

**TOWN OF PLYMOUTH CAPITAL IMPROVEMENT PLAN REQUEST  
FY25 SPRING ANNUAL TOWN MEETING**

<b>Department:</b> Department of Public Works	<b>Priority #:</b>	1
<b>Project Title and Description:</b> Roadway Preservation	<b>Total Project Cost:</b>	\$3,000,000.00

**Department/Division Head:** William Coyle, Director

**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
<i>Planning and Design</i>			<i>FY26</i>		
<i>Labor and Materials</i>	\$3,000,000.00		<i>FY27</i>		
<i>Administration</i>			<i>FY28</i>		
<i>Land Acquisition</i>			<i>FY29</i>		
<i>Equipment</i>			<i>FY30</i>		
<i>Other</i>					
<i>Contingency</i>					
<b>Total Capital</b>					

**Project Justification and Objective:** As part of the Town's annual roadway improvement program, these funds will be used to preserve and improve roads identified in the pavement management program as prepared by BETA Engineering along with DPW.

**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

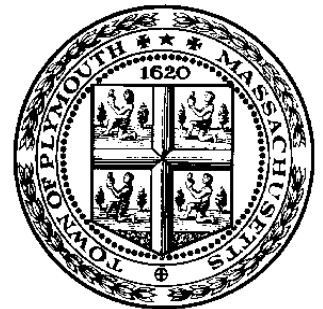
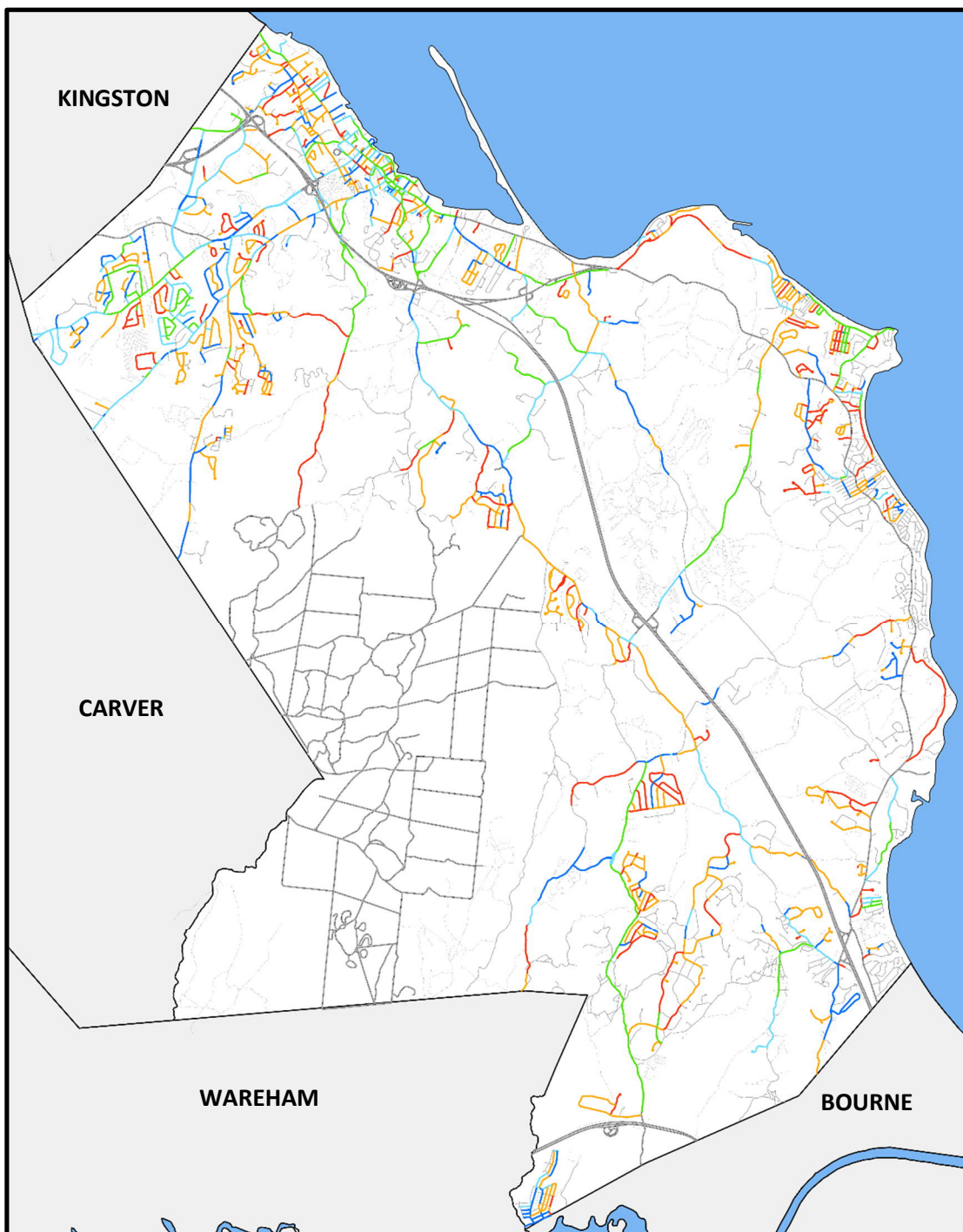
**What is the expected lifespan of this new/replacement equipment:** \_\_\_\_\_

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

# Pavement Management Summary of Findings

Date: June 27, 2023

Date of Inspections: Winter 2022 - 2023



**Town of  
Plymouth,  
Massachusetts**

# Introduction

## Background

The Town of Plymouth retained BETA Group, Inc. (BETA) to conduct a reassessment of its Town maintained roadway network as well as to continue providing pavement management services. BETA was originally hired by the Town in 2011 to develop its Pavement Management Program (PMP) which included a field evaluation of pavement conditions and has provided support services since. This comprehensive study was undertaken with the goal of establishing an extensive database of roadway surface conditions to produce a prioritized list of improvements. The Pavement Management Program (PMP) is a planning tool intended to provide the foundation to manage the Town's roadway resources in conjunction with local institutional knowledge. These efforts will result in the creation of a dynamic Capital Improvement Plan for the Town's roadway network.



## 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 life 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.

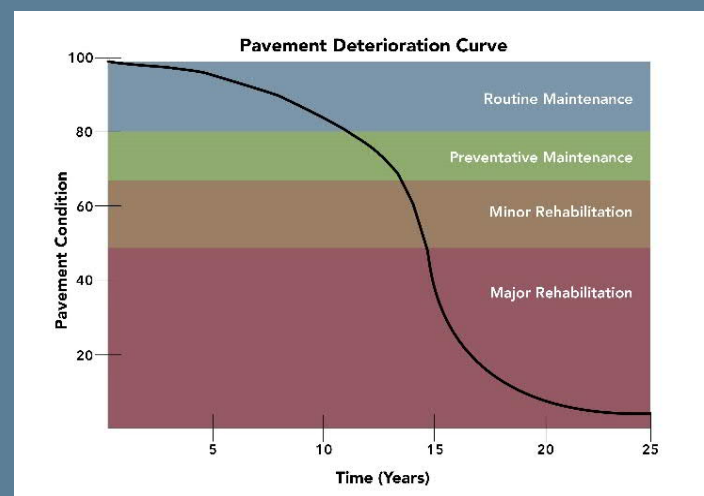
Implementing a PMP involves identification of the road network, evaluation of its surface conditions, and specification of its maintenance practices and associated repair costs. Roadway condition data is compiled to facilitate the calculation of a **Road Surface Rating (RSR)** for each street segment. 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 accepted and unaccepted roadways, was completed in the Winter of 2022-2023. A total of **228.89 accepted and 73.72 unaccepted centerline miles (303.30 total)** were inspected for condition, serving as the new baseline for this project. 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 20' 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. Additionally, as part of the survey, approximately 74.5 miles of accepted and unaccepted gravel roads were identified and had 20' imagery captured.

## Pavement Deterioration Curve





## Summary of Findings

Based on the update completed in June 2023, the **overall Road Surface Rating for Plymouth's Town accepted roadway network was 68.54 and 65.47 for its unaccepted network**, resulting in an **overall average of 67.75**. 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.

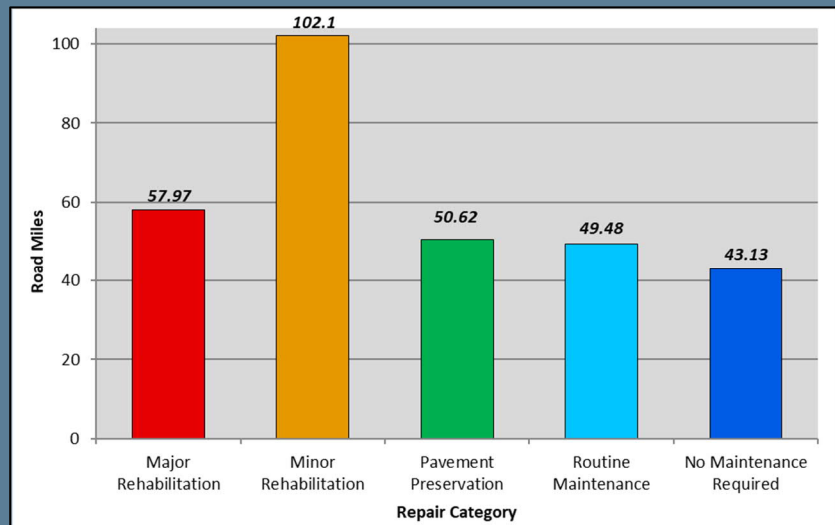
As part of the pavement management process, repair strategies and associated unit costs were defined (as shown below) to develop the Town's Backlog Summary. This analysis summarizes the mileage of roadway that fall within each suggested repair category as well as the estimated cost based to complete the recommended maintenance or repair. **The current backlog summary for the Town's roadway network is approximately \$135.52 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.

# 67.75

**CURRENT TOWN NETWORK  
ROADWAY SURFACE RATING (RSR)  
(June 2023)**

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*



### Backlog Summary

Repair Method	Length (Miles)	Square Yards	Percent Repair	Estimated Cost
Major Rehabilitation	57.97	833,442.66	19.11%	\$83,344,266.19
Minor Rehabilitation	102.10	1,568,215.95	33.66%	\$39,205,398.74
Pavement Preservation	50.62	809,183.95	16.69%	\$12,137,759.21
Routine Maintenance	49.48	834,573.39	16.31%	\$834,573.39
No Maintenance Required	43.13	675,048.37	14.22%	\$0.00
<b>Total</b>	<b>303.30</b>	<b>4,720,464.32</b>	<b>100%</b>	<b>\$135,521,997.53</b>
<b>AVERAGE RSR by Segment:</b>	<b>67.75</b>			







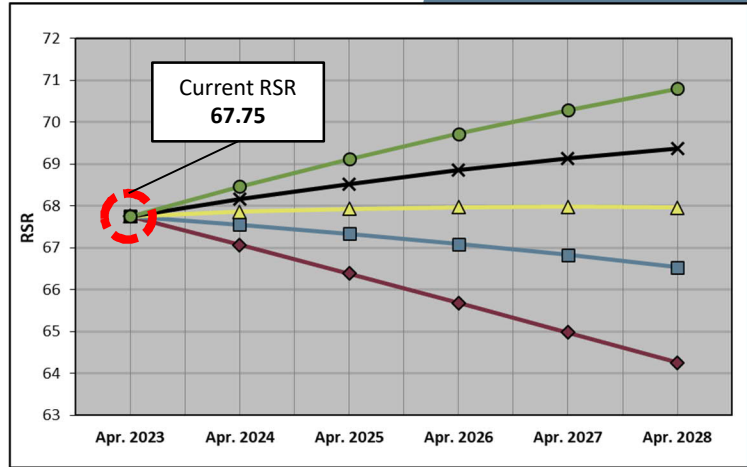
# Capital Planning & Concluding Remarks

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 potentially adjust based on different funding scenarios and repair strategies. Utilizing unit prices established in the program, the model suggests that the Town allocate approximately \$5.50M annually to maintain the current rating. However, if the Town were to allocate \$8.50M annually, the Network RSR is projected to approach a 69 in 5 years. This model can be customized based on repair treatments the Town plans to implement. The current model accounts for 3% annual inflation

## Forecast Model

Projected RSR By Year



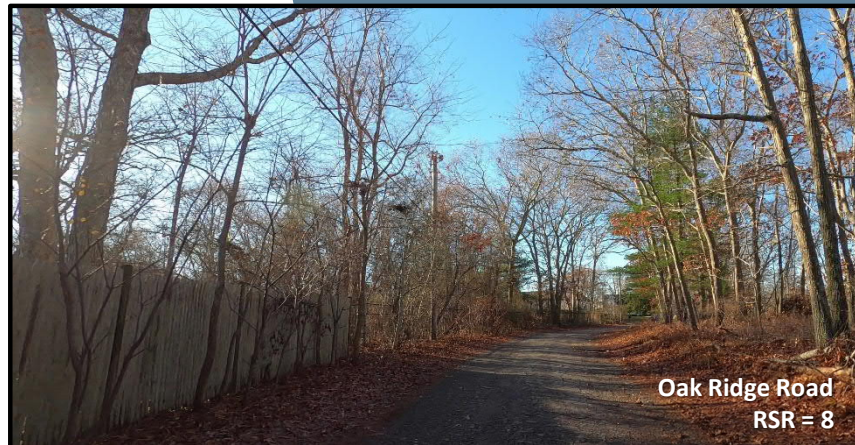
\*Denotes FY2024 Ch. 90 Allotment

## Program Maintenance

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

- 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.
- Assign one or more individuals to oversee system upkeep and to request annual pavement condition updates.
- Review developments in pavement technology that might offer a more cost-effective alternative to pavement maintenance or rehabilitation over the pavement's life cycle.
- Re-inspect the roadway network every 3-4 years to keep the system 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.



# Plymouth, MA

## Roadway Status Summary

Roadway Type		Length (Miles)
Town Classification: Accepted		
BC		228.89
GR		14.43
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		70.93
GR		62.73
Total:		133.65
Total:		661.45

**FY 2024 Chapter 90 Accepted Road Miles - 237.14**

\*State Grouping includes roads classified as State Forest

\*\*Exclusion Grouping only includes roads classified as Private

# Plymouth, MA

## Estimated Roadway Improvement Costs - Overall

Repair Method	Length (Miles)	Square Yards	Percent Repair	Estimated Cost
Major Rehabilitation	57.97	833,442.66	19.11%	\$83,344,266.19
Minor Rehabilitation	102.10	1,568,215.95	33.66%	\$39,205,398.74
Pavement Preservation	50.62	809,183.95	16.69%	\$12,137,759.21
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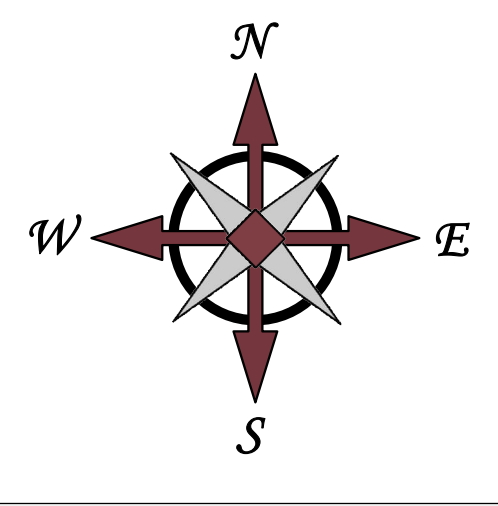
Total:	303.30	4,720,464.32	100.00%	\$135,521,997.53
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Average RSR By Segment:	67.67
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\*RSR - Road Surface Rating (0-100)

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



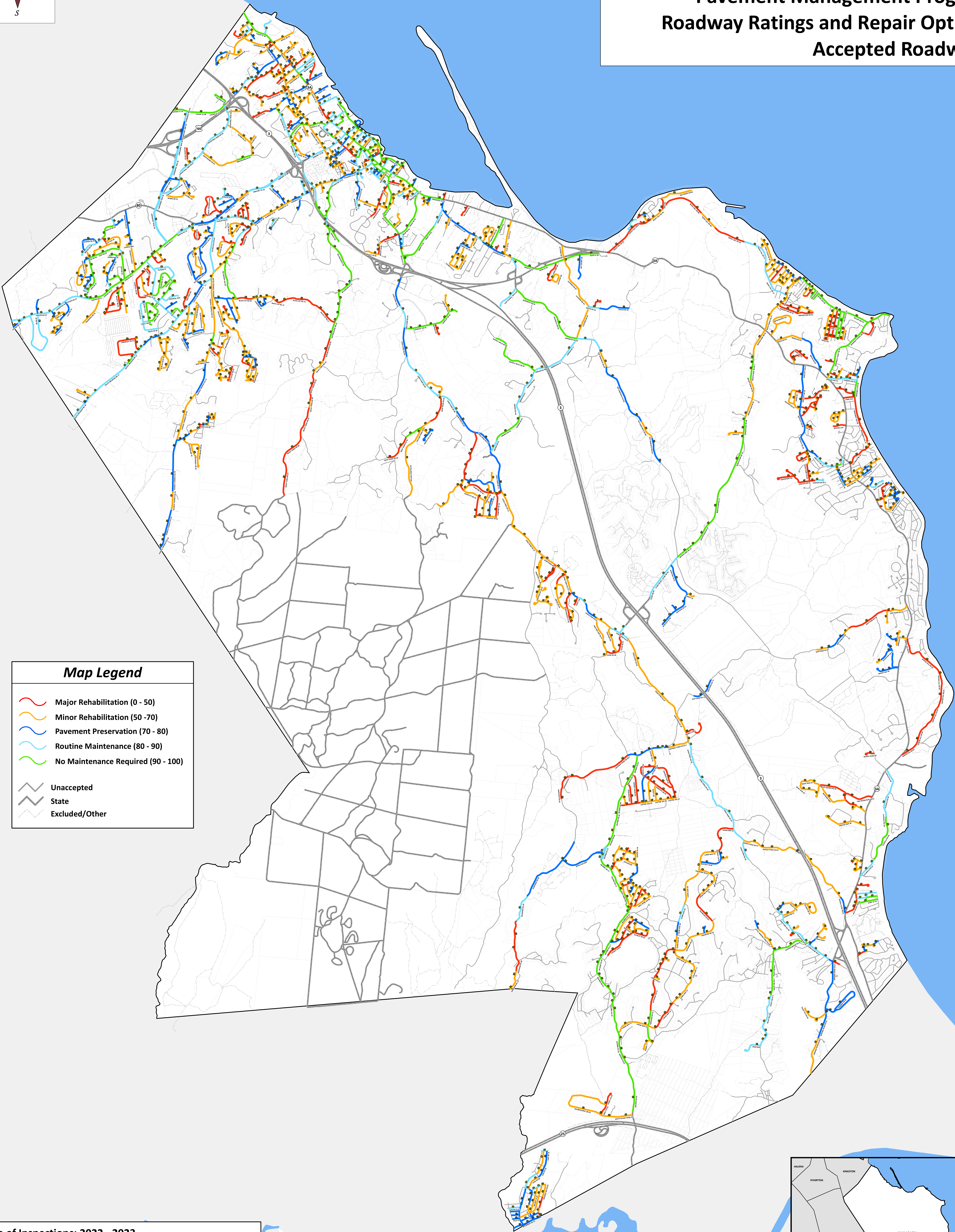


# Town of Plymouth, Massachusetts

## Pavement Management Program

### Roadway Ratings and Repair Options

#### Accepted Roadways



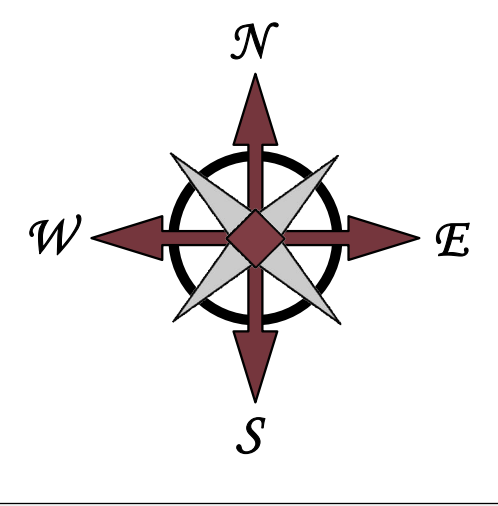
#### Map Legend

- Major Rehabilitation (0 - 50)
- Minor Rehabilitation (50 - 70)
- Pavement Preservation (70 - 80)
- Routine Maintenance (80 - 90)
- No Maintenance Required (90 - 100)
- Unaccepted
- State
- Excluded/Other

Date of Inspections: 2022 - 2023  
Data Sources: Town of Plymouth, MassDOT, MassGIS  
RSR Snapshot: July 12, 2023





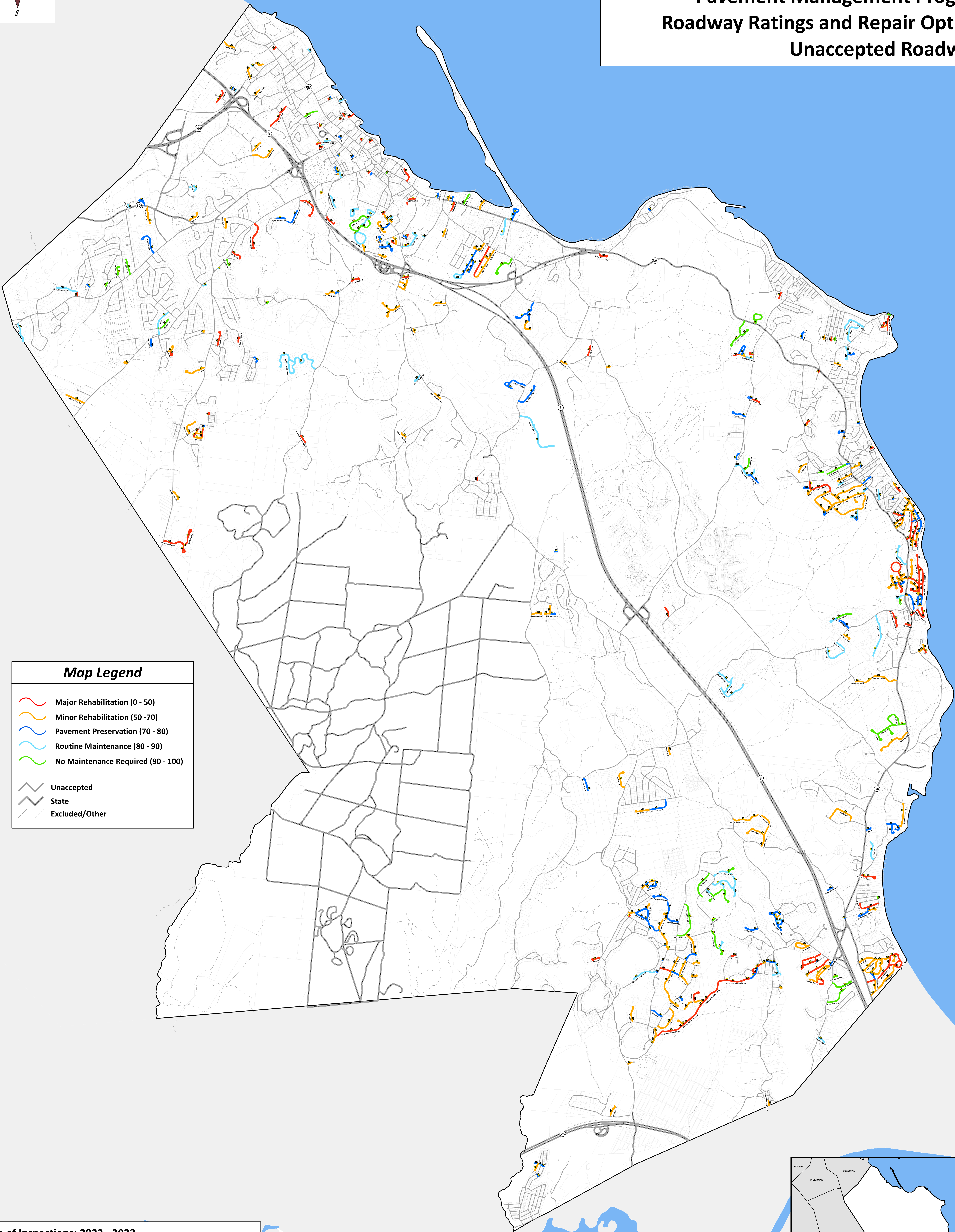


# Town of Plymouth, Massachusetts

## Pavement Management Program

### Roadway Ratings and Repair Options

#### Unaccepted Roadways



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- Major Rehabilitation (0 - 50)
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