** the assessment of how well the pavement serves the user over time. The engineer often associates pavement condition with an arbitrary, but quantifiable, value relating to pavement roughness, pavement distress, or

pavement strength. Performance is the measured change of condition and/or serviceability over increments of time.

**PAVEMENT TYPES:** RoadManager™ assigns an unlimited number of pavement types, including bituminous concrete, surface treated, gravel, Portland Cement concrete, and composite, to the streets and roads. Pavement types serve to inform pavement engineers of the operating condition of the street, and provide a meaningful communication tool when engineering judgment is required to select possible rehabilitation alternatives. “Surface treated” designates a road surface and pavement structure that evolves over time. Generally, this type of surface starts as a dirt road, then is built up over time with a series of sand seals and stone seals. Conversely, a “bituminous concrete” roadway is typically engineered with a pavement structure designed to withstand predicted traffic volumes. The roadway usually has a gravel base, a binder course, and an asphalt wearing surface. The “composite” surface type is used to describe a bituminous concrete roadway that has a Portland Cement concrete base.

**PREVENTIVE MAINTENANCE:** activities performed at planned intervals to protect and seal the pavement. Seals are designed to provide one or more of the following benefits:

1. Prevent the intrusion of air and moisture;
2. Fill small cracks and voids;
3. Rejuvenate an oxidized binder;
4. Provide a new wearing surface.

**PROJECT LEVEL:** a detailed assessment or identification of needs relative to a specific roadway, or a section thereof, as opposed to network level applications. It may include on site pavement testing, lab evaluation, life cycle cost analysis, and treatment recommendation for the particular pavement section.

**RECONSTRUCTION:** the complete removal and replacement of a failed pavement, which might also involve widening, realignment, traffic control devices, safety hardware, and major base and drainage work.

**REHABILITATION:** any work needed to restore the pavement to a condition that will allow it to perform satisfactorily for several years. Rehabilitation also includes the work necessary to prepare the pavement for an overlay. The major activities involved in the rehabilitation process are:

1. Partial depth patching;
2. Full depth patching;
3. Joint and crack sealing.
4. Grouting and undersealing (filling voids);
5. Grinding and milling (removal of high spots in the pavement.);
6. Overlays.

**REPAIR STRATEGIES:** RoadManager™ represents repair strategies a table of user defined "if, then" statements used in the RoadManager™ application. The recommended repairs are based on seven decision factors: PCI range, Base Index, Surface Index, Functional Classification, Surface Type, Utility Index, and Drainage Index. These conditions input into the repair strategy table represent the various conditions for each decision factor.

**REPAIR TYPES:** the various choices of treatment available for providing a solution to a pavement deficiency or problem. The associated repair type cost is based on a locality's past experience.

**RIDEABILITY INDEX (RI):** a measure of the smoothness of a pavement, (traveled surface) as perceived by the public traveling in a vehicle at a speed appropriate for the particular surface. It is a serviceability rating having a scale of 0 to 100, with 100 being excellent. A controlled measurement of longitudinal profile pavement surface condition distress or deficiencies can be made using a profilometer and can be correlated to a roughness scale.

**ROADSIDE MAINTENANCE INDEX (RMI):** an index derived from evaluations of required roadside maintenance activity levels, such as mowing, litter collection, overhanging branches, and sand residue from plowing operations. It is a rating established for determining the present status or relative condition of the roadside maintenance, and is measured on a scale of 0 to 100, with 100 being excellent.

**ROADWAY MANAGEMENT SYSTEM:** a system having all the database attributes of a pavement management system as defined above, along with recording additional inventory and condition data on a range of roadside elements. These additions to the management system database may include drainage features, utilities, traffic signs, pavement markings, sidewalks, pedestrian ramps and other road related elements within the right of way. Because the roadway management system has common locating and identifying fields for each roadside element, the database can be comprehensively evaluated for system wide planning and management.

**ROUTINE MAINTENANCE:** activities performed or steps taken to correct a specific pavement failure or area distress. Routine maintenance usually addresses localized pavement defects and includes activities such as:

1. Full depth patching;
2. Skin patching;
3. Crack sealing.

**SIDEWALK CONDITION INDEX (SCI):** an index derived from controlled measurements and evaluations of sidewalk and/or walkway and/or pedestrian ramp deficiencies and conditions. It is a serviceability rating established for determining the present status or performance of sidewalks and pedestrian ramps, and is measured on a scale of 0 to 100, with 100 being excellent.

**SURFACE INDEX (SI):** an index derived from controlled measurements and evaluations of the pavement condition survey distresses attributed to such asphalt mixture and material components as: surface wear/raveling, corrugations, shoving/slippage, bleeding, and polished aggregate. It is a rating established as an indicator of asphalt materials quality and performance on a scale from 0 to 100, with 100 being excellent.

**THRESHOLDS:** values that define various condition index ranges used in the determination of recommended repairs. These thresholds identify PCI ranges from 1 to 5, with 5 representing optimal conditions and 1 representing complete reconstruction.

**TRAFFIC CONTROL INDEX (TCI):** an index derived from factors pertaining to traffic control measures such as traffic signs and signals, lighting, and other warning devices. It is a rating established for determining the performance of the roadway as it relates to traffic control, and is measured on a scale of 0 to 100, with 100 being excellent.

**TRAFFIC SAFETY INDEX (TSI):** an index derived from measurements and evaluations of stopping sight distance, horizontal and vertical curves, accident data, geometry and other factors which may affect the public safety while traveling on the roadway. It is a rating established for determining the performance of the roadway as it relates to safety, and is measured on a scale of 0 to 100, with 100 being excellent.

**UTILITY CONDITION INDEX (UCI):** an index derived from controlled measurements and evaluations of utility patches and utility structure conditions in the pavement surface area. It is a serviceability rating established for determining the present status or performance of the utility features on a scale from 0 to 100, with 100 being excellent.

# Appendix C

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Repair Alternative Costs ■

<b>Code</b>	<b>Description</b>	<b>Unit Cost (/SY)</b>
BCBRSI	Reclamation w/ 50% Concrete Sidewalk Replacement	\$27.50
BCBRAC	Reclamation of a Major Road	\$18.40
BCBRLO	Reclamation of a Local Road	\$16.70
BCSIAC	Overlay of a Major Road	\$10.90
BCSIAM	Mill and Overlay of a Major Road	\$12.20
BCSILO	Overlay of a Local Road	\$9.90
BCSILM	Mill and Overlay of a Local Road	\$11.20
BCPMBB	Double Chip Seal w/ 1/2" leveling	\$5.10
BCPMGB	Single Chip Seal	\$3.40
BCRMBB	Crackseal & Local Base Repair	\$1.50
BCRMGB	Crack Seal	\$0.40