

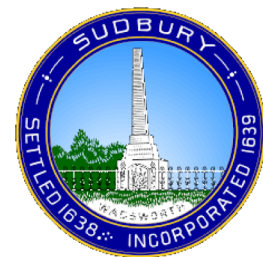


TIPS AND TRICKS FOR ESTABLISHING A THRIFTY CULVERT MANAGEMENT PROGRAM

NEWEA 2019 Annual Conference

January 30, 2019

Daniel Nason, Town of Sudbury, MA
William O'Rourke, Town of Sudbury, MA
Janet Moonan, Tighe & Bond
Eric Ohanian, Tighe & Bond



PRESENTATION OBJECTIVES

- **Explain Town's motivation, vision, and approach**
- **Review culvert inventory process**
- **Summarize risk-based prioritization process**
- **Present overview of findings**
- **Identify next steps for Town**
- **Recognize tips and tricks for culvert management program**



MOTIVATION FOR A CULVERT PROGRAM

Aging infrastructure

- Unknown number and condition of crossings
- Landham Road Culvert collapse
- Concern about Dutton Road Bridge condition
- Public safety and potential flooding
- Opportunity to be proactive

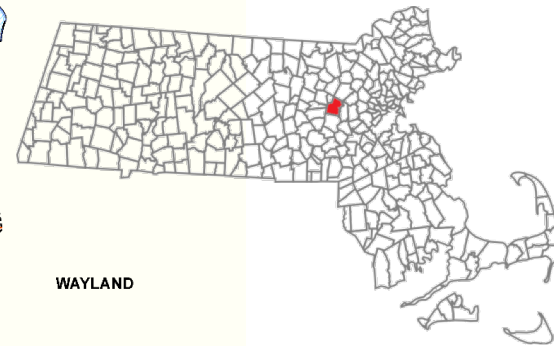
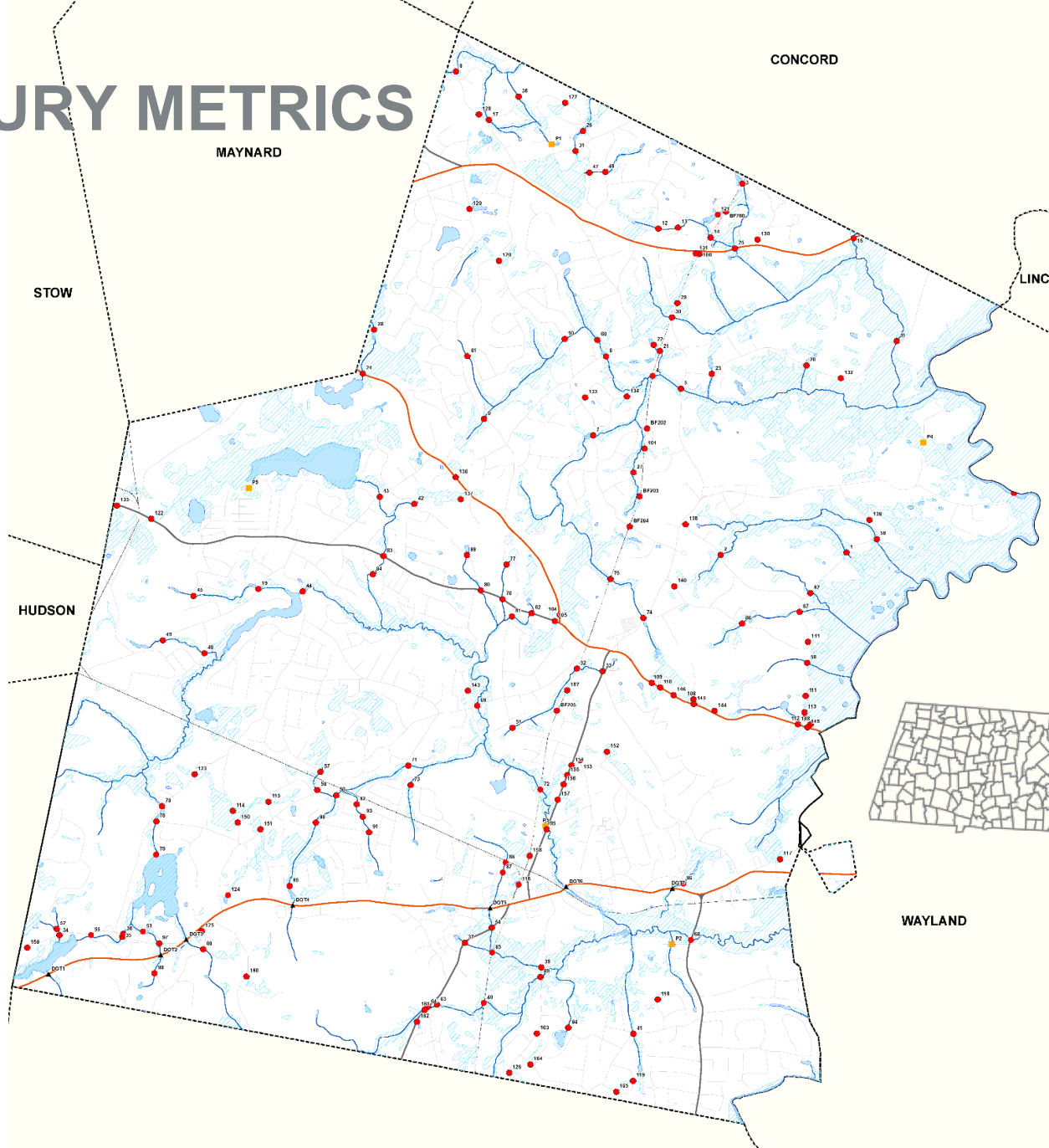
Landham Road Closed Until Further Notice

Originally scheduled as a three-week job, repairs on the bridge will now take longer.

By Robert Fucci, Patch Staff | Aug 15, 2013 3:54 pm ET | Updated Aug 15, 2013 4:40 pm ET



SUDBURY METRICS



OUR VISION



Maintain safe, passable streets



Create ownership of assets by using Town staff



Coordinate with Utilities and Water District projects



Reduce long-term costs



Program repair and replacement



Defensible plan



Identify funding sources



THE SOLUTION

- **Leverage Expertise of Town Staff**

- Experienced survey crew
- Known problem areas

- **Engage**

- Current
- On-site
- Risk
- Capabilities



Desktop Inventory

Protocol and Tablet App

Training

Ongoing Support

Assess Risk

Written Plans



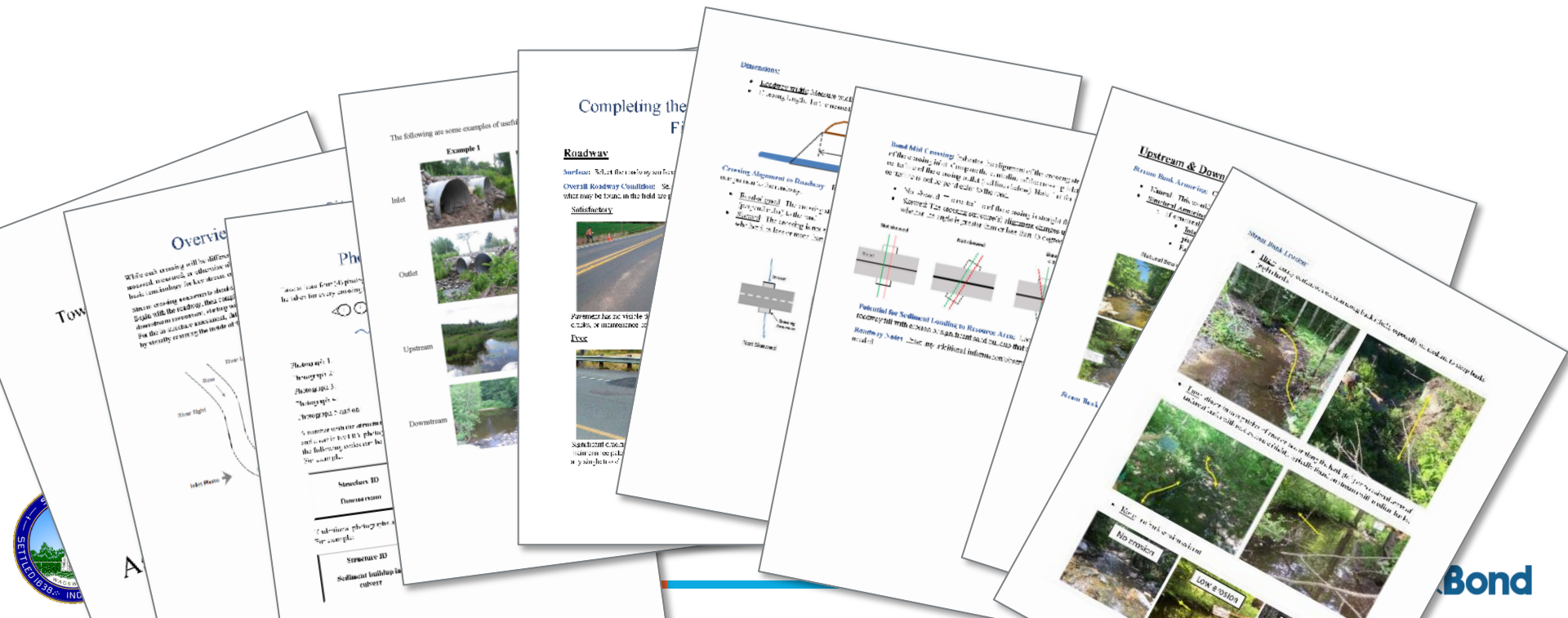
Areas known to have
Flooding Problem

- 1) #147 Water Row
- 2) #1 Water Row @ S Barr
- 3) #23 Lincoln Rd
- 4) #20 Lincoln Rd
- 5) Lincoln Rd @ Shirman's Back



WRITTEN INVENTORY GUIDANCE

- Inspiration
- State and National Guidance
- Considerations
 - Guidance customized to Sudbury's needs
 - Categories to support funding opportunities



INVENTORY COMPONENTS

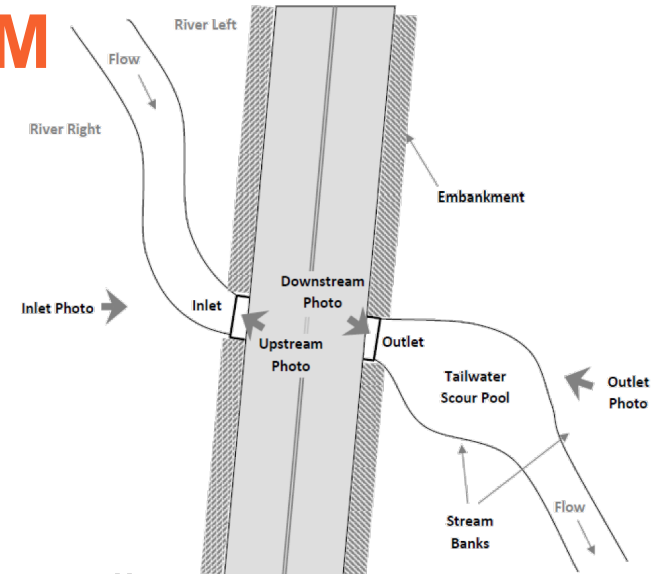
- **Inventory of condition and O&M**

1. Roadway
2. Upstream
3. Crossing Inlet
4. Crossing Outlet
5. Downstream

- **Condition rating**

- Satisfactory, fair, poor, critical/failing or low, medium, high, or unknown

- Roadway
- Cracking
- Headwall/wingwall
- Invert
- Joins and seams
- Upstream and downstream embankments
- Apron
- Damage
- Scour
- Cross-section
- Footing



**TOWN OF SUDBURY, MASSACHUSETTS
BRIDGE & CULVERT ASSESSMENT FIELD FORM**

Date: _____ Time: _____ Assessed By: _____

Road Name: _____ Culvert ID: _____

ROADWAY					
Surface:	<input type="checkbox"/> Paved	<input type="checkbox"/> Unpaved – gravel	<input type="checkbox"/> Unpaved – dirt	<input type="checkbox"/> Other:	
Overall Roadway Condition:	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Fair	<input type="checkbox"/> Poor	<input type="checkbox"/> Critical/Failing	<input type="checkbox"/> Unknown
Dimensions:	Total roadway width: _____ ft.		Total culvert length: _____ ft.		
Crossing Alignment to Roadway:	<input type="checkbox"/> Flow-aligned	<input type="checkbox"/> Skewed (< 45°)	<input type="checkbox"/> Skewed (> 45°)	<input type="checkbox"/> Unknown	
Bend Mid-Crossing:	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<i>If yes:</i> <input type="checkbox"/> Skewed (< 45°) <input type="checkbox"/> Skewed (> 45°) <input type="checkbox"/> Unknown		
Potential for Sediment Loading to Resource Area:	<input type="checkbox"/> High	<input type="checkbox"/> Medium	<input type="checkbox"/> Low	<input type="checkbox"/> None	
Roadway Notes: 					

UPSTREAM					
Stream Bank Armoring:	<input type="checkbox"/> Natural	<input type="checkbox"/> Structural	<i>Condition, if structural:</i> <input type="checkbox"/> Intact <input type="checkbox"/> Critical/Failing <input type="checkbox"/> Unknown		
Stream Bank Vegetated?	<input type="checkbox"/> No	<input type="checkbox"/> Yes			
Erosion:	<input type="checkbox"/> High	<input type="checkbox"/> Low	<input type="checkbox"/> None		
Angle of Stream Flow Approaching Crossing:	<input type="checkbox"/> Sharp bend	<input type="checkbox"/> Mild bend	<input type="checkbox"/> Naturally straight	<input type="checkbox"/> Channelized straight	
Bankfull Width:	_____ ft.				
Dominant Bed Material:	<input type="checkbox"/> Bedrock	<input type="checkbox"/> Boulder	<input type="checkbox"/> Cobble	<input type="checkbox"/> Silt/Muck	
	<input type="checkbox"/> Gravel	<input type="checkbox"/> Sand	<input type="checkbox"/> Unknown		
Upstream Notes: 					



CROSSING INVENTORY PROCESS

• Tablet application with ArcGIS Online/Survey123

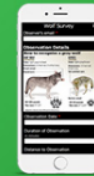


Collector for ArcGIS

Efficient, accurate data collection on smartphones or tablets replaces paper forms. Respond, record, work on- or offline, and sync automatically.

Collector for ArcGIS

- Map-based
- Offline and relationship support
- Extension of existing workflows



Survey123 for ArcGIS

Use a form-based survey interface in a lightweight, intuitive app. In just a few clicks you can collect, manage, and analyze survey results.

Survey 123

- Form-based
- Replace paper
- Avoid duplication and errors
- Smart fields
 - Default values, multiple choice
 - If/then





Sudbury Culvert Inspection



Potential for sediment loading to resource area

- High
- Medium
- Low
- None

Roadway Photo



Roadway Notes

Upstream

The following questions pertain the the upstream side of the culvert.

Stream Bank Armoring

Stream Bank Structure Condition

- Intact
- Critical/Failing
- Unknown

Stream Bank Vegetated?

- Yes
- No

Erosion

S
C
C
E
C
R
B
P
L
R

1
1
t



CROSSING INVENTORY PROCESS

- **Tablet application with ArcGIS Online/Survey123**
- **Training – Classroom and field**



CROSSING INVENTORY PROCESS

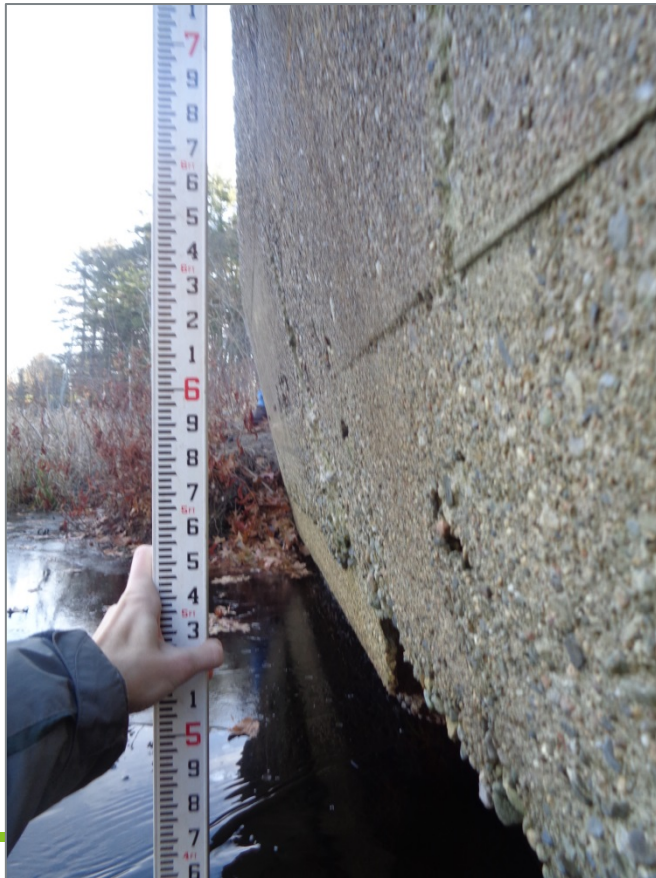
- Tablet application with ArcGIS Online/Survey123
- Training – Classroom and field
- Tracking & ongoing data review

	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
	Date Observed	Time	Culvert ID	Culvert ID	Assessed by	Other - Assessed by	Town	Road name	Location Description	Road Type	Other - Road Type	Roadway Condition	Roadway Width	Culvert Length	Flow Alignment	Potential
2	2017-08-21 4:00	09:58	35	35	JMurphy & RWell		Sudbury	WAYSIDE INN ROAD		Paved		Fair	22	25	Flow-Aligned	Medium
3	2017-08-21 4:00	10:52		36	JMurphy & RWell		Sudbury		Private							
4	2017-08-21 4:00	11:03		90	JMurphy & RWell		Sudbury	BENT ROAD		Paved		Satisfactory	25	61.5	Skewed (>45)	Low
5	2017-08-21 4:00	11:56		44	JMurphy & RWell		Sudbury	DUTTON ROAD		Paved		Satisfactory	22	29	Flow-Aligned	Low
6	2017-08-21 4:00	12:26		44	JMurphy & RWell		Sudbury	Dutton								
7	2017-08-21 4:00	12:38		43	JMurphy & RWell		Sudbury	FAIRBANK ROAD		Paved		Satisfactory	22	50	Skewed (>45)	Low
8	2017-08-24 4:00	10:28		8	JMurphy & RWell		Sudbury			Paved		Satisfactory	23	52	Flow-Aligned	Low
9	2017-08-24 4:00	11:05		128	JMurphy & RWell		Sudbury			Paved		Satisfactory	23	61	Flow-Aligned	Low
10	2017-09-12 4:00	10:15		17	JMurphy & RWell		Sudbury			Paved		Satisfactory	26	84	Flow-Aligned	Low
11	2017-09-12 4:00	10:47		38	JMurphy & RWell		Sudbury			Paved		Satisfactory	24	83	Flow-Aligned	Low
12	2017-09-13 4:00	10:53		3	JMurphy & RWell		Sudbury		Rail trail	Unpaved - Dirt, Unpaved - Gravel					Flow-Aligned	Low
13	2017-09-13 4:00	11:22		14	JMurphy & RWell		Sudbury			Other	Rail trail				Flow-Aligned	Low
14	2017-09-13 4:00	14:24			JMurphy & RWell		Sudbury	Bruce Freeman Rail Trail		Unpaved - Dirt, Unpaved - Gravel					Flow-Aligned	Low
15	2017-09-14 4:00	10:28		100	JMurphy & RWell		Sudbury			Unpaved - Dirt, Unpaved - Gravel		Satisfactory			Flow-Aligned	Low
16	2017-09-14 4:00	10:56		29	JMurphy & RWell		Sudbury			Unpaved - Dirt		Satisfactory			Flow-Aligned	Low
17	2017-09-14 4:00	11:03		30	JMurphy & RWell		Sudbury			Paved		Satisfactory	22	55	Flow-Aligned	Low
18	2017-09-25 4:00	10:32		21	JMurphy & RWell		Sudbury			Unpaved - Dirt					Flow-Aligned	Low
19	2017-09-25 4:00	10:52		BF202	JMurphy & RWell		Sudbury			Unpaved - Dirt		Satisfactory			Flow-Aligned	Low
20	2017-09-25 4:00	14:31		BF203	JMurphy & RWell		Sudbury								Flow-Aligned	Low
21	2017-09-25 4:00	14:47		101	JMurphy & RWell		Sudbury			Unpaved - Dirt					Flow-Aligned	Low
22	2017-09-26 4:00	10:36			JMurphy & RWell		Sudbury	Morse		Paved		Satisfactory	22	54	Flow-Aligned	None
23	2017-09-26 4:00	11:04		75	JMurphy & RWell		Sudbury			Unpaved - Dirt					Flow-Aligned	None
24	2017-09-26 4:00	14:32		32	JMurphy & RWell		Sudbury			Unpaved - Dirt					Flow-Aligned	None
25	2017-09-27 4:00	10:37		107	JMurphy & RWell		Sudbury			Unpaved - Dirt					Flow-Aligned	None
26	2017-09-27 4:00	14:44		158	JMurphy & RWell		Sudbury			Unpaved - Dirt		Satisfactory			Flow-Aligned	Low
27	2017-09-28 4:00	13:39			JMurphy & RWell		Sudbury									
28	2017-09-28 4:00	13:39			JMurphy & RWell		Sudbury									
29	2017-10-05 4:00	08:56		31	JMurphy & RWell		Sudbury	Powers rd		Paved		Satisfactory	18	37	Flow-Aligned	Low
30	2017-10-04 4:00	09:11		26	JMurphy & RWell		Sudbury	Maynard farm		Paved		Fair	23	48	Flow-Aligned	Low
31	2017-10-05 4:00	09:29		26	JMurphy & RWell		Sudbury									
32	2017-10-05 4:00	09:43		127	JMurphy & RWell		Sudbury			Paved		Satisfactory	24	58	Flow-Aligned	Low
33	2017-10-05 4:00	10:03		47	JMurphy & RWell		Sudbury						24	80	Flow-Aligned	Low
34	2017-10-05 4:00	10:18		46	JMurphy & RWell		Sudbury			Paved		Satisfactory	24	110	Flow-Aligned	None
35	2017-10-05 4:00	10:43		15	JMurphy & RWell		Sudbury			Paved		Satisfactory	24	60	Flow-Aligned	Low
36	2017-10-05 4:00	11:18		130	JMurphy & RWell		Sudbury			Paved		Satisfactory	24	52	Flow-Aligned	None
37	2017-10-05 4:00	13:14		25	JMurphy & RWell		Sudbury			Paved		Satisfactory	30	64	Flow-Aligned	None
38	2017-10-05 4:00	13:32			JMurphy & RWell		Sudbury	Windmill drive 1		Paved		Satisfactory	22	50	Flow-Aligned	None
39	2017-10-05 4:00	13:44		131	JMurphy & RWell		Sudbury									
40	2017-10-05 4:00	13:50			JMurphy & RWell		Sudbury			Paved		Satisfactory	24	50	Flow-Aligned	None



PRELIMINARY RISK-BASED PRIORITIZATION

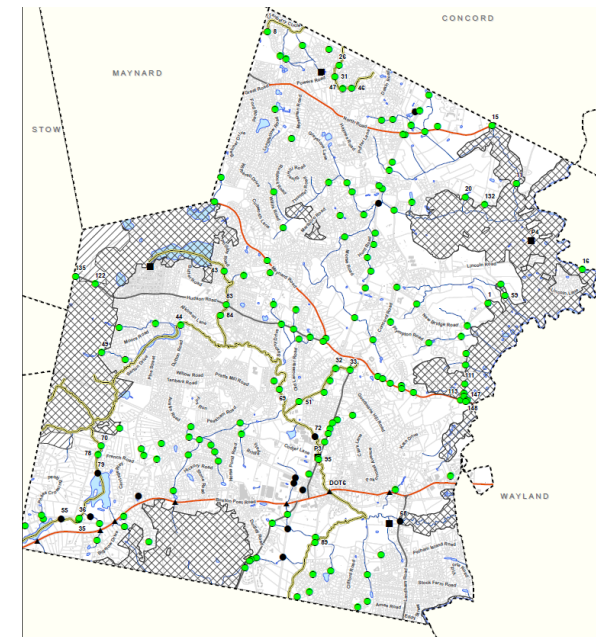
- Likelihood of failure from Town staff inventory
- Photographs
- Best professional judgment



PROFESSIONAL EVALUATION

- **Validate data collection**
- **Field Evaluation**
 - Hands-on assessment
 - Joined by Assistant DPW Director / Town Engineer
 - Limited consultant effort by completing long days
- **Wetlands scientist review**
 - Permitting issues
 - Habitat considerations (e.g. Coldwater fisheries resources, NHESP Priority and Estimated habitat)

Field Evaluation by
Structural Engineer and
Visual Assessment by
Professional Wetlands
Scientist



COMPREHENSIVE RISK-BASED PRIORITIZATION

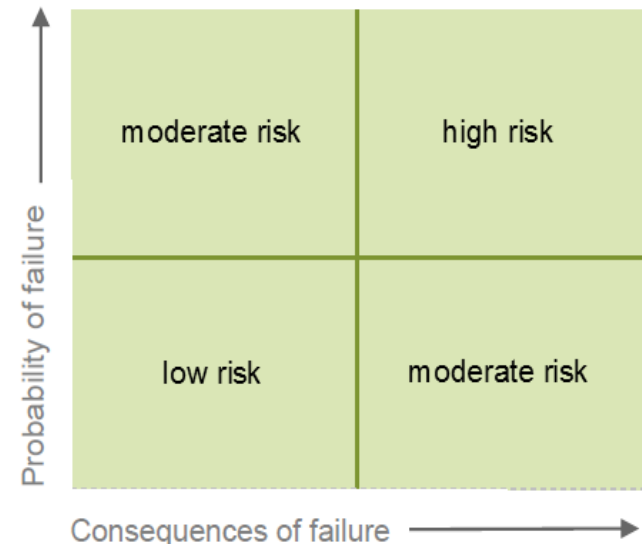
- **Probability of Failure**

- Factors from inventory
- Factors from professional evaluation

- **Consequence of Failure**

- Safety related
 - Roadway classification
 - Re-route distance
 - Dead ends
- Flooding

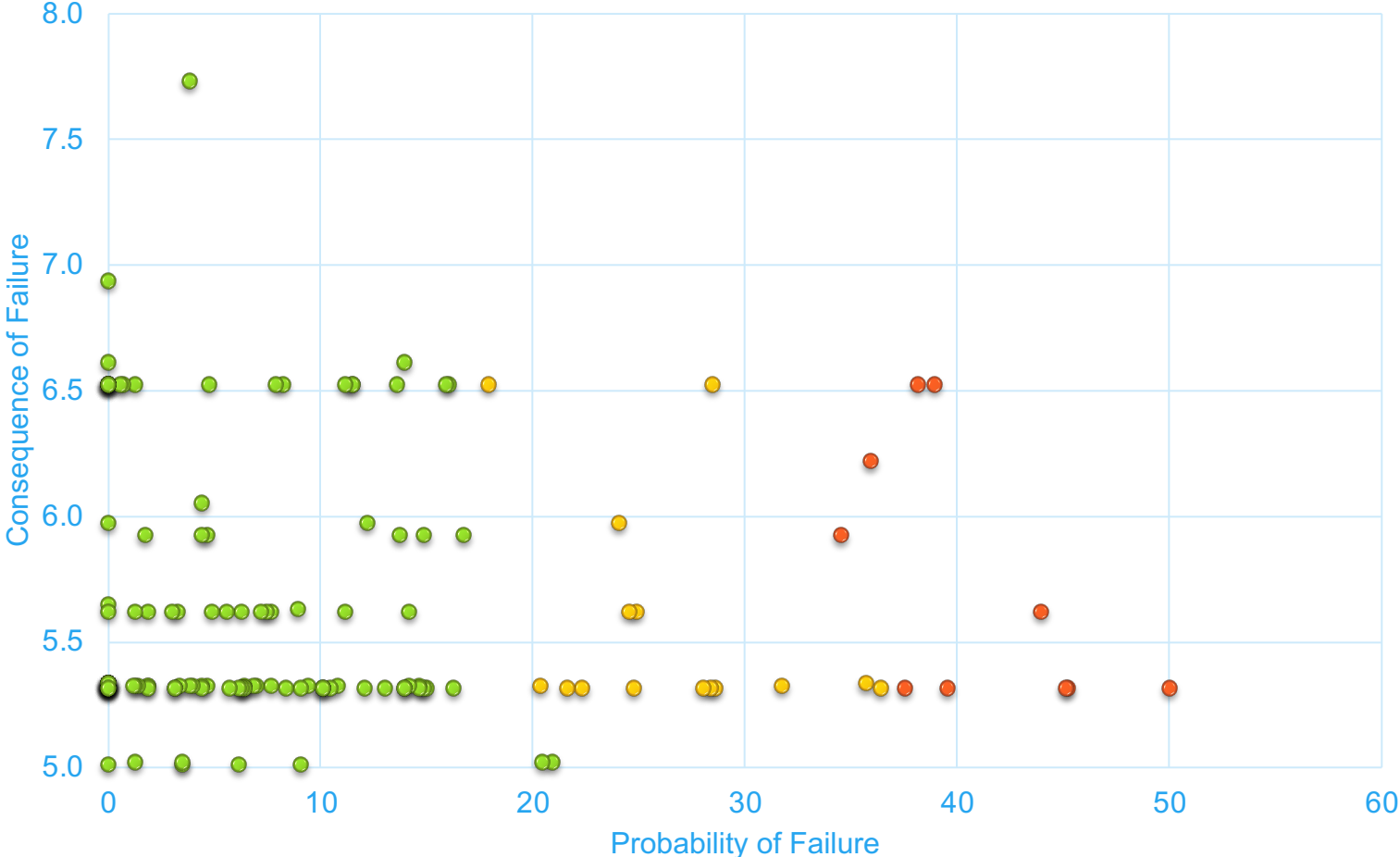
Criticality Matrix



Source: EPA, "Fact Sheet: Asset Management for Sewer Collection Systems," April 2002.

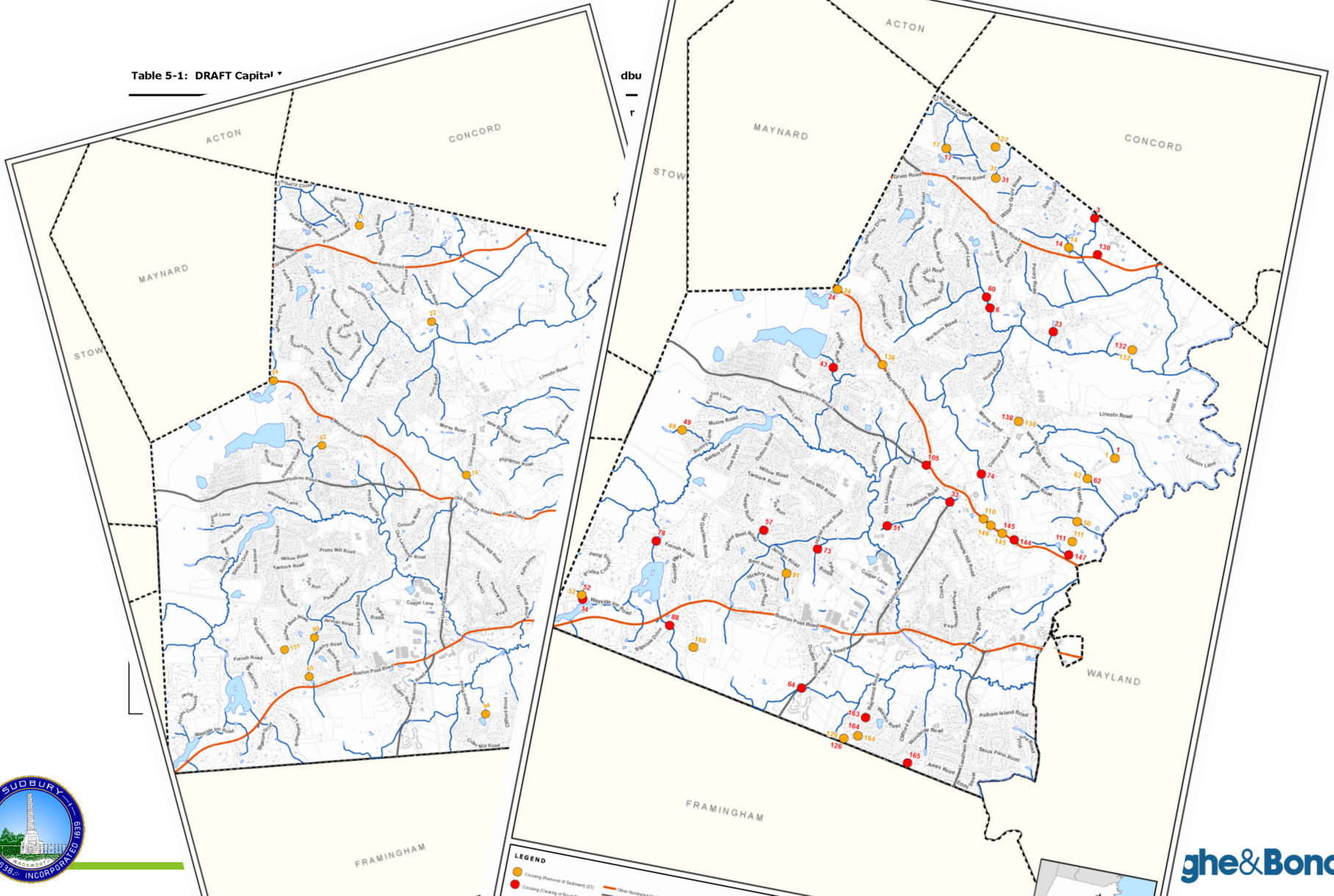


OVERVIEW OF RESULTS



CIP AND O&M PLAN

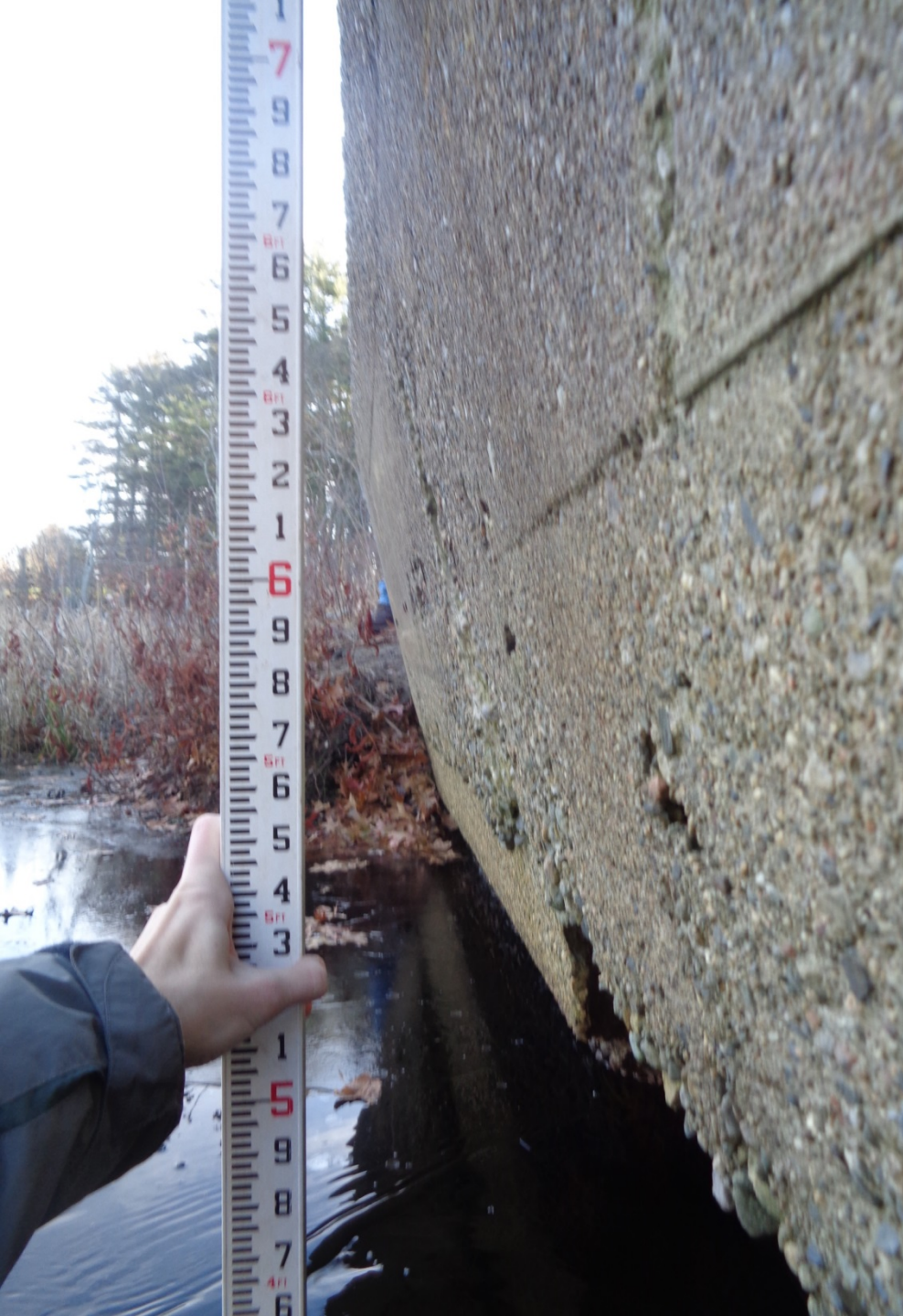
Table 5-1: DRAFT Capital



dbu

















NEXT STEPS

- **Garner political buy in & local commitment to funding**
- **Working to achieve grant \$ wherever possible**
 - MassDOT Small Bridge Program
 - DER Culvert Replacement Municipal Assistance Grants
 - MVP Action Grants
- **Implement recommendations at high priority crossings**
- **Ongoing maintenance and inspection program**



SUMMARY OF TIPS AND TRICKS FOR A COST-EFFECTIVE CULVERT MANAGEMENT PROGRAM

1. **No matter how sure you are, start with desktop inventory**
2. **Consider funding strategy up front & include factors in inventory**
3. **Gather as much information as reasonable during site visits**
4. **Use gadgets for data collection, but don't forget the paper!**
5. **Plentiful and well taken photographs are key**
6. **Remember site safety throughout**
7. **Be okay with long days, it's actually faster**
8. **Engage a consistent reviewer dedicated to all data management**
9. **Risk-based prioritization must recognize replacement, repairs, and maintenance in scoring**



QUESTIONS AND DISCUSSION

- Dan Nason, Director of Public Works
NasonD@sudbury.ma.us
(978) 440-5421
- Bill O'Rourke, Assistant Director/ Town Engineer
ORourkeW@sudbury.ma.us
(978) 440-5421
- Jennie Moonan, Tighe & Bond
JSMoonan@tighebond.com
781-708-9826
- Eric Ohanian, Tighe & Bond
EOhanian@tighebond.com
781-708-9834

