

**TOWN OF PLYMOUTH CAPITAL IMPROVEMENT PLAN REQUEST
FY27 SPRING ANNUAL TOWN MEETING**

Department: Engineering Div. DPW	Priority #:	1
Project Title and Description: Roadway Improvement Program & Preservation	Total Project Cost:	\$6,000,000.00

Department/Division Head: Richard Bosse, P.E. - Acting Town Engineer

Check if project is: New ☒ Resubmitted ☐ **Cost estimate was developed:** Internally ☒ Externally ☐

For project re-submittals, list prior year(s):

List any funding sources and amounts already granted: _____

Basis of Estimated Costs (attach additional information if available)			If project has impact on 5 Year Plan and future operating budgets, insert estimated amounts.		
Capital:	Cost	Comments	Fiscal Year:	Capital	Operations & Maintenance
Planning and Design			FY28	\$6,000,000.00	
Labor and Materials	\$6,000,000.00		FY29	\$6,000,000.00	
Administration			FY30	\$6,000,000.00	
Land Acquisition			FY31	\$6,000,000.00	
Equipment			FY32	\$6,000,000.00	
Other					
Contingency					
Total Capital					

Project Justification and Objective: See attached narrative: _____

For Capital Project Requests:

Will this project be phased over more than one fiscal year? If yes, enter it on the 5 Year Plan Yes ☐ No ☒
Can this project be phased over more than one fiscal year? Yes ☐ No ☒

For Capital Equipment Requests:

☐ Check if equipment requested is replacement and enter the year, make & model, VIN and present condition of existing equipment

What is the expected lifespan of this new/replacement equipment: _____

Attach backup information, estimates, or justification to support this request.

As part of the Town's annual roadway improvement program, these funds will be used to improve and preserve roads identified in the pavement management program prepared by BETA Engineering.

The requested \$6,000,000.00 would be divided, 75% for Public Roadways (\$4,500,000.00) and 25% for Un-Accepted Private Roadways (\$1,500,000.00).

Public and Unaccepted Road and Bridge

Improvements. To see if the Town will vote to appropriate the sum of Six Million Dollars (\$6,000,000), to pay costs of improving various public and unaccepted roads, and bridges, and for the payment of all costs incidental and related thereto, including but not limited to reconstructing, resurfacing, crack sealing, drainage, engineering, sidewalks, lighting, traffic control, bridges, tree planting and landscaping and to determine whether this amount shall be raised by taxation, transfer from available funds, borrowing or otherwise; or to take any other action relative thereto.

Town of Plymouth, Massachusetts



Pavement Management Program

UPDATE REPORT

Date: January 22, 2025

Date of Inspections: Winter 2022 - 2023

Town of Plymouth, Massachusetts



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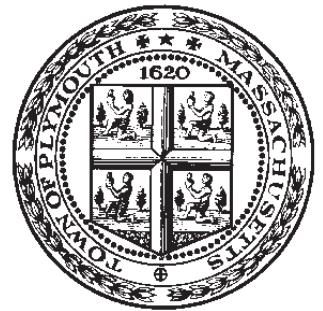
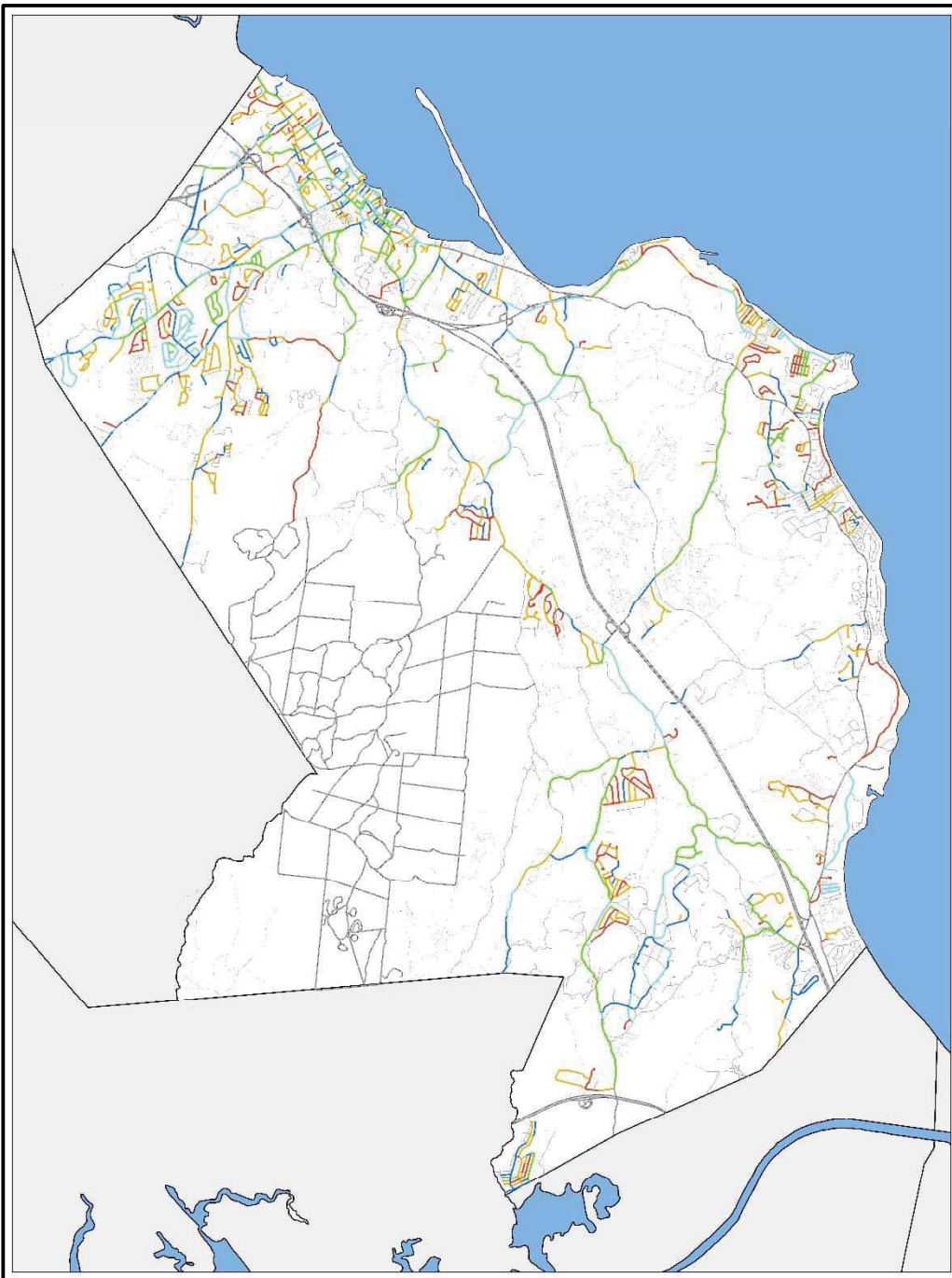
Maps

- *Roadway Ratings and Repair Options - Accepted Roadways (36"x48")*
- *Roadway Ratings and Repair Options - Unaccepted Roadways (36"x48")*
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Pavement Management Summary of Findings

Date: January 22, 2025

Date of Inspections: Winter 2022 - 2023



**Town of
Plymouth,
Massachusetts**

Introduction

Background

The Town of Plymouth, Massachusetts retained BETA Group, Inc. (BETA) in 2024 to provide an update to the Town's current Pavement Management Program (PMP). BETA was originally contracted by the Town in 2015 to develop the program and has been providing support services since, including multiple rounds of pavement reinspections. The PMP is a planning tool intended to provide the foundation to manage the Town's roadway resources in conjunction with local institutional knowledge. Ultimately, these efforts will assist in the development of a dynamic Capital Improvement Plan for the Town's roadway network.

The Town is committed to maintaining the PMP and improving its roadway network. This will be achieved by preserving and maintaining the existing infrastructure to the greatest extent possible.



Pavement Management Approach

Pavement management is based on the theory of predicting roadway deterioration over time. This theory allows pavement managers to perform timely maintenance designed to extend the roadway's lifecycle and avoid more costly and extensive structural repairs. A key aspect of pavement management, as illustrated by the Pavement Deterioration Curve, is the recognition that roadways deteriorate in an accelerated fashion at specific times in the roadway lifecycle. Understanding this concept allows opportune decisions that yield the most cost-effective results.

Implementing a PMP involves identification of the road network, evaluation of its surface conditions, and specification of its maintenance practices and associated repair costs. Roadway condition data is compiled to facilitate the calculation of a **Road Surface Rating (RSR)** for each street segment. This range includes a possible low value of 0 for a road characterized by a high severity of distress, and a possible maximum value of 100 for a road with no visible defects. Ultimately, the RSR value allows each roadway segment to be placed into a planning level repair category.

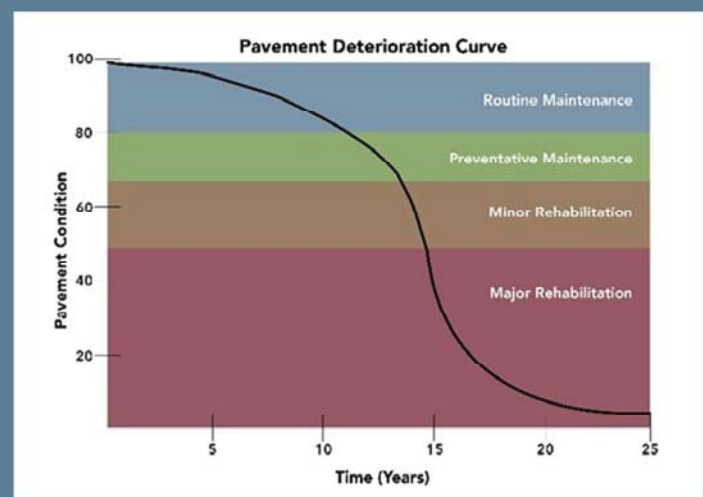


Roadway Survey

The roadway survey in Plymouth, consisting of paved, town-maintained roadways, was completed in Winter 2022/2023. A total of **303.66 centerline miles** were inspected, serving as the basis for this report. The required field inspections were performed autonomously utilizing a LiDAR sensor mounted on a vehicle. As the vehicle traveled each roadway, a 3D digital point cloud was developed and all roadway assets within a 50' radius of the Lidar sensor were scanned and populated. As part of the data collection, images were captured, georeferenced and timestamped every 30' section of roadway.

Upon completion of the field data collection, proprietary algorithms and AI machine learning technology were run to identify pavement surface distresses such as cracks, potholes, seals, patches, and pavement oxidation to generate RSRs at the segment level. BETA then conducted a thorough review to ensure the quality of the data for analysis and reporting.

Pavement Deterioration Curve





Summary of Findings

Based on the update completed in Winter 2024, the **overall Road Surface Rating for Plymouth's Town accepted roadway network was 70.54 and 64.46 for its unaccepted network**, resulting in an **overall average of 69.12**. The overall RSR represents a benchmark for performance measuring of the Town's pavement management program moving forward. If the overall RSR were to drop in the years to come, this would be a sign that the program may need to be adjusted or funding for the program may need to be reevaluated.

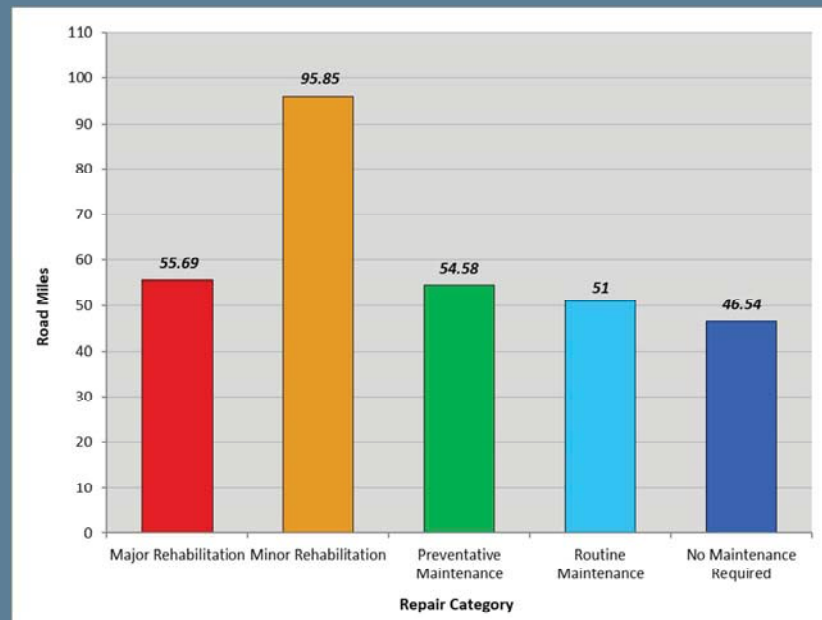
As part of the pavement management process, repair strategies and associated unit costs were defined (as shown below) to develop the Town's Estimated Roadway Improvement Costs Summary. This analysis summarizes the mileage of roadways that fall within each suggested repair category as well as the estimated cost to complete the recommended maintenance or repair. **The current improvement summary for the Town's public roadway network is approximately \$131.39 million based on current market trends.** This budgetary dollar figure represents a snapshot of the funding it would take to perform all outstanding maintenance for the town's road network within the next year. While this is not typically feasible, this analysis acts as another benchmark for the magnitude of work necessary at the time of inspections.

69.12

**CURRENT TOWN NETWORK
ROADWAY SURFACE RATING (RSR)
(January 2025)**

Repair Method	RSR Range	Unit Price* (sy)
Major Rehabilitation	0-50	\$100.00
Minor Rehabilitation	50-70	\$25.00
Pavement Preservation	70-80	\$15.00
Routine Maintenance	80-90	\$1.00
No Maintenance Required	90-100	\$0.00

RSR Breakdown by Mileage



Estimated Roadway Improvement Costs				
Repair Method	Length (Miles)	Square Yards	% Repair	Estimated Cost
Major Rehabilitation	55.69	803,269	18.34%	\$80,326,907
Minor Rehabilitation	95.85	1,463,571	31.57%	\$36,589,278
Preventative Maintenance	54.58	909,472	17.97%	\$13,624,087
Routine Maintenance	51	829,417	16.80%	\$829,417
No Maintenance Required	46.54	717,547	15.33%	\$0
Total	303.66	4,723,277	100%	\$131,369,689
AVERAGE RSR by Segment:	69.12			





Capital Planning & Concluding Remarks

A series of Cost Benefit Value (CBV) analyses were generated to serve as a tool to prioritize potential roadway projects for inclusion in a multi-year Capital Improvement Plan (CIP). The CBV considers traffic volumes, repair types and RSR to serve as a guide in the planning process. The development of a CIP will assist the town in improving its network rating over time.

A 5-year forecast model (right) was developed to demonstrate how the network-level RSR would likely adjust over time based on different funding scenarios and repair strategies. Utilizing unit prices established in the program, the model suggests that the town allocate approximately \$4.5M annually to maintain the current rating. However, if the town were to allocate \$7.5M annually, the Network RSR is projected to approach 72 in 5 years. Conversely, utilizing only the Chapter 90 apportionment of \$1.59M would likely cause the network RSR to degrade to below 66. The current model accounts for 3% annual inflation.

The PMP provides decision makers with a picture of existing roadway conditions, a cost estimate to protect those paved roadways in good condition, and a recommended strategy to meet the town's goals and objectives.

Program Maintenance

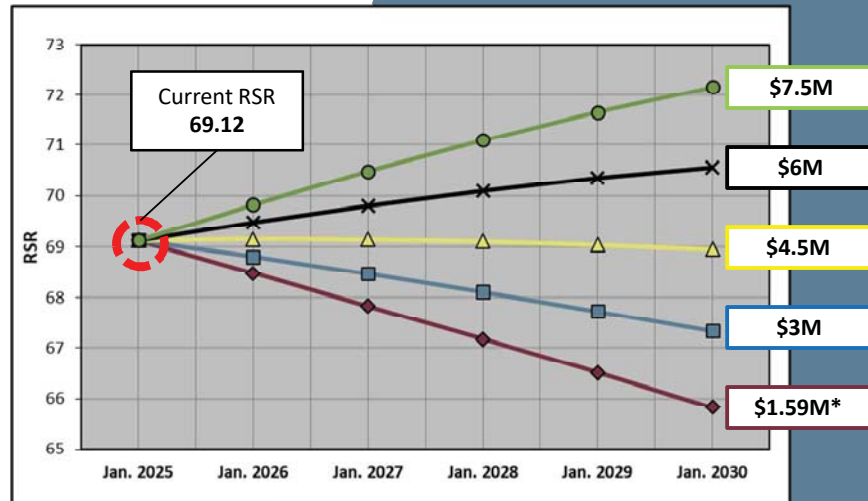
To best manage and update the Town's PMP database, the following practices are suggested:

- When utilizing pavement data to aid in capital planning, other assets such as sidewalks, utilities, etc. should be considered on a case-by-case basis.
- Post all annual roadway improvements into the database. Both the pavement condition rating and repair history information should be entered.
- Add any new roadway network descriptions to the database as soon as the town accepts the roadways.
- Update repair method unit costs annually to provide accurate work plan forecasts.
- Review developments in pavement technology that might offer a more cost-effective alternative to pavement maintenance or rehabilitation over the pavement's life cycle.
- Continue to reassess road network every 3 years to keep data and imagery current.

The Pavement Management Program will serve as a valuable instrument to the town and facilitate a progressive approach to managing roadway infrastructure.

Forecast Model

Projected RSR By Year



*Denotes FY2025 Ch. 90 Allotment

Please note: photos are from 2022 inspection



Plymouth, MA

Roadway Status Summary

Roadway Type		Length (Miles)
Town Classification: Accepted		
BC		229.01
GR		14.31
Total:		243.32
Town Classification: Unaccepted		
BC		73.72
GR		60.08
Total:		133.80
Town Classification: State		
BC		102.38
GR		47.16
UNK		1.13
Total:		150.67
Town Classification: Exclusion		
BC		71.16
GR		62.49
Total:		133.65
Total:		661.45

FY 2025 Chapter 90 Accepted Road Miles - 237.27

*State Grouping includes roads classified as State Forest

**Exclusion Grouping only includes roads classified as Private

Plymouth, MA

Roadway Repair Categories and Banding

Repair Method	Banding Low Range	Banding High Range	Unit Cost Sq.Yrd.
Major Rehabilitation			
Major Rehabilitation	0	50	\$100.00
Reconstruction			\$120.00
Reclamation			\$80.00
Minor Rehabilitation			
Minor Rehabilitation	50	70	\$25.00
Cold-In-Place Recycling - 3" HMA			\$25.00
Cold-In-Place Recycling - 3" HMA (No Structures)			\$22.00
Mill and Overlay - 2"			\$20.00
Hot-In-Place Recycling - 1" Top			\$20.00
Level and Overlay - 2.5"			\$20.00
Mill and Overlay - 1.5"			\$18.00
Preventative Maintenance			
Pavement Preservation	70	80	\$15.00
Nova Chip			\$15.00
Microsurface - Double (w/Fiber)			\$15.00
Cape Seal			\$12.00
Double Chip Seal			\$10.00
Rubber Asphalt Chip (20%)			\$10.00
Microsurface - Single Lift			\$8.00
Routine Maintenance			
Routine Maintenance	80	90	\$1.00
Fog Seal			\$1.80
Crack Seal			\$0.60
Defer Maintenance			
No Maintenance Required	90	100	\$0.00

Plymouth, MA

Estimated Roadway Improvement Costs - Overall

Repair Method	Length (Miles)	Square Yards	Percent Repair	Estimated Cost
Major Rehabilitation	55.69	803,269.08	18.34%	\$80,326,907.81
Minor Rehabilitation	95.85	1,463,571.14	31.57%	\$36,589,278.49
Pavement Preservation	54.58	909,472.46	17.97%	\$13,642,086.88
Routine Maintenance	51.00	829,417.05	16.80%	\$829,417.05
No Maintenance Required	46.54	717,547.08	15.33%	\$0.00

Total:

303.66

4,723,276.82

100.00%

\$131,387,690.23

Average RSR By Segment:

69.12

*RSR - Road Surface Rating (0-100)

Please Note: Unit pricing accounts for curb to curb improvements only; Does not include any drainage, sidewalk, ADA, gravel subbase or utility improvements.

Plymouth, MA

Estimated Roadway Improvement Costs - Accepted

Repair Method	Length (Miles)	Square Yards	Percent Repair	Estimated Cost
Major Rehabilitation	38.68	580,701.94	16.89%	\$58,070,194.35
Minor Rehabilitation	69.48	1,096,465.17	30.34%	\$27,411,629.19
Pavement Preservation	41.52	740,144.04	18.13%	\$11,102,160.59
Routine Maintenance	38.41	657,641.68	16.77%	\$657,641.68
No Maintenance Required	40.93	640,275.20	17.87%	\$0.00

Total:	229.01	3,715,228.03	100.00%	\$97,241,625.81
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Average RSR By Segment:	70.54
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*RSR - Road Surface Rating (0-100)

Please Note: Unit pricing accounts for curb to curb improvements only; Does not include any drainage, sidewalk, ADA, gravel subbase or utility improvements.

Plymouth, MA

Estimated Roadway Improvement Costs - Unaccepted

Repair Method	Length (Miles)	Square Yards	Percent Repair	Estimated Cost
Major Rehabilitation	16.32	212,835.91	22.13%	\$21,283,591.05
Minor Rehabilitation	26.38	367,105.97	35.78%	\$9,177,649.30
Pavement Preservation	13.06	169,328.42	17.72%	\$2,539,926.29
Routine Maintenance	12.59	171,775.37	17.08%	\$171,775.37
No Maintenance Required	5.37	75,898.58	7.29%	\$0.00

Total:	73.72	996,944.25	100.00%	\$33,172,942.01
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Average RSR By Segment:	64.46
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*RSR - Road Surface Rating (0-100)

Please Note: Unit pricing accounts for curb to curb improvements only; Does not include any drainage, sidewalk, ADA, gravel subbase or utility improvements.