New England Environmental Finance Center

Local Transportation Decisions for a Resilient Future

Project Report for the Town of Scarborough, Maine

April 2019

UNIVERSITY OF SOUTHERN MAINE

Executive Summary

This report documents results of a pilot project generously funded by the University of Maine system through the Research Reinvestment Fund. The work used a new tool created by the Maine Department of Transportation and evaluated its potential use for municipal governments. The tool assembles information about several types of risk to infrastructure project delivery (e.g., bridge and culvert upgrades) and makes it available to field engineers to enhance their design decisions.

The New England Environmental Finance Center tested the tool's use in Scarborough, Maine and identified several ways public works managers could benefit from information provided by the tool, including to help ensure that resiliency-related goals of the comprehensive plan are more likely to be reflected in the capital investment plan and spending activities. The report discusses goals, achievements, and next steps to continue the work in Phase II. Details are provided on the project launch and implementation including data processing and GIS mapping of municipal data, analysis of local plans, and recommendations made to Scarborough public officials based on the results.

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Partners: The New England Environmental Finance Center (EFC) at the University of Southern Maine (USM) was the lead organization on the project. The EFC's close partner was USM GIS program, including two student assistants that helped pre-process the municipal data and create a GIS layer to match the TRAPPD framework input requirements. Other partners included the Maine Department of Transportation, GEI Consultants, and the US Geological Survey.

Background

The Maine Department of Transportation (Maine DOT) has a federal mandate to establish risk-based transportation asset management plans. In response, Maine DOT created a framework that *considers risk in terms of project delivery (i.e. on schedule and budget)* that mirrors *the* strategic goals of the Department and does not lessen the ability to maximize safety, condition, and level of service when they determine priority of work on one asset over another.

The "Transportation Risk Assessment for Project Planning and Delivery" (TRAPPD) framework can be accessed on a desktop or in app form bit.ly/TRAPPDapp. TRAPPD allows the contextual elements (location) of the transportation assets (culverts, bridges, and potentially road segments) to be considered along with regulatory, natural resource, and public safety issues, all in one place. Contextual elements that pose inordinate risk (time delays and budget overruns)

to transportation projects include: the presence of an endangered species; hydrologic and hydraulic limitations; natural resource impacts like sea level rise and/or storm surge; and traffic management tasks such as emergency evacuation routes. With TRAPPD, field engineers can view combined and individual proxy scores and adjust expectations for asset condition and project delivery, either before or after inclusion of a project in a work plan. This capability represents a transition from proof-of-concept status to an automated, implemented, and transferable framework for risk-based decision-making by state DOTs or municipalities.

In developing TRAPPD, Maine DOT inventoried and included state owned assets into TRAPPD - it did not include municipal assets. The intent was to provide a flexible system that could later incorporate assets of interested municipalities. The New England Environmental Finance Center (EFC) recruited the Town of Scarborough to participate in a pilot project to present the TRAPPD framework with a focus on culverts owned and managed by the Town. Goals of the pilot project were to:

1) Collect municipal data on culverts in Town;

2) Pre-process the data to match the TRAPPD framework input requirements;

3) Use TRAPPD output to identify links between the Town Comprehensive Plan and Capital Improvement Plan in an effort to strengthen Scarborough's long term environmental and fiscal resiliency; and

4) Develop next steps to create a value proposition for other municipalities that might participate and develop a business model the EFC may pursue in the future.

In bringing this tool to Scarborough, there appeared to be an opportunity to do something novel regarding how municipalities plan for and upgrade their infrastructure. In particular, there is a frequent planning dilemma where Comprehensive Plans and Capital Investment Plans often do not inform each other well. This situation can result in a disconnect between the vision statements and goals of the Comprehensive Plan on the one hand, and the actual spending patterns of the Capital Investment Plan on the other. This project attempts to bring these two processes together using risk-based information with the goal of providing cost savings to the town over time.

Scarborough is a progressive town with a recent (June 2018) update to its Comprehensive Plan producing clear visions, goals, and strategies. Regarding flood-related risks, stated concerns in the Plan include that "Business and critical infrastructure are in locations with increasing threats due to climate change ..." and in discussing exceptionally high "King" tides, states that "…. it's easy to overlook the seriousness of risk associated with these 'normal' flood events …". It also describes plans to "identify key roads that warrant flood mitigation upgrades to better

function as evacuation corridors as well as critical neighborhood connection points for emergency services vehicles like ambulances, fire trucks and gas and power providers."

The Capital Improvement Plan documents are similarly cognizant of flood risks, noting for example that unanticipated drainage design problems are likely to be the largest cost increase factors for large infrastructure projects. However, in the five-year plan (2019 – 2023) where Fire, Police, School, and other Departments all presented their intended capital expenditures, we noted that of 33 planned expenditures between the Public Works and Planning Departments, 15 projects had potential drainage issues (highlighted in the below tables). For the majority of these projects there was no identified method to address the flood risk-mitigation goals of either the Comprehensive Plan or the Capital Investment Plan.

Public Works Department Capital Projects

Description	5-Year Total	2019		2020	2021	2022	2023
Public Works Department - Town-Wide Projects							
Mid-Level Road Rehabilitation **(TBD)**	$ -						
Rte 1: Mill & Pave (Broadturn Rd to Saco Line)	$ 280,000	$ 280,000	B				
Subsurface Drainage Assessment Project	$ 195,750	$ 118,750	B	$ 77,000			
Phase II LED Conversion	$ 215,000	$ 215,000	B				
Adaptive Traffic Lights (Dunstan Intersection)	$ 135,000	$ 135,000	I				
PW Facility Fire Panel Upgrade	$ 25,000	$ 25,000	A				
Traffic - UPS/Generator/Battery Standby Install	$ 36,000	$ 36,000	A				
Final Design Gorham Rd Reconstruction Phase II (Maple Ave - Ridgeway Rd	$ 80,000	$ 80,000	B				
Traffic - Install & Connect Fiber (Oak Hill south - Southgate)	$ 133,000			$ 133,000			
Gorham Rd Reconstruction Phase II Maple Ave - Ridgeway	$ 1,010,400			$ 1,010,400			
Rte.1 Greening Initiative Ph 1 (Sawyer Rd N to Millbrook)	$ 125,000			$ 125,000			
Subsurface Drainage Rehabilitation Project Phase II	$ 1,000,000			$ 250,000	$ 250,000	$ 250,000	$ 250,000
Traffic - Interconnect Traffic Signals w/Fiber (Oak Hill North - ME MEd)	$ 95,000				$ 95,000		
Gorham Rd Reconstruction Phase III Ridgeway - Nonesuch	$ 1,485,108				$ 1,485,108		
Rte.1 Greening Initiative Phase II (Willowdale Rd Area)	$ 125,000				$ 125,000		
Traffic: Fiber Connection (Haigis Pkwy/Rte. 1 - Exit 42)	$ 30,000				$ 30,000		
Pine Point Area Improvement Project	$ 2,500,000					$ 2,500,000	
Route 1 Greening Initiative Phase III (Willowdale Rd Area)	$ 90,000					$ 90,000	
Traffic: Install Fire Alarm Cable & Fiber Optic (Haigis/Payne - Gorham Rd)	$ 80,000					$ 80,000	
Payne Rd. Reconstruction (Cabela's -Flaherty Hill) **Tentative -Pending Sewer ext**	$ 1,400,000						$ 1,400,000
Replace Town Hall Generator **(TBD)**	$ -						
Gorham Rd Phase IV (Nonesuch - Mussey) **(in FY 2024)**	$ 1,500,000						
Total Public Works	**$ 10,540,258**	**$ 889,750**		**$ 1,595,400**	**$ 1,985,108**	**$ 2,920,000**	**$ 1,650,000**

Planning Department Capital Projects

Description	5-Year Total	2019		2020	2021	2022	2023
Planning Department							
Office Renovations	$ 25,000	$ 25,000	A				
North Scarborough Traffic Signal Improvement Plan	$ 150,000	$ 150,000	I				
Phillips Brook Watershed Management Implementation Ph I	$ 50,000	$ 50,000	B				
Route 1 Corridor Study (Partnership w/Saco, PACTS, & Maine DOT)	$ 10,000	$ 10,000	I				
N Scarborough Traffic Signal Improvement Plan Construction	$ 600,000			$ 600,000			
Mill Brook Watershed Planning	$ 45,000			$ 45,000			
Route 1 Corridor Study Implementation Project Phase I	$ 200,000			$ 200,000			
Route 1 Corridor Study Implementation Project Phase II	$ 400,000				$ 400,000		
Route 1 Corridor Study Implementation Project Phase III	$ 250,000					$ 250,000	
Phillips Brook Watershed Management Implementation Ph II	$ 50,000					$ 50,000	
Route 1 Corridor Study Implementation Project Phase IV	$ 150,000						$ 150,000
Planning Department	**$ 1,930,000**	**$ 235,000**		**$ 845,000**	**$ 400,000**	**$ 300,000**	**$ 150,000**

This apparent disconnect created an opportunity to evaluate whether access to flood risk information *before* culverts are designed and installed would generate more risk-informed

decision-making, better fulfill the goals of the Comprehensive Plan, and perhaps reduce cost and schedule overruns on project delivery.

Methods

The TRAPPD Tool

The TRAPPD tool relies on proxy indicators of risk for variables of concern to Maine DOT. Proxy indicators are those that provide parallel information or context for questions that would otherwise require a burdensome data gathering effort. From 2016 to 2018, Maine DOT and partners integrated large volumes of data via Python code, creating a single layer of scored spatial data made available through a mapping tool on a handheld device or desktop computer bit.ly/TRAPPDapp. This layer provided thousands of Maine DOT bridges and culverts with scores for twelve risk elements. Engineers can now use the tool results in the field for screening purposes and to inform candidate designs.

Risk elements used in TRAPPD at the time of this project (2018-early 2019) are in the table below. Only elements (questions) 5 and 8 were relied upon for the culvert flood risk data presented here. **Question 5** is about whether the culvert is "≥ the calculated bankful width," which means "Is the structure large enough to pass expected flow when the channel is full?" If the answer is no, the culvert is generally considered to be undersized and vulnerable to extreme flows. A gradation indicates relative vulnerability: if culvert capacity is >1.2x calculated bankful width, the ranking is 0; if culvert capacity is 1.0 – 1.2x calculated bankful width, the ranking is 1; and if culvert capacity is <1.0x calculated bankful width, the ranking is 2.

Question 8 combines sea level rise and storm surge to create a 0 – 5 vulnerability ranking for each culvert. Sea level rise and storm surge projections for coastal Maine were developed by Maine DOT using Maine Geological Survey data and applied to tidally-influenced assets. Rankings were as follows: No overlap with spatial extent of sea level rise or 100-year storm surge polygons = 0; overlap with a 100-year storm surge polygon = 1; overlap with a 6 ft sea level rise polygon = 2; overlap with a 3.3 ft sea level rise polygon = 3; overlap with a 2 ft sea level rise polygon = 4; and overlap with a 1 ft sea level rise polygon = 5.

TRAPPD Risk Elements Table (Proxy Indicators)

Risk Element	Proxy Description
1	Is the drainage area part of a priority Atlantic salmon watershed?
2	Is the project located within a mapped buffer for habitat for a state endangered, threatened, or special concern species?
3	Is the feature a mapped stream barrier?
4	Is the location identified as a large undeveloped habitat block connector?
5	**Is the existing structure > the calculated bankful width?**
6	What is the drainage area to (i.e. watershed size of) the feature?
7	Is the feature located within an identified FEMA 100-year floodway?
8	**Is the feature subject to coastal threats of sea level rise (SLR) and/or storm surge (SS)?**
9	What percentage of the drainage area to the feature is developed and/or impervious?
10	Is the asset within the watershed of an urban impaired stream (UIS) or within a Municipal Separate Stormwater Sewer (MS4) community?
11	Is the asset an eligible historic resource or within a historic district pursuant to Section 106?
12	Is the road a sole access, hurricane evacuation route or emergency access for emergency response vehicles?

Most - but not all - elements have values of 0 - 1 for the presence of risk. Maine DOT weighted some elements by giving them a wider range of values. At the time of this pilot project (2018-early 2019), possible combined risk scores for culverts in the system ranged from 0 – 25.

In the case of questions 5 and 8 and using the statewide TRAPPD database, Maine DOT field engineers who have the results can now make sizing and design decisions that take possible future flooding conditions into account. Other risk elements represent similar utility. For example, if a field engineer learns that a culvert is in Atlantic salmon habitat (question 1), they may choose to add 12 – 18 months to the project delivery schedule to account for regulatory and permitting delays that are reasonable to expect. This addition can save the agency money by keeping projects on budget and on schedule. Bringing the tool to Scarborough, our method was to evaluate whether similar results could accrue at the municipal level.

Data Management for Scarborough

Scarborough is a large town in southern Maine with a population of more than 19,000 in an area of 70 square miles. The town inventories over 2,000 culverts both inside and outside of the State-Urban compact zone. The town's Department of Public Works classifies culverts according

to jurisdiction and siting as either 'cross culverts', 'driveway culverts', 'field culverts', or 'other'. We identified cross culverts as the primary type relevant to the pilot analysis – 626 in total – and applied several data preprocessing steps before implementing the TRAPPD tool.

The tool requires data generated by USGS StreamStats, a hydrology and flow analysis tool covering most of the United States. The StreamStats online batch processing tool generates flow and basin characteristics for sets of point features; however, these point features must first be aligned with the raster StreamStats grid. This step utilizes a python script tool for ESRI ArcGIS developed and shared by USGS staff called Dynamic Snapping (now Point Snapping) which relocates points to the nearest stream feature.

Additionally, the implementation of the TRAPPD tool requires that multiple culverts – or spans – transmitting flow as part of the same flow feature be aggregated into a single point with a combined span width. During the aggregation process multiple coincident spans are manually combined, and their respective diameters or widths are added. For example, two adjacent 36-inch diameter culverts would be aggregated into one 72-inch diameter span feature. These two steps – aligning points to the stream grid and aggregating features – require additional quality control and quality assurance measures to mitigate excessive snap distances and to verify aggregation accuracy.

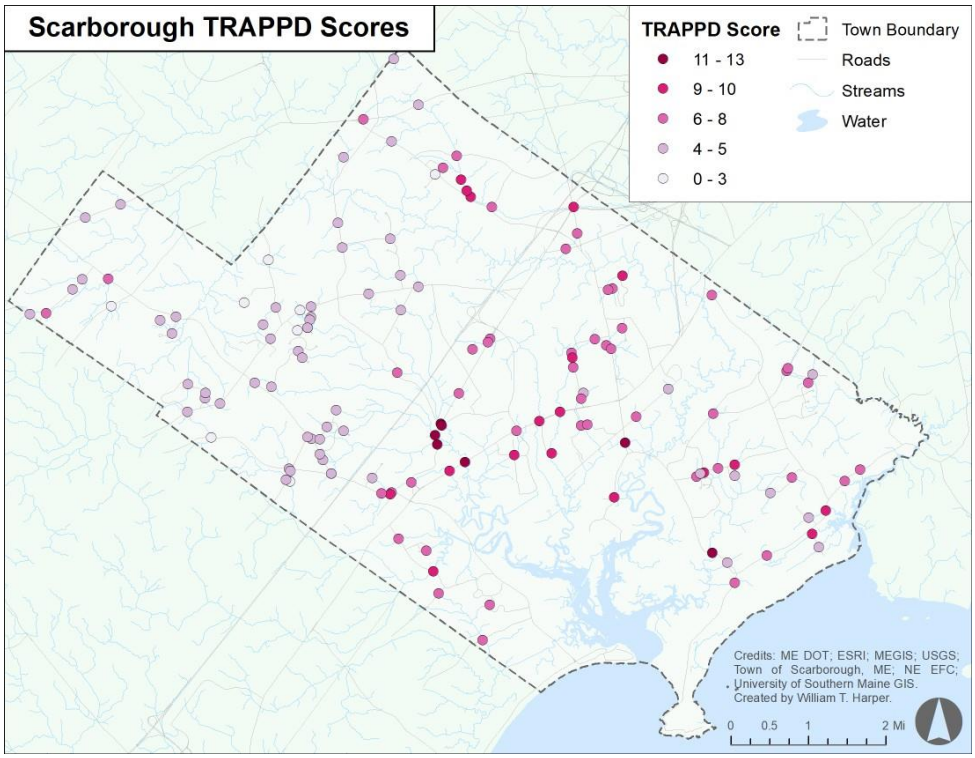
During our preprocessing operations, the 626 identified culvert points were "snapped" to the StreamStats grid. Many points were snapped more than 100 feet to the nearest stream and were subsequently discarded from the analysis because these points did not transmit flow along a mapped StreamStats stream. The resulting points were then manually aggregated by identifying multiple culvert features that were snapped to a coincident snap point. This process yielded 138 valid asset points which were successfully evaluated through StreamStats batch processing and then analyzed using the TRAPPD tool.

The results of the TRAPPD analysis were cleaned, explored, and presented using ESRI ArcMap 10.6.1. Additional tables and histograms were generated in Microsoft Excel. Additional considerations on the sourcing of data and the use of GIS software include:

- The accuracy and completeness of original culvert data, including conversion from line features to points;
- The extent of the study area and coordinate reference system used;
- The use of coincident road features to aid in the snapping process; and
- The limitations of current Stream Stats grid resolution (i.e., 10 meters) and stream reach detail
- The continued availability and use of the few restricted or internal state of Maine DOT data within TRAPPD tool or the need to find and use appropriate substitutes.

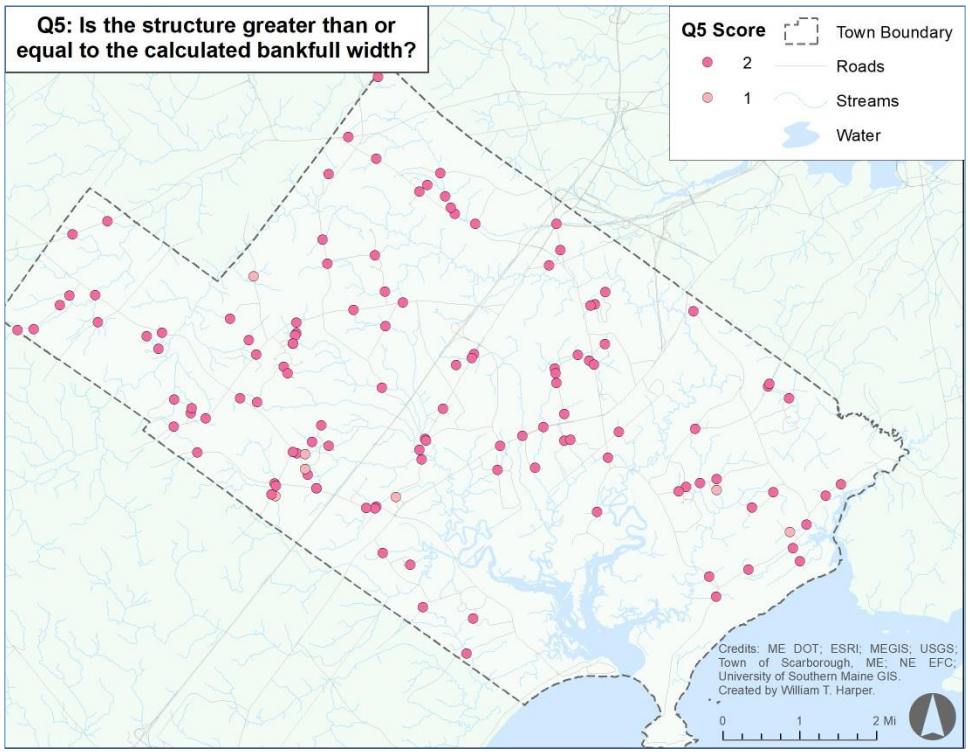
Results

The Town of Scarborough owns and manages over 2,000 culverts; of these, 138 culvert assets were identified as serving as a conduit for a substantial waterway as represented in StreamStats. As in the below figure, TRAPPD scores for these culverts ranged from 0 – 13.



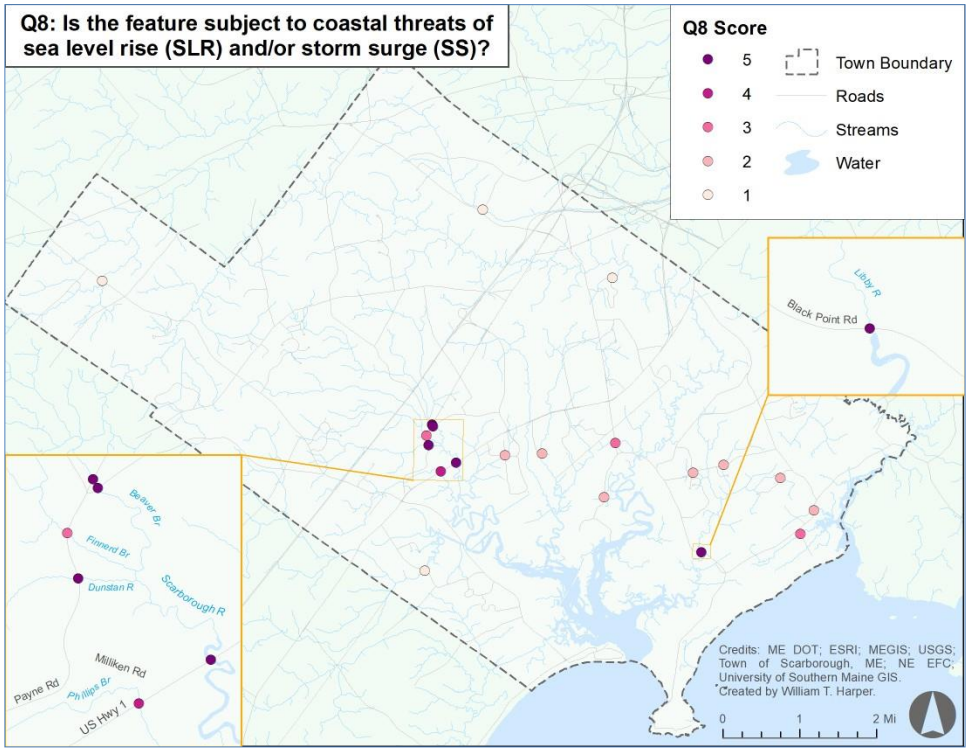
Scores encompass all 12 risk elements and provide Scarborough officials with information about various types of risks. For example, besides risk from flooding (questions 5 and 8), 71 of 138 culverts are within a mapped buffer for habitat for a state endangered, threatened, or special concern species (question 2). Scarborough officials could thus benefit from paying attention to regulatory or permitting delays that could emerge during culvert upgrades or replacements.

Data for all 12 questions are available from the EFC for each of the 138 culvert assets. This pilot project focused on questions 5 and 8, on risk from flooding. Question 5, assessing risk from undersized culverts, resulted in 125 of 138 culverts earning non-zero scores evenly distributed throughout the Town:

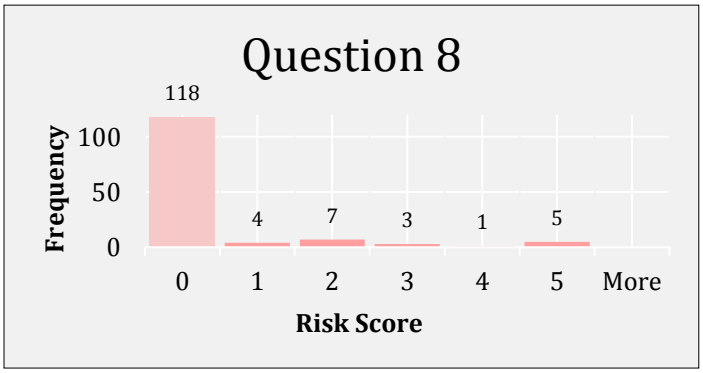


The majority of these non-zero culverts were extremely undersized (<1.0 bankful width), receiving the most vulnerable rank of 2:

Results from Question 8 illustrate the presence of risk from sea level rise and storm surge. Only 20 culverts had non-zero risk rankings; these are shown below:



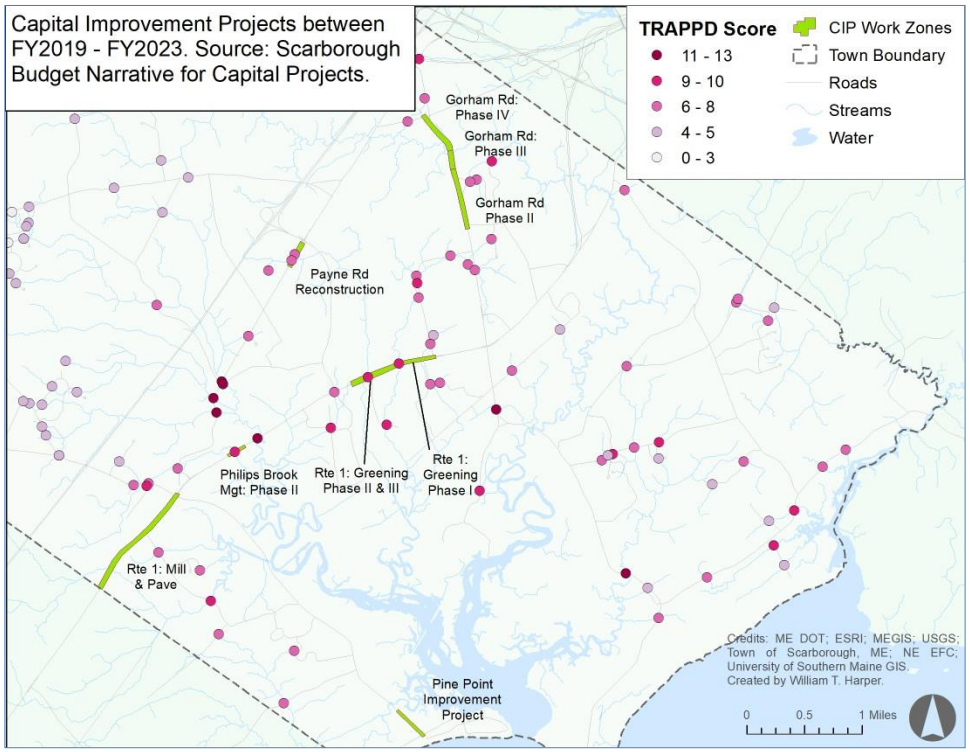
Four of these had a risk ranking of 1, meaning they were vulnerable to storm surge only. The other 16 non-zero ranked culverts were vulnerable to both storm surge and sea level rise in varying degrees.



Discussion

Data developed and assembled for this project include GIS data about local culverts, information about flood risks in each location, and spending schedules for each location from the CIP. Collectively they now allow evaluation of 1) whether access to flood risk information *before* culverts are designed and installed could generate more risk-informed decision-making; and 2) the degree to which they may a) help fulfill goals of the Comprehensive Plan and b) reduce cost and schedule overruns on project delivery.

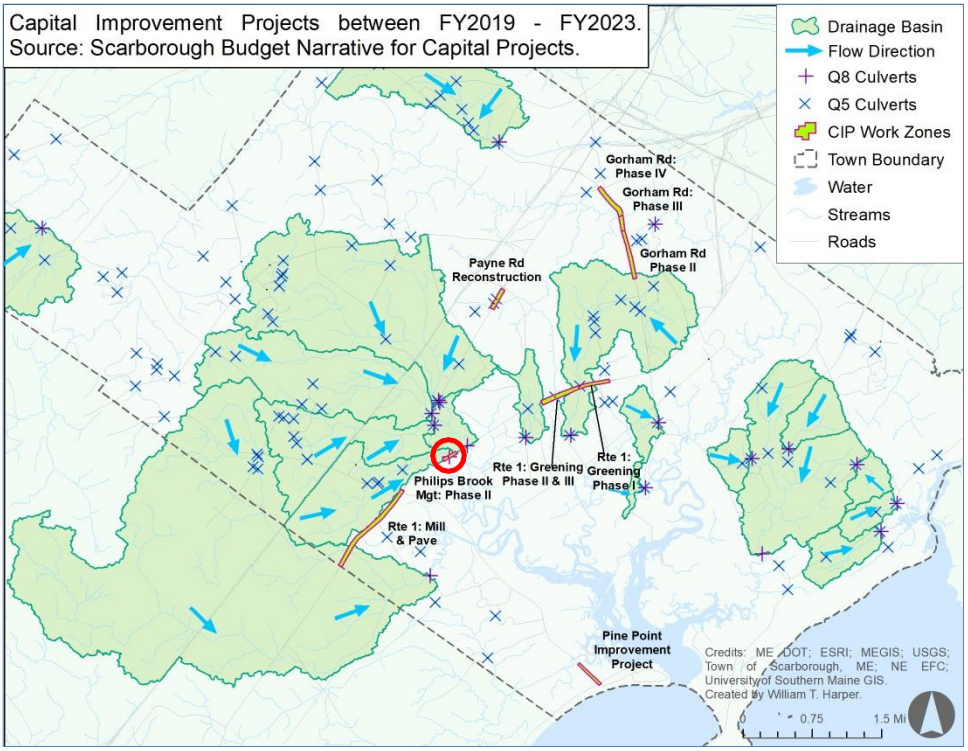
Green lines in the below figure represent projects planned in Scarborough's current CIP. In three cases there are identified culvert assets with vulnerability rankings of 9 – 10. Two are located on the Route 1 Greening project and one is located on the Phillips Brook Watershed Management Implementation project:



In the Route 1 Greening project, the Town of Scarborough may now find it useful to know that those two culverts are currently undersized according to TRAPPD question 5 on bankful width. The CIP indicates this project will cost $125,000 in 2020 and 2021, then another $90,000 in 2022. Although most typical greening projects by public works departments do not also include culvert upgrades, in this case it may make sense to upsize because crews will be doing

substantial work in the area already. Also, because it will likely be too expensive to upsize all of Scarborough's undersized culverts in a short period, taking opportunities like this may be a good means of distributing those upgrades over time and enhancing overall resiliency of Scarborough's system of culverts.

Similarly, the Phillips Brook Watershed Management Implementation project is a road upgrade along a section of road with a culvert (in the red circle below) that received the most vulnerable rank for the threats of sea level rise and storm surge. The figure also depicts how this culvert is at the receiving end of sub-watershed flow from the southwest.



The CIP indicates $50,000 will be spent on this project in 2019 and an additional $50,000 will be spent in 2022. However, the Town of Scarborough indicated that upsizing the culvert was not part of the project. They may thus find it useful to know about this culvert's vulnerability and could now choose to upsize the culvert as part of project implementation.

Making design decisions of this type would address the goals of this initiative by showing that access to flood risk information before culverts are designed and installed can generate more risk-informed decision-making. It would also address goals of the Comprehensive Plan including the goal to "identify key roads that warrant flood mitigation upgrades." The degree to which upsizing the culvert might avoid cost overruns is not certain but avoided damages could be considerable. These would include repair or replacement of the culvert after inundation events

that may occur during the culvert's useful life. Other benefits of upsizing are likely to include maintaining the road's function as an evacuation corridor and connection point for emergency services vehicles.

When the EFC team presented these results to Planners and Public Works staff in Scarborough, feedback was that the results were useful and could indeed help them better plan their infrastructure spending. One plot was of particular interest, showing that fully 125 of Scarborough's 138 identified culvert assets are not large enough to pass expected flow when the channel is full. It indicated that most upcoming projects involving culverts may require design attention regarding increased flows due to storm surge and sea level rise.

Benefits to Scarborough of bringing their culverts onto the TRAPPD system thus include connecting goals of the Comprehensive Plan with on-the-ground infrastructure investments; maintaining emergency services access during extreme weather events; and likely avoided damages from storm surge-related and sea level rise-related repair costs. By avoiding infrastructure failures, the Town is also more likely to maintain its economic health in the face of a changing climate, because business interruptions may be less likely.

Put another way, environmental change – especially the combination of sea level rise and increases in frequency and intensity of extreme weather events – may cause increases in municipal spending and decreases in economic productivity. Incorporating flood risk information into culvert design has the potential to lessen some of these negative outcomes.

At present, municipalities can view upcoming projects in the MaineDOT queue, which shows projects three years into the future. They do this through a public-facing map viewer that shows scheduled workplan items. When towns know it is the DOT's intention to upsize a culvert upstream from projects they are considering, it could result in a different design decision. By referring to the DOT's TRAPPD score for each culvert, also viewable online, municipalities gain information about state-owned assets in their jurisdiction that may be of interest or concern. Similarly, by expanding the TRAPPD database to include scores for their own assets, possible synergies between state-level and local-level transportation planning are created. As with the overall rationale for participating in the TRAPPD system, these synergies have the potential to reduce losses and increase economic competitiveness for participating municipalities. For the future, regional use of the tool could increase the opportunity for contiguous municipalities to know what their neighbors as well as Maine DOT are planning. This represents a novel new way to advance regional climate resiliency efforts in Maine.

Next Steps

The Scarborough project is a good early demonstration of one way to realize these benefits. For this to happen at scale, however, many additional municipalities will need to begin participating with MaineDOT's TRAPPD system and using it to inform their capital investment decisions. A large-scale rollout of this type will require a service provider to pre-process each municipalities' data, ensure that migration of culvert data to the TRAPPD system is smooth, and educate

planners and public works staff in how to conduct the evaluations.

EFC is positioning itself to be that service provider. However, as part of developing a service model, a few additional technical issues still need to be resolved. These include testing the practical scale of the service (when is a municipality too small for the service), the most effective way to recruit municipalities (consultants, COGs, others?) and the monetary value of the service. To resolve these issues, EFC aims to work with several additional municipalities of different sizes and staff capacities in a procedure similar to what was completed in Scarborough. Interest in this further work has been voiced by 3 – 5 additional municipalities. Appendix A contains outreach documents that EFC will be using in Phase II of the project to elicit interest and feedback on using the tool form other municipalities. EFC is now working to secure funds to conduct this work and implement a marketing approach.

Appendix A: Marketing Outreach Documents

[FUTURE] E-mail letter to all Maine Municipal managers, engineers and planners:

Would you avoid unplanned road and drainage project costs or future losses due to surprise damage in the future if you could? The Maine Department of Transportation (MaineDOT) is, by using a tool they developed called TRAPPD ("Transportation Risk Assessment for Project Planning & Delivery" tool). MaineDOT experiences expensive delays when project underway or even designed run into hazards or regulatory or other issues. TRAPPD assesses assets against twelve kinds of risks including physical (floodways, sea level rise), regulatory (Atlantic Salmon drainages, historic resources) and functional (priorities for emergency management). The New England Environmental Finance Center at USM's Muskie School and partners have just collaborated with the Town of Scarborough, ME to see how TRAPPD may be useful to municipalities. Selected risks were identified for the Town's drainage culverts due to Scarborough's concerns about unplanned drainage costs in their projects and future sea level rise. The Town can now anticipate any needs for over 100 drainage culverts that were identified with risk.

We would like to get your feedback on just the few questions about your asset risk management situation. The survey monkey questionnaire will take you about 5 minutes to answer and you can access it here. The questionnaire is anonymous and was designed to inform us on how TRAPPD may apply to local needs.

SURVEY MONKEY QUESTIONS: Municipal Transportation Asset Needs

Maine's Department of Transportation (MDOT) developed an asset-and-project-risk-management planning tool called Transportation Risk Assessment for Project Planning and Delivery (TRAPPD).

TRAPPD is an ESRI ArcGIS-based tool that scores assets such as a culverts, road segments, or bridges according to a list of designated risk factors. The factors may be physical (like a floodway zone) or regulatory or operational (like an historic preservation designation or a critical evacuation route). These are all elements that could lead to different project design, timing, or priority that may help avoid future losses or reconstruction costs.

The Environmental Finance Center at University of Southern Maine is testing the usefulness of this tool for towns and cities. Please answer the following three Yes/No questions to help us evaluate municipal interest in this tool.

No specific municipality's input will be identified; the purpose is to understand how TRAPPD may apply to local needs.

Top of Form

Question Title

1. Does your municipality have computer-based records of the geographic locations of your culverts?

Yes

No

Question Title

2. Does your municipality currently evaluate your infrastructure projects for possible project delays or future hazards?

Yes

No

Question Title

3. Would using this tool be of interest to your municipality?

Likely

Unlikely

Question Title

4. Please add any comments/questions you have about the tool here:

Bottom of Form

Municipal Outreach Fact Sheet (Attachment that will be E-mailed to Maine municipal managers, engineers and planners)

TRAPPD – Managing Your Infrastructure to Avoid Added Project Costs and Future Hazard Losses

Would you avoid delays, added costs or even expensive do-overs for inadequate construction or design of your road, drainage, bridge and other crucial infrastructure, if you could? Maine's Department of Transportation (MaineDOT) is answering that question with a recently developed asset-and-project-risk-management planning tool called TRAPPD. TRAPPD stands for "Transportation Risk Assessment for Project Planning and Delivery." With the cooperation of MaineDOT, the New England Environmental Finance Center at USM's Muskie School and its partners have been testing the usefulness of this tool for towns and cities. We want to briefly tell you about this effort and find out how Maine localities view needs for risk-based asset management.

Why Read This?

We worked with the Town of Scarborough, which volunteered as a test site, to use TRAPPD to evaluate possible risks to state and local drainage culverts in town. Scarborough's capital improvements planning (CIP) identifies added costs due to unanticipated design needs for drainage infrastructure as a major issue; And, Scarborough's new comprehensive plan recognizes that sea level rise (SLR) is increasing risks from king tides and other coastal and watershed-driven hazards like storm surge flooding.

Many towns face similar vulnerabilities, which are only part of what TRAPPD evaluates. For example, a paving project that's vulnerable due to an under-sized culvert may need to be re-designed now to avoid losses and added reconstruction and upgrading costs in the future from a potential blow-out failure in a storm. But another kind of risk that MaineDOT has been working to reduce as well is that of expensive project delays and redesigns due to unanticipated issues like wildlife and fisheries restrictions, emergency management needs, and other factors. That is the essence of risk-based asset management.

What Does TRAPPD Do?

TRAPPD bit.ly/TRAPPDapp is an ESRI ArcGIS-based tool originally designed at MaineDOT for their needs. TRAPPD checks whether a geo-located asset such as a drainage culvert or bridge is in the same place as any of a list of designated risk factors. As described in examples above, those risk factors may be physical—like a floodway zone—or regulatory or operational, like an historic preservation designation or a critical evacuation route. Any of these factors might lead to different project design, timing or priority to avoid future losses or reconstruction costs.

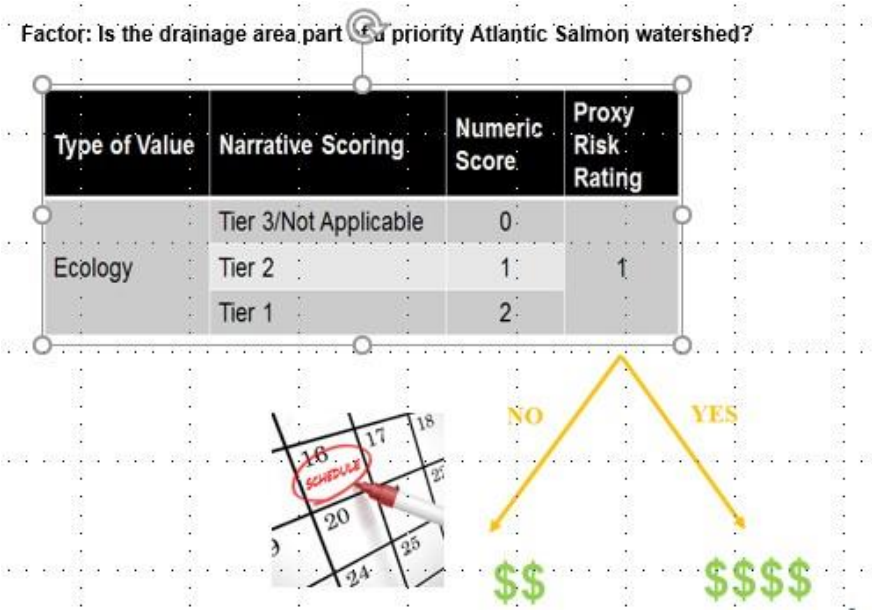
At present, TRAPPD includes the twelve (12) risk indicators listed briefly in the first sidebar here.

Asset Risk/Vulnerability Factors in TRAPPD:

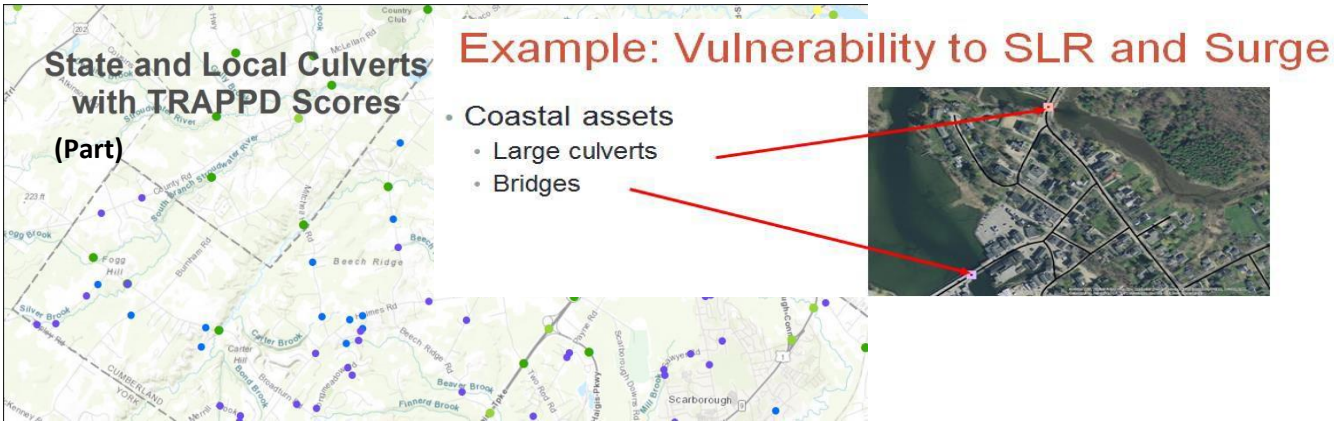
1. Atlantic Salmon watershed
2. Asset in buffer for protected species
3. Asset a mapped stream barrier
4. Asset in mapped undeveloped habitat block connector
5. Asset adequacy for bank-full width
6. Drainage area size
7. In FEMA 100-year floodway
8. Sea level rise/storm surge risk level
9. Drainage area impervious % and developed %
10. Impaired stream drainage or municipal stormwater sewerage (MS4) community
11. Asset in historic district/is historic resource

TRAPPD assigns a summary total score for these 12 factors from 0 to 25 if they are present. For example, the illustration for Atlantic Salmon perceived regulatory risk shows that zero (no habitat) or a 1 or a 2 can be assigned to that total. If "yes" with a 1 or 2, project plans must take into account possible added costs.

In the Scarborough prototype case, over 100 local drainage culverts were identified with more than a zero (0) risk score, with some occurring in the current CIP planning locations.



The map illustration below shows some of the identified assets (culverts) with some risk.



What Do You Need to Use TRAPPD?

You will need local geo-coded data (location coordinates), a unique asset ID, and asset span width for the transportation assets of interest, preferably in the form of a GIS data layer. Most of the risk factor layers are available from state and federal sources, such as the Maine GeoLibrary, although a few state data require permission for access and use. . The New England Environmental Finance Center and University of Southern Maine GIS are exploring the costs and needs for preparing the information for TRAPPD, which itself runs directly in ArcGIS.