

Bridge Asset Management: The Value of Preservation

Presented By:

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Phone (517) 512-3120



State DOT (29)

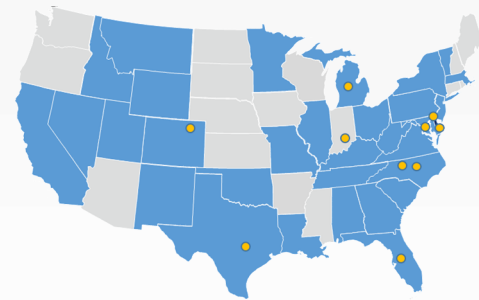
Counties (12)

Cities (100+)

FHWA

AASHTO

NCHRP



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What is Bridge Preservation?

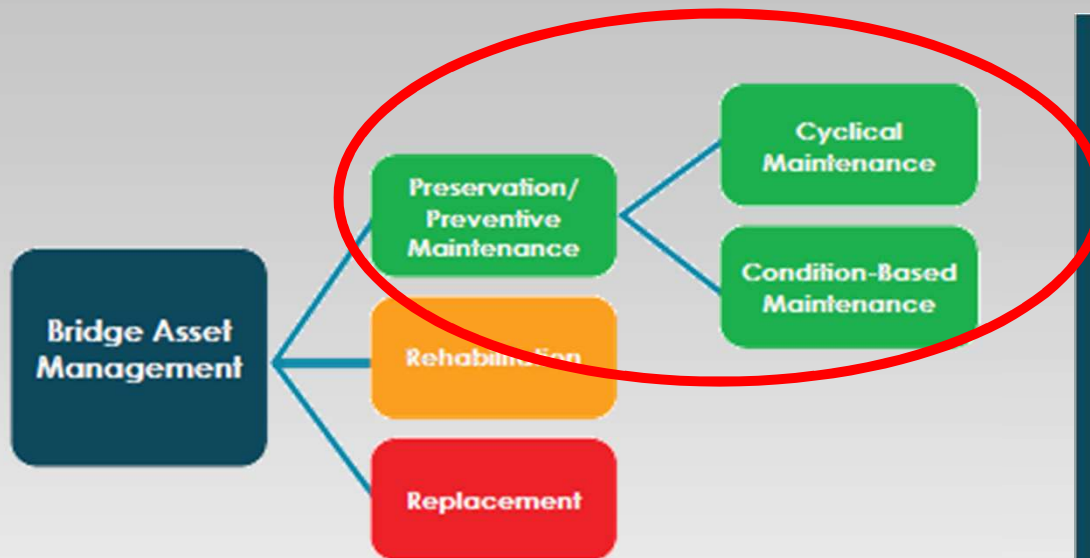
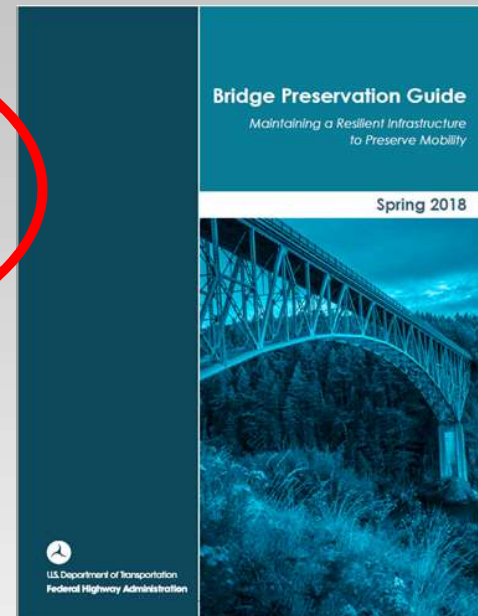


Figure 2. Bridge action categories.



<https://www.fhwa.dot.gov/bridge/preservation/guide/guide.pdf>

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Maintenance

- In-house
- By contract



Figure 4. Broadcasting aggregate on sealer.

Photo courtesy of GPI



Figure 3. Bridge washing.

Photo courtesy of Washington State DOT

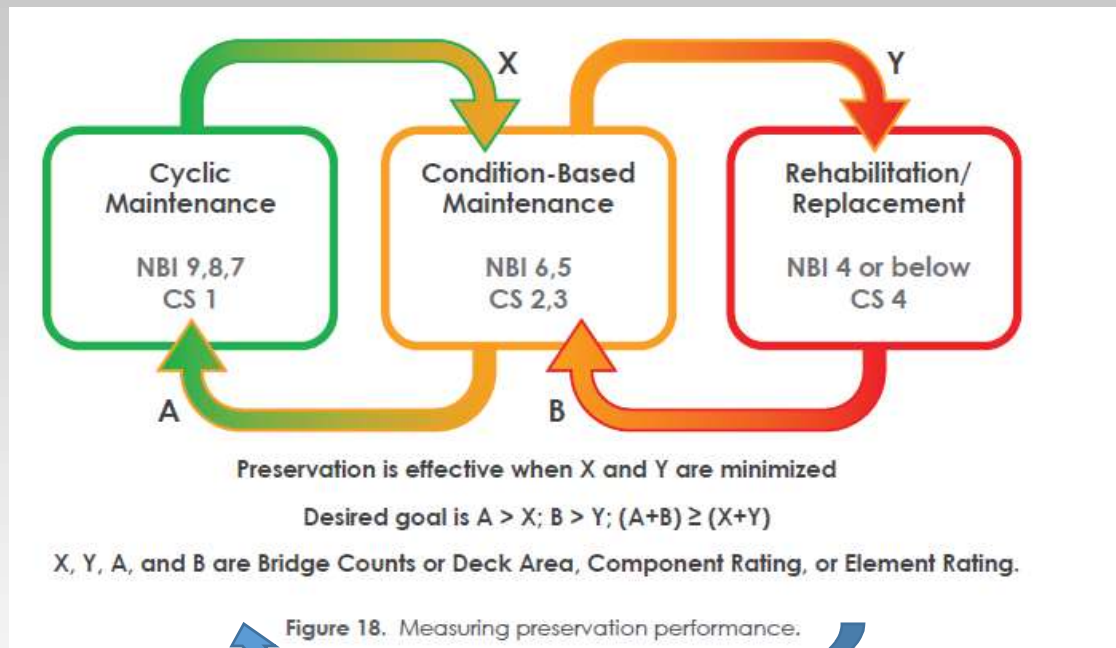
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The Value of Preservation is to Slow Down Deterioration

Deterioration



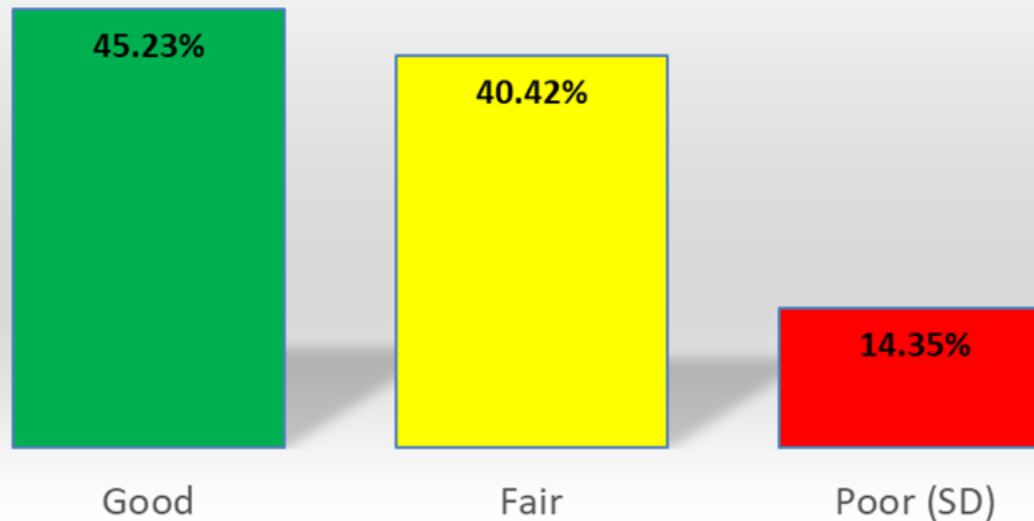
Improvement



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Michigan Local Agency Bridge Condition

2019 Michigan Local Agency Bridges
Overall Bridge Condition

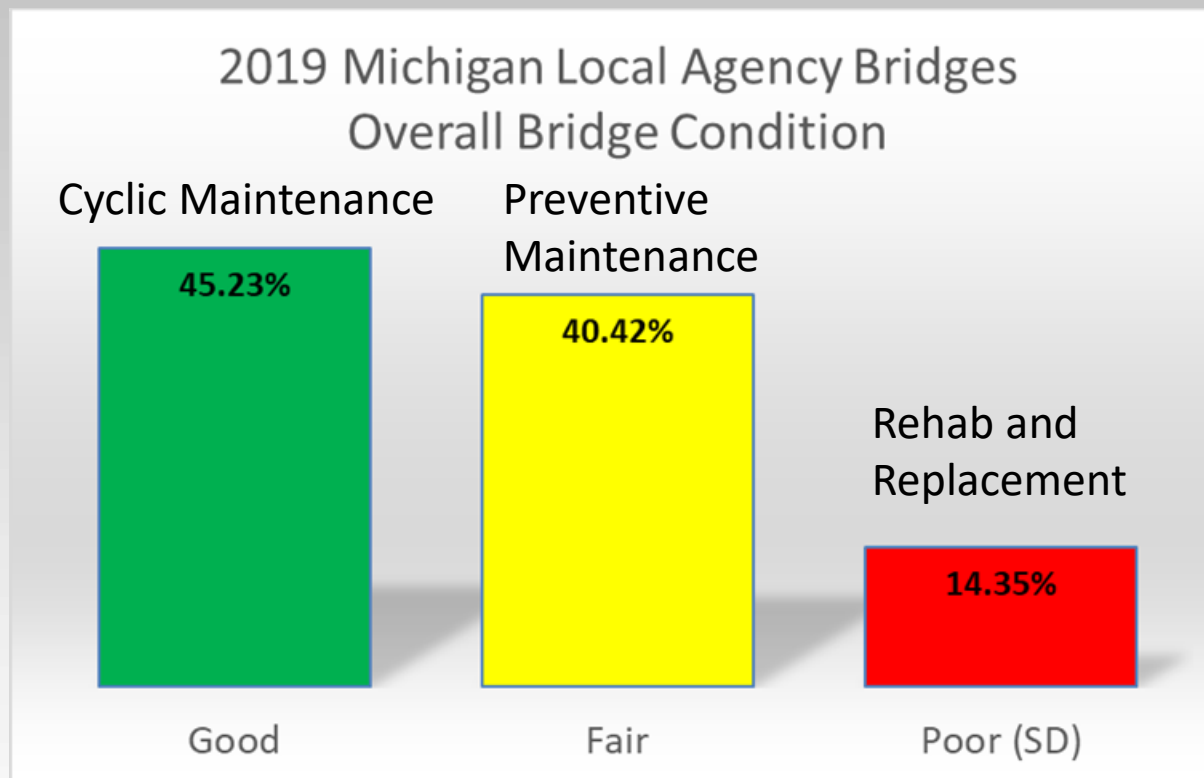


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Michigan Local Agency Bridge Condition

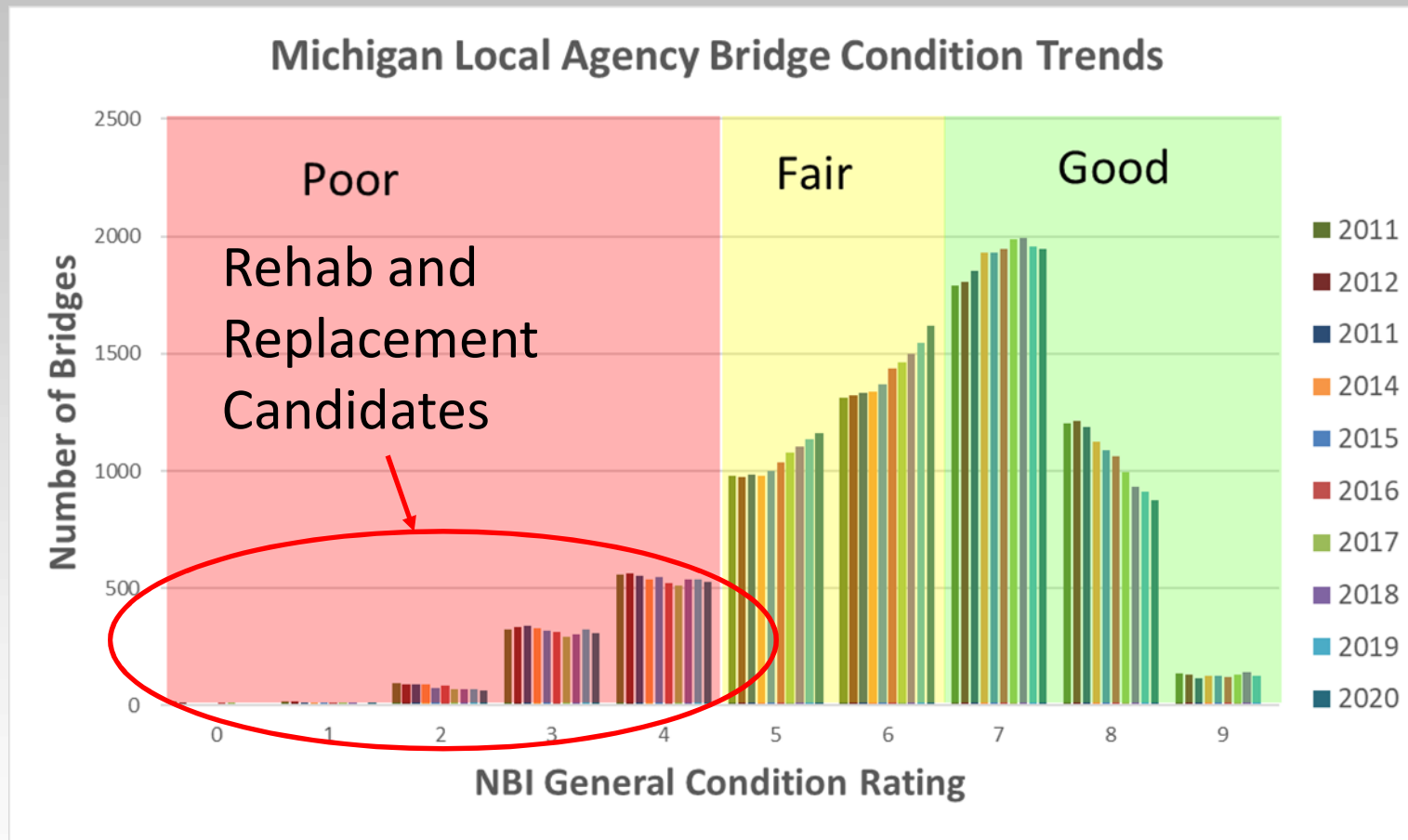


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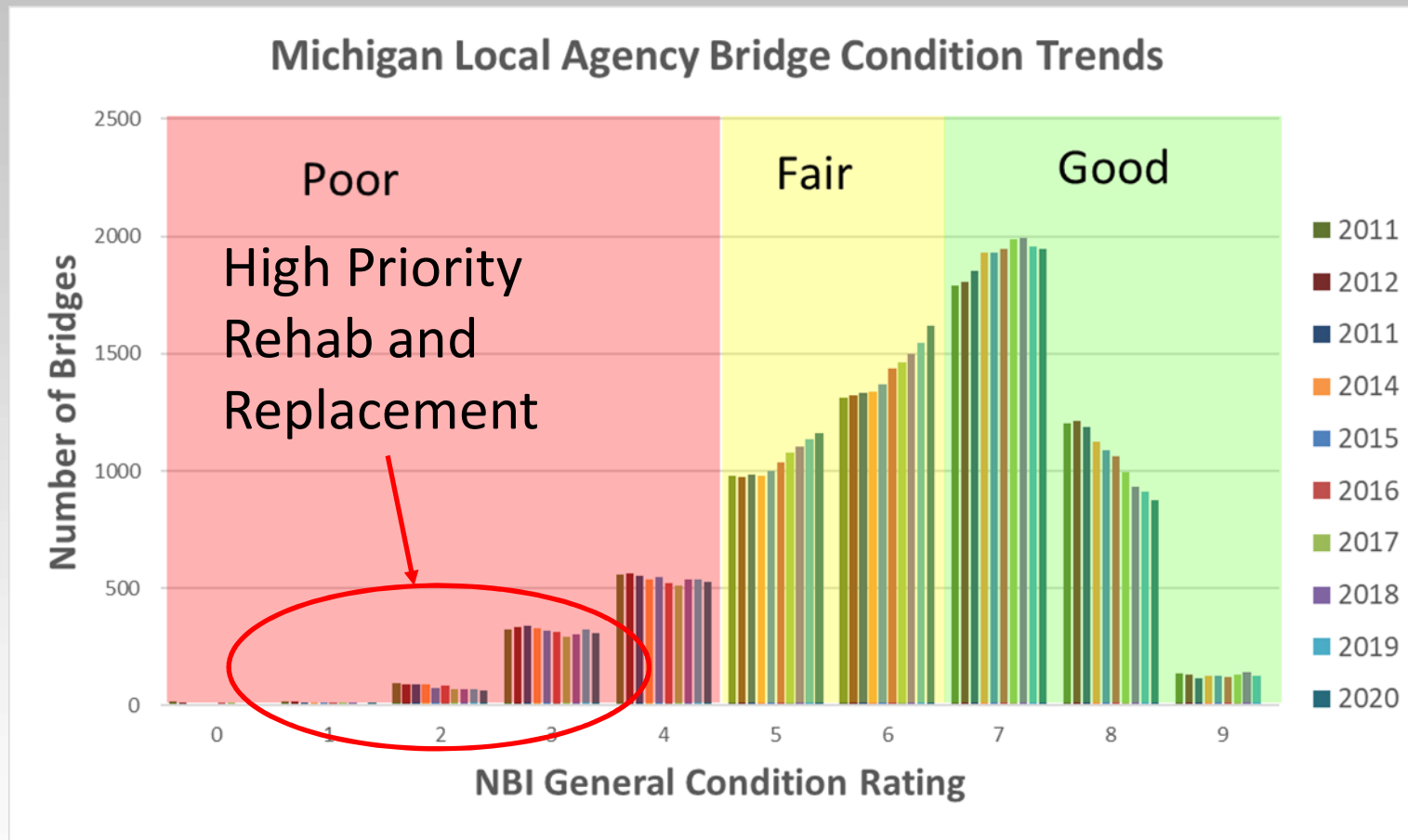
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Michigan Local Agency NBI GCR Condition Trends



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Michigan Local Agency NBI GCR Condition Trends



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We are busy taking care of the poor, serious, and critical bridges



Reactive! Crisis Mode



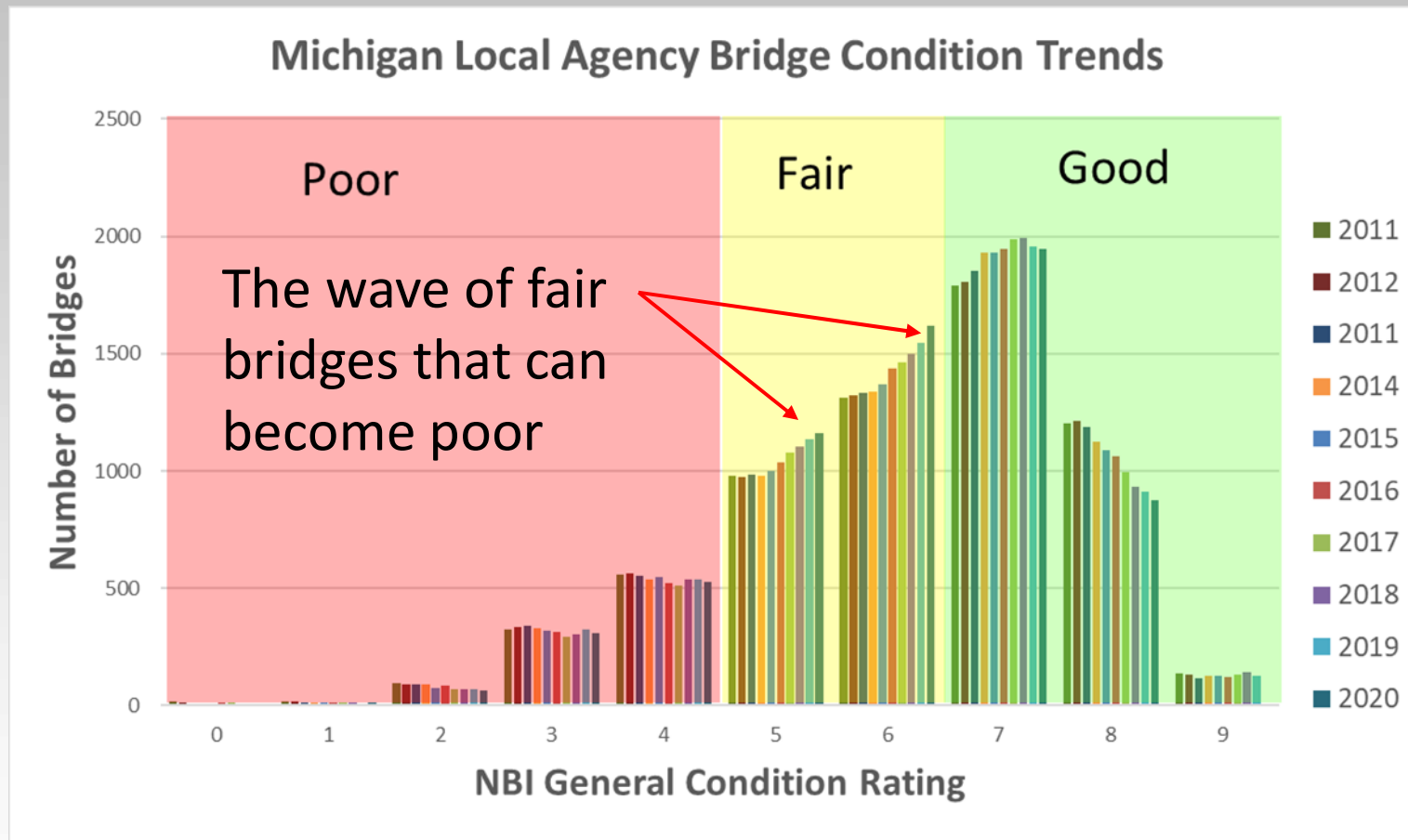
Are we thinking about the best way to manage all our bridges?

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Michigan Local Agency NBI GCR Condition Trends



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Local Agency Bridges Becoming Poor Each Year (the hole in the boat)

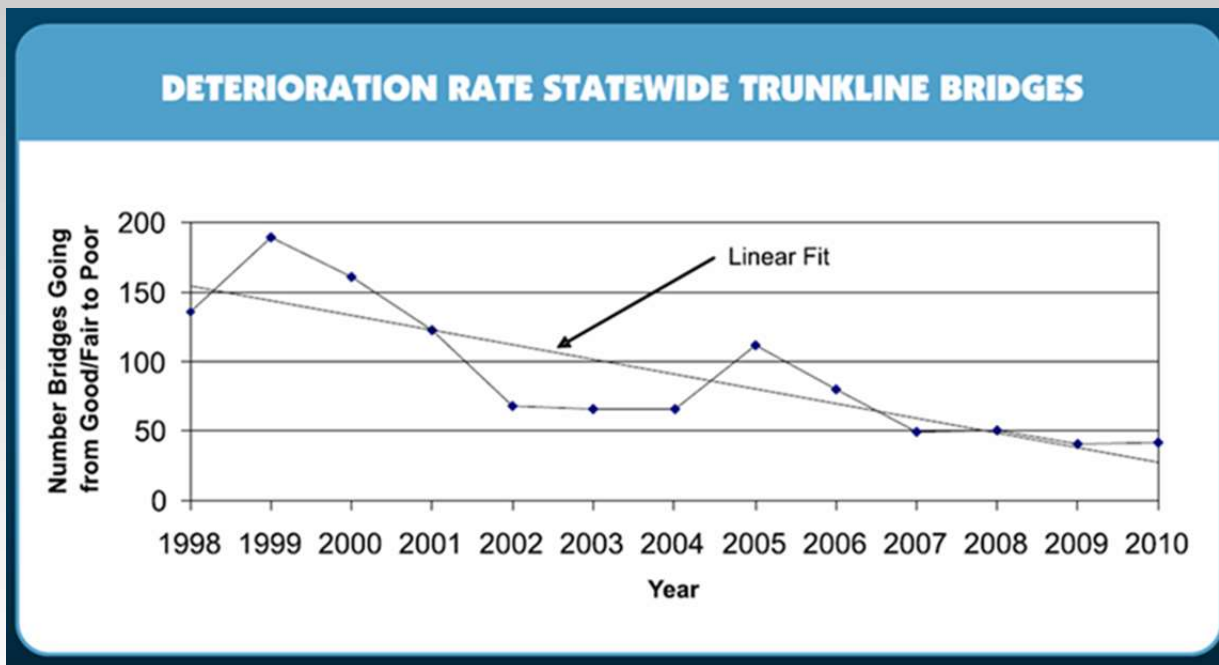
- 2017 – 64 Structures
- 2018 – 96 Structures
- 2019 – 80 Structures
- 2020 – 50 Structures



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Showing the Value of Preservation

Track How many Bridges Become Poor Each Year



- 2018 - 44
- 2019 - 41
- 2020 - 74

Lag Measure

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Showing the Value of Preservation

Benefit Cost Analysis (BCA)

$$\frac{\Delta Benefit}{Cost}$$

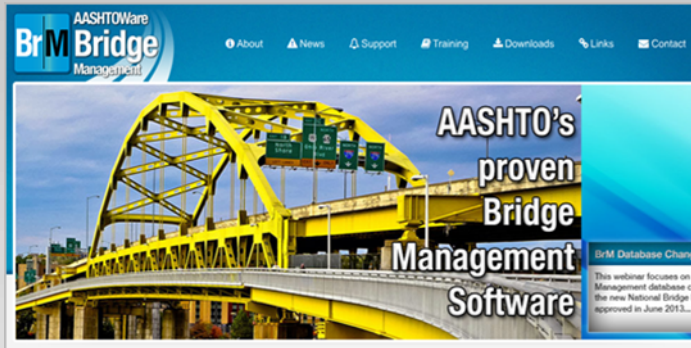
The heart of a Bridge Management System (BMS)

Lead Measure



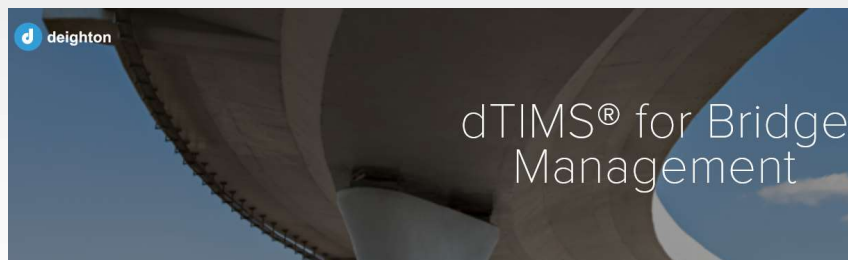
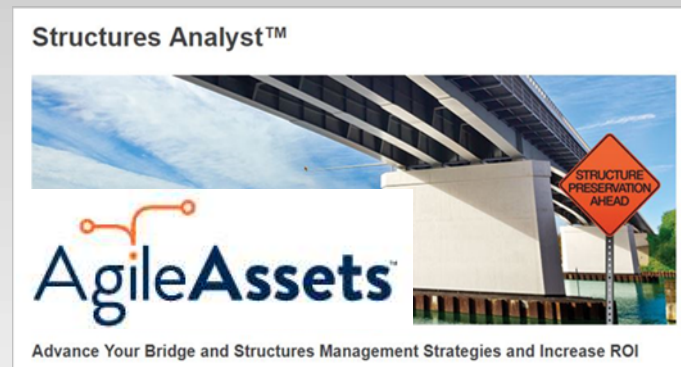
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Benefit Cost Analysis is Part of All Advanced Bridge Management Systems



$$\frac{\Delta \text{Benefit}}{\text{Cost}}$$

$$\frac{\Delta \text{Benefit}}{\text{Cost}}$$



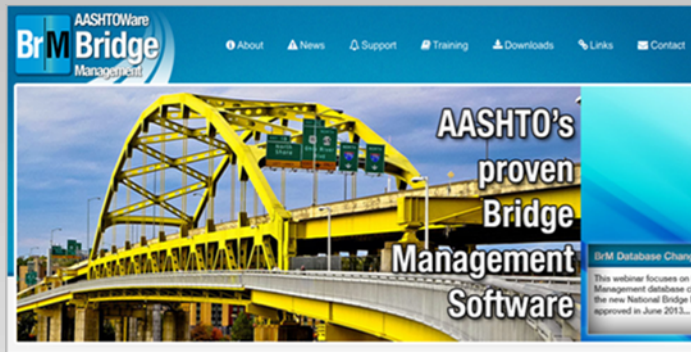
$$\frac{\Delta \text{Benefit}}{\text{Cost}}$$

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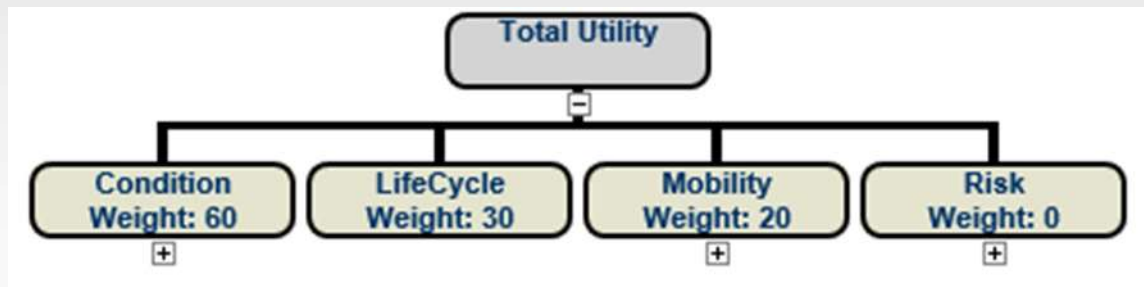
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Benefit Examples



$$\frac{\Delta Benefit}{Cost}$$

Benefit = Delta Total Utility

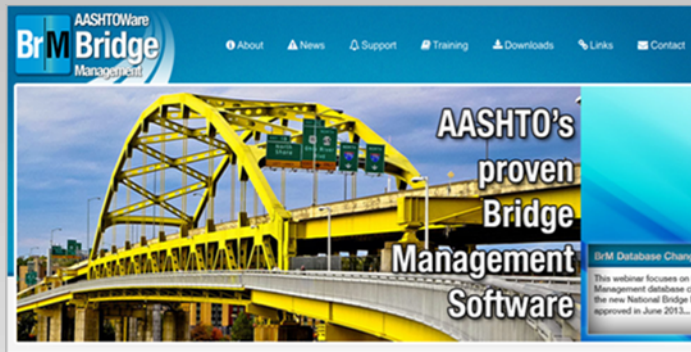


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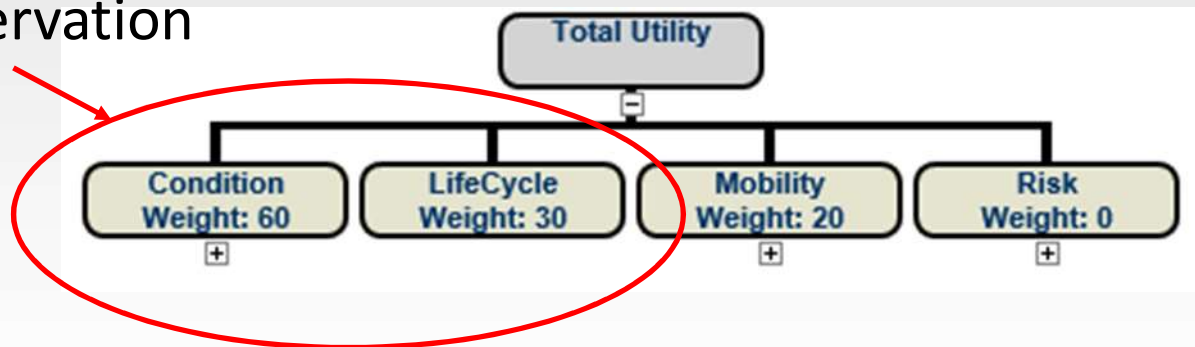
Benefit Examples



$$\frac{\Delta Benefit}{Cost}$$

Benefit = Delta Total Utility

Value of
Preservation

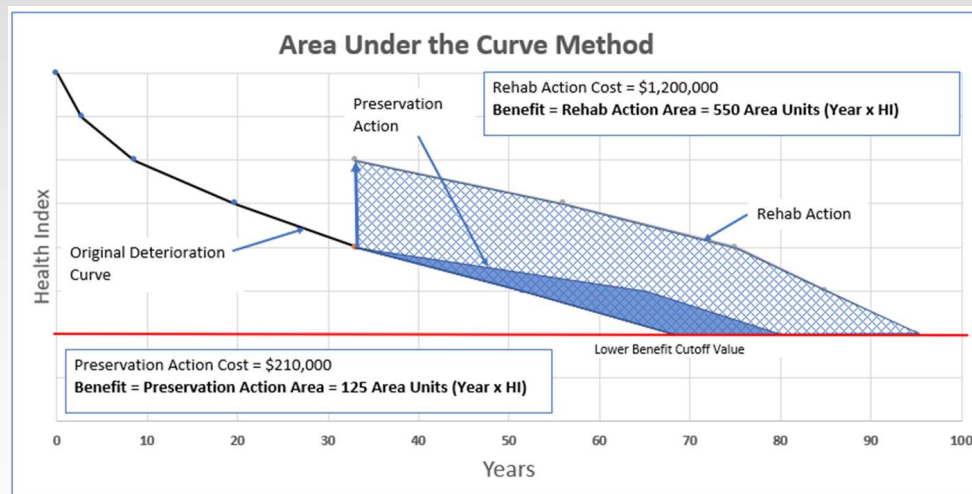


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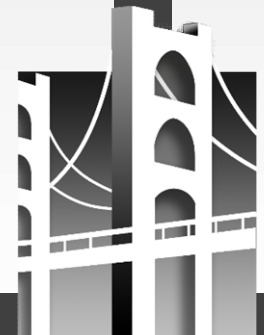
Benefit Examples



Benefit = Area Between Deterioration Curves



$$\frac{\Delta \text{Benefit}}{\text{Cost}}$$



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Simple Benefit Example

Bridge Replacement:

Service Life = 75 years

Cost = \$1.5 Million



$$\frac{\Delta Benefit}{Cost} = \frac{75}{\$1.5 \text{ Million}} = 50$$



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Benefit Example

Deck Epoxy Overlay

Service Life = 15 years

Cost = \$50,000

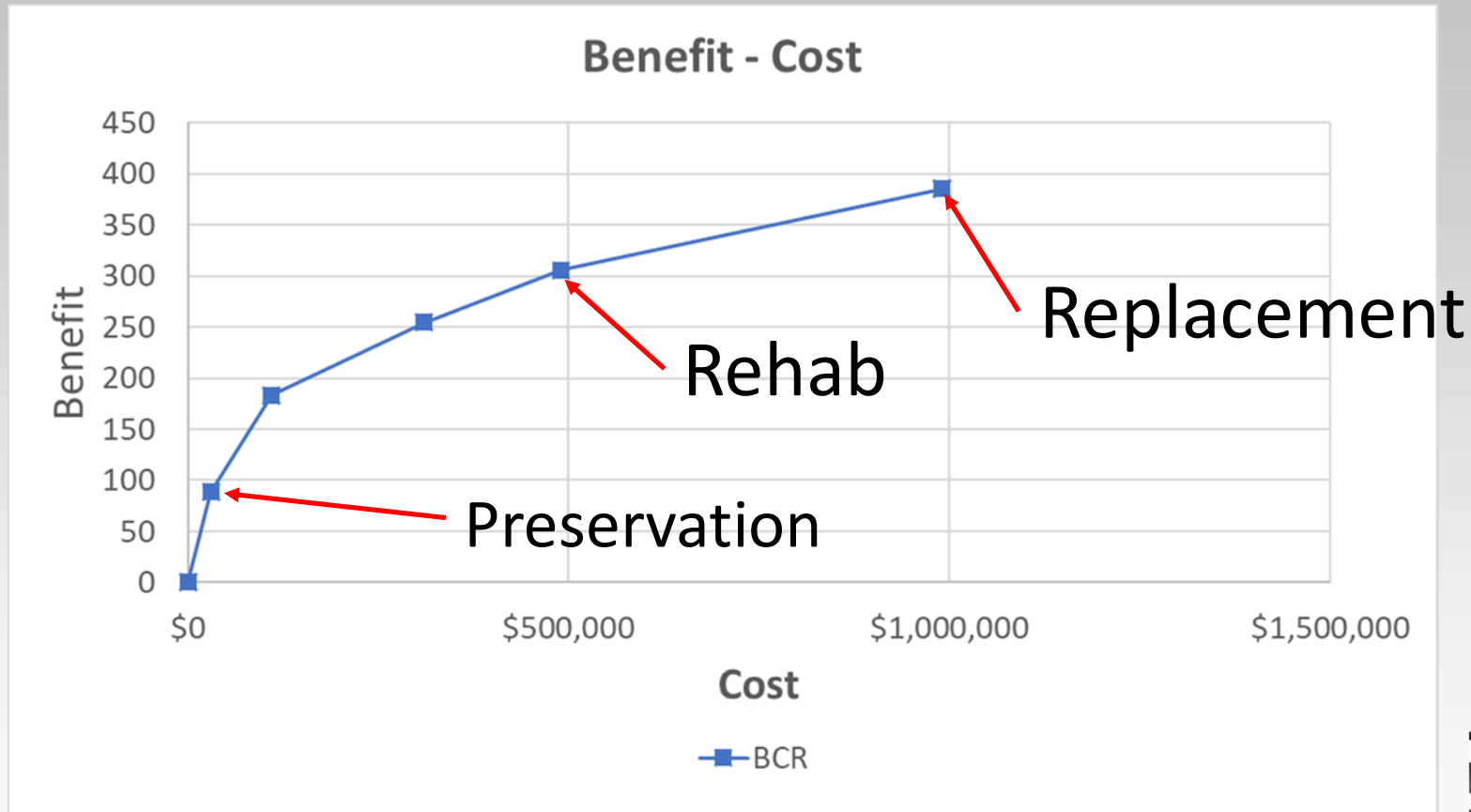


$$\frac{\Delta Benefit}{Cost} = \frac{15}{\$0.05 \text{ Million}} = 300$$



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BCA - Law of Diminishing Returns



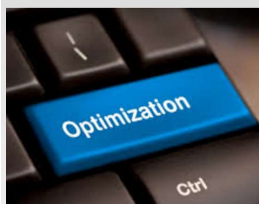
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How This is Used in a Bridge Management System

■ Example

- Objective Function
 - Maximize Bridge Condition
- Constraints
 - Budget \$200 Million Annually
 - Do not allow any bridges to become Serious or Critical (NBI GCR < 4)

BMS
Optimizer



■ Optimized List of Projects

- Bridge 1001 - PM
- Bridge 2056 - PM
- Bridge 3412 - PM
- Bridge 4443 - Rehab
- Bridge 5512 - Rehab
- Bridge 6600 - Replacement
-
-
-

Scenario comparisons are made by changing input variables and running the optimizer.



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Example – Post Process Optimized List of Bridges To Develop Strategic Investment Strategy

■ Example

- Objective Function
 - Maximize Bridge Condition
- Constraints
 - Budget \$200 Million Annually
 - Do not allow any bridges to become Serious or Critical (NBI GCR < 4)

BMS
Optimizer

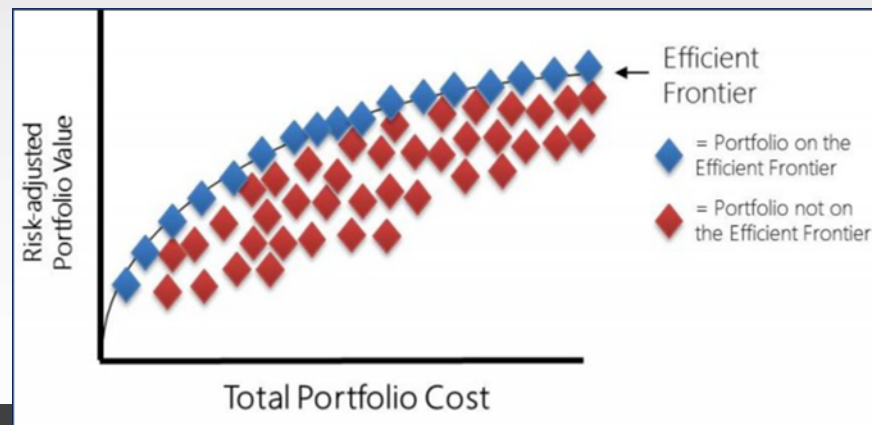
■ Optimized List of Projects

- Bridge 1001 – PM
- Bridge 2056 – PM
- Bridge 3412 – PM
- Bridge 4443 – Rehab
- Bridge 5512 – Rehab
- Bridge 6600 – Replacement
-
-
-

Post-
processing

■ Strategy (Mix of Fixes)

- 20% PM
- 30% Rehab
- 50% Replacement



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FHWA Minimum Requirements for Developing and Operating a Bridge Management System

- Collecting, processing, storing, and updating inventory and condition data
- Forecasting deterioration
- Determining the benefit-cost over the life cycle of assets to evaluate alternative actions
- Identifying short- and long-term budget needs for managing the condition
- Determining the strategies for identifying potential bridge projects
- Recommending programs and implementation schedules to manage the condition of bridge assets within policy and budget constraints



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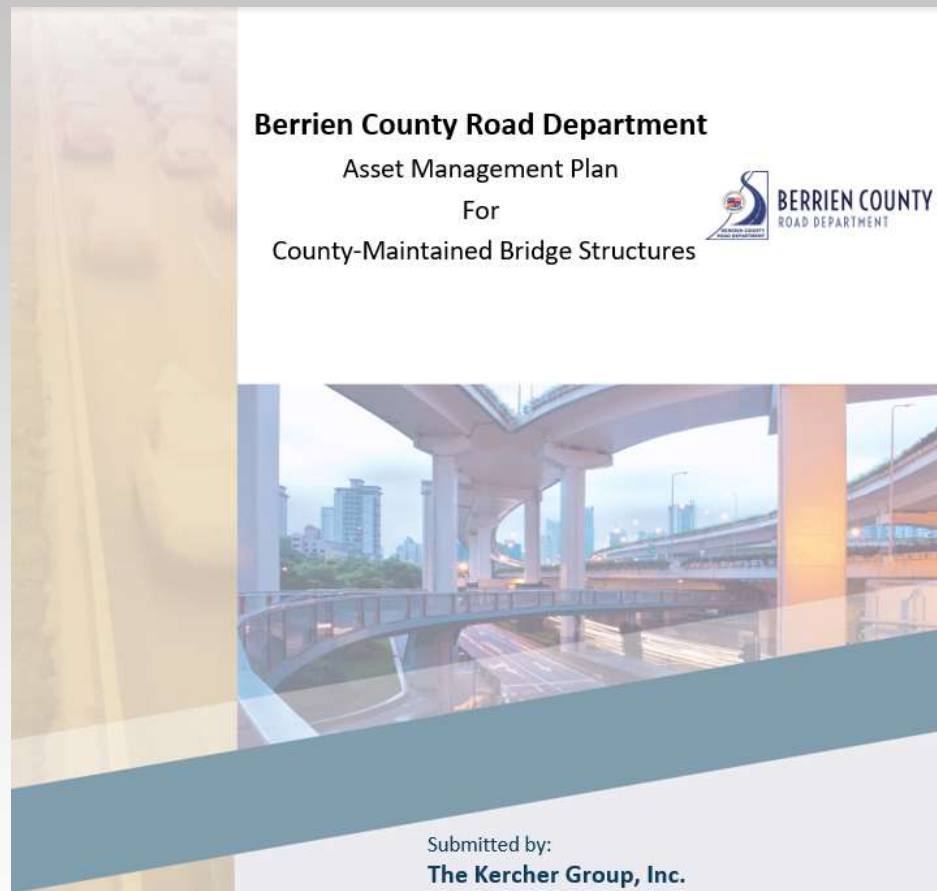
LOCAL AGENCY BRIDGE MANAGEMENT

- Bridge Asset Management is not just for State DOTs
- It is for agencies of all sizes and budget



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Berrien County's Bridge Asset Management Plan



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Mi-Bridge Data Export

MiBRIDGE Bridge Management and Inspection System

[Michigan.gov Home](#)
[MIBRIDGE Home |](#)
[Contact MIBRIDGE |](#)
[Feedback |](#)
[Help](#)
Sign Out

Welcome David Juntunen
Jurisdiction: MIDOT - Region - Statewide

Administration
Assignments
Dashboards
Reports

Structure Condition Dashboard

Jurisdiction County - Berrien ▼

Structure Inventory Summary

Total No. of Structures	103
Highway (NBI) Structures greater than 20'	102
Highway Structures less than 20'	0
Rail Road Structures (X)	0
Pedestrian Structures (P)	1
Other Non-Highway Structures (V, Plaza)	0

Additional Bridge Inventory Information

Posted Structures	21
Closed Structures	1
Fracture Critical Structures	0
Scour Critical Structures	5
Scheduled/Under Construction (S, G)	0

Structure Condition Summary

Good/Fair (5 or Greater)	89
Highway included in NBI	88
Non NBI Structures (<20, RR, Ped, etc.)	1
Poor (4)	7
Highway included in NBI	7
Non NBI Structures (<20, RR, Ped, etc.)	0
Serious/Critical (3 or less)	7
Highway included in NBI	7
Non NBI Structures (<20, RR, Ped, etc.)	0
Unrated Structures	0
Highway included in NBI	0
Non NBI Structures (<20, RR, Ped, etc.)	0

SD/FO Summary

*Structurally Deficient	14
*Functionally Obsolete	8
*Non-Deficient Structures	80
*No Current SD/FO Rating	11

NBI Condition - Goals Summary

*Good/Fair (5 or Greater)	Pct.
Freeway	86.3%
Non-Freeway	0.0%
*Poor/Serious/Critical (4 or Less)	86.3%
Freeway	13.7%
Non-Freeway	0.0%
*Poor NHS Deck Area	13.7%
*Applies ONLY to Highway Structures > 20'	0.0%

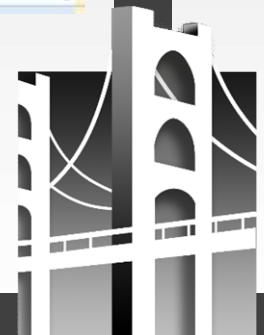
Structure Inventory Summary
 Open ▼

Select	Strukt. Nbr.	Bridge ID	Facility Carried	Features Intersected	Structure Name	Region	NBI	Fwy	Insp. Date	Fract Crit	Scour Crit	Deck Rtg	Surf Rtg	Deck Botm Rtg	Super Str Rtg	Sub-Str Rtg	Culv. Rtg	SD FO	MDOIT Suff Rtg
<input type="checkbox"/>	956	11200002000B010	FOREST LAWN ROAD	S BR GALIEN RIVER	Southwest	Y	N	04/23/2018	N	5	7	7	N	7	8	N	N		87.9
<input type="checkbox"/>	957	11200002000B020	FOREST LAWN ROAD	SPRING CREEK	Southwest	Y	N	04/23/2018	N	8	8	8	N	8	8	N	N		99.9
<input type="checkbox"/>	958	11200004000B010	BERTRAND ROAD	ST JOSEPH RIVER	Southwest	Y	N	07/28/2018	N	5	6	7	6	6	5	N	N		88.6
<input type="checkbox"/>	959	11200006000B010	KRUGER ROAD	S BR OF GALIEN RIVER	Southwest	Y	N	04/23/2018	N	5	7	7	7	8	7	N	N		97.9
<input type="checkbox"/>	960	11200006000B020	KRUGER ROAD	DOWLING CREEK	Southwest	Y	N	04/23/2018	N	5	N			N	N	8	N		99.9
<input type="checkbox"/>	962	11200013000B010	WARREN WOODS ROAD	GALIEN RIVER	Southwest	Y	N	06/19/2018	N	5	7	7	7	7	8	N	N		99.8
<input type="checkbox"/>	963	11200013000B020	WARREN WOODS ROAD	GALIEN RIVER	Southwest	Y	N	06/19/2018	N	5	7	7	N	7	8	N	N		99.6
<input type="checkbox"/>	964	11200014000B010	PUCKER STREET	DOWAGIAC CREEK	Southwest	Y	N	07/11/2018	N	8	7	7	N	7	7	N	N		
<input type="checkbox"/>	965	11200015000B010	GLENDORA ROAD	E BR GALIEN RIVER	Southwest	Y	N	04/02/2019	N	3	4	7	3	4	6	N	SD		
<input type="checkbox"/>	966	11200015000B020	GLENDORA ROAD	E BR GALIEN RIVER	Southwest	Y	N	04/02/2019	N	3	4	6	4	3	5	N	SD		
<input type="checkbox"/>	967	11200015000B030	GLENDORA ROAD	E BR GALIEN RIVER	Southwest	Y	N	06/19/2018	N	8	N			N	N	4	SD		55.4
<input type="checkbox"/>	969	11200019000B020	SNOW ROAD	HICKORY CREEK	Southwest	Y	N	06/20/2018	N	7	6	6	7	7	4	N	SD		50.8
<input type="checkbox"/>	970	11200020000B010	SHAWNEE ROAD	FOWLER DRAIN	Southwest	Y	N	06/20/2018	N	5	N			N	N	7	N		99.1
<input type="checkbox"/>	971	11200020000B020	SHAWNEE ROAD	HICKORY CREEK	Southwest	Y	N	06/20/2018	N	5	N			N	N	8	N		99.1
<input type="checkbox"/>	13484	11200024000B010	DEANS HILL ROAD	LOVE CREEK	Southwest	Y	N	0											

Berrien County Michigan Spreadsheet BMS

A	AV	AW	AY	AZ	BA	BB	BC
Facility over Features Intersected	2019	Arrow 2019	Estimated Time to Condition Drop 2019	2019 Projects	Cost 2019	Updated Bridge Rating 2019	PM Added Time in Condition Rating 2019
FOREST LAWN ROAD over S BR GALIEN RIVER - 956	7		4				
FOREST LAWN ROAD over SPRING CREEK - 957	7	↓	12				
BERTRAND ROAD over ST JOSEPH RIVER - 958	5		9				
KRUGER ROAD over S BR OF GALIEN RIVER - 959	6	↓	15				
KRUGER ROAD over DOWLING CREEK - 960	8		1				
WARREN WOODS ROAD over GALIEN RIVER - 962	7		4				
WARREN WOODS ROAD over GALIEN RIVER - 963	7		0				
PUCKER STREET over DOWAGIAC CREEK - 964	6	↓	15				
GLENDORA ROAD over E BR GALIEN RIVER - 965	4		17				
GLENDORA ROAD over E BR GALIEN RIVER - 966	3		5	Replacement	\$760,000	9	
GLENDORA ROAD over E BR GALIEN RIVER - 967	4		19				
SNOW ROAD over HICKORY CREEK - 969	4		7				
SHAWNEE ROAD over FOWLER DRAIN - 970	7		10				
SHAWNEE ROAD over HICKORY CREEK - 971	7	↓	12				
HINCHMAN ROAD over HICKORY CREEK - 972	6	↓	15				
GLENLORD ROAD over HICKORY CREEK - 973	5	↓	19				
NAOMI ROAD over PIPESTONE CREEK - 974	6	↓	15				
NAPIER AVENUE over ST JOSEPH RIVER - 975	5		11				
TERRITORIAL ROAD over BLUE CREEK - 976	7	↓	12				
COLOMA ROAD over PAW PAW RIVER - 977	5		9	Preventive Maintenance	\$22,000		5

Evaluate how much 'life' a component has at it's current GCR
 Example: Deck rated 5 with 20 percent life left vs. Deck rated 5 with 80 percent life left

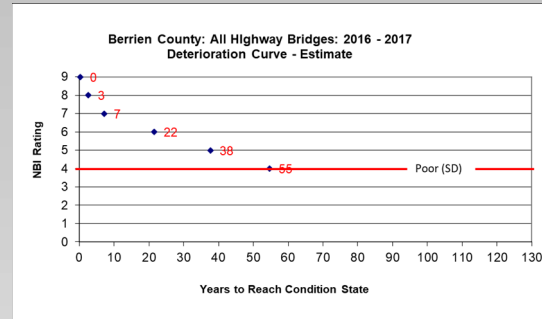


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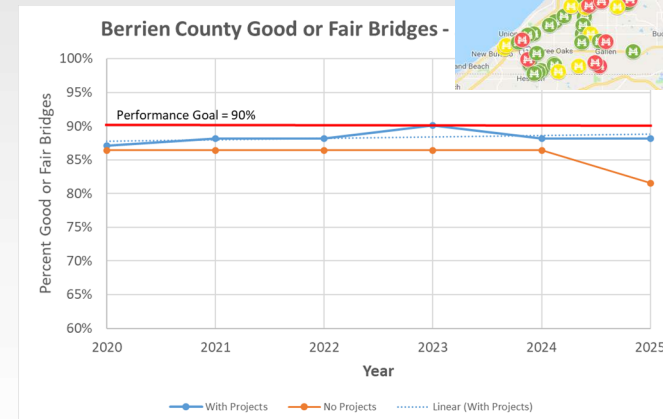
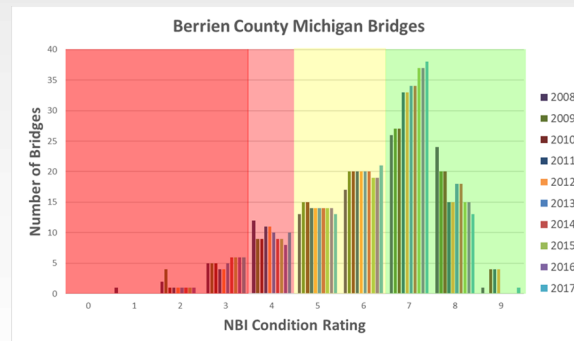
Berrien County Michigan Bridge Management Tools



- Spreadsheets
 - Condition trends
 - Deterioration Models
 - Basic Forecasting
 - Annual Project Selection
- Google Maps



Str Num	Facility	Feature	ADT	Year Built	Deck Area	Deck Surface	Super	Subst.	Culvert
990	HOLLYWOOD ROAD	BIG FEATHER DRAIN	1555	1921	168	E	E	N	N
13096	LINCOLN AVE	HICKORY DRAIN	664	1980	483	N	N	N	N
1033	PERNDALE STREET	BRANDYWINE CREEK	147	1950	504	N	N	N	N
1032	LAKEVIEW ROAD	S BRANCH GALLEN RIVER	80	1961	1193	E	E	7	N
1034	HESS ROAD	GALLEN RIVER	36	1930	699	E	E	N	N
1035	SALEP ROAD	PIPPSTONE CREEK	4	1924	97	E	E	N	N
13095	HINCHMAN ROAD	HICKORY DRAIN	1531	1956	461	N	N	N	N
985	GLENDORA ROAD	E BR GALLEN RIVER	1037	1941	731	E	E	4	N
987	GLENDORA ROAD	E BR GALLEN RIVER	1037	1966	818	N	N	N	N
1039	LOG CABIN ROAD	EAST BRANCH GALLEN RIVER	212	1939	1081	E	E	6	N
13147	HOLDEN ROAD	E BR GALLEN RIVER	187	2000	1140	E	E	4	N
989	ENLOW ROAD	HICKORY CREEK	179	1924	624	E	E	7	N



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Building an In-house Bridge Maintenance Program

- Annual Operations and Maintenance Plan for Bridges and Structures
 - Bridge Deck Cleaning
 - Concrete Bridge Deck Sealing
 - Bituminous Wearing Surface Sealing
 - Brush Cutting



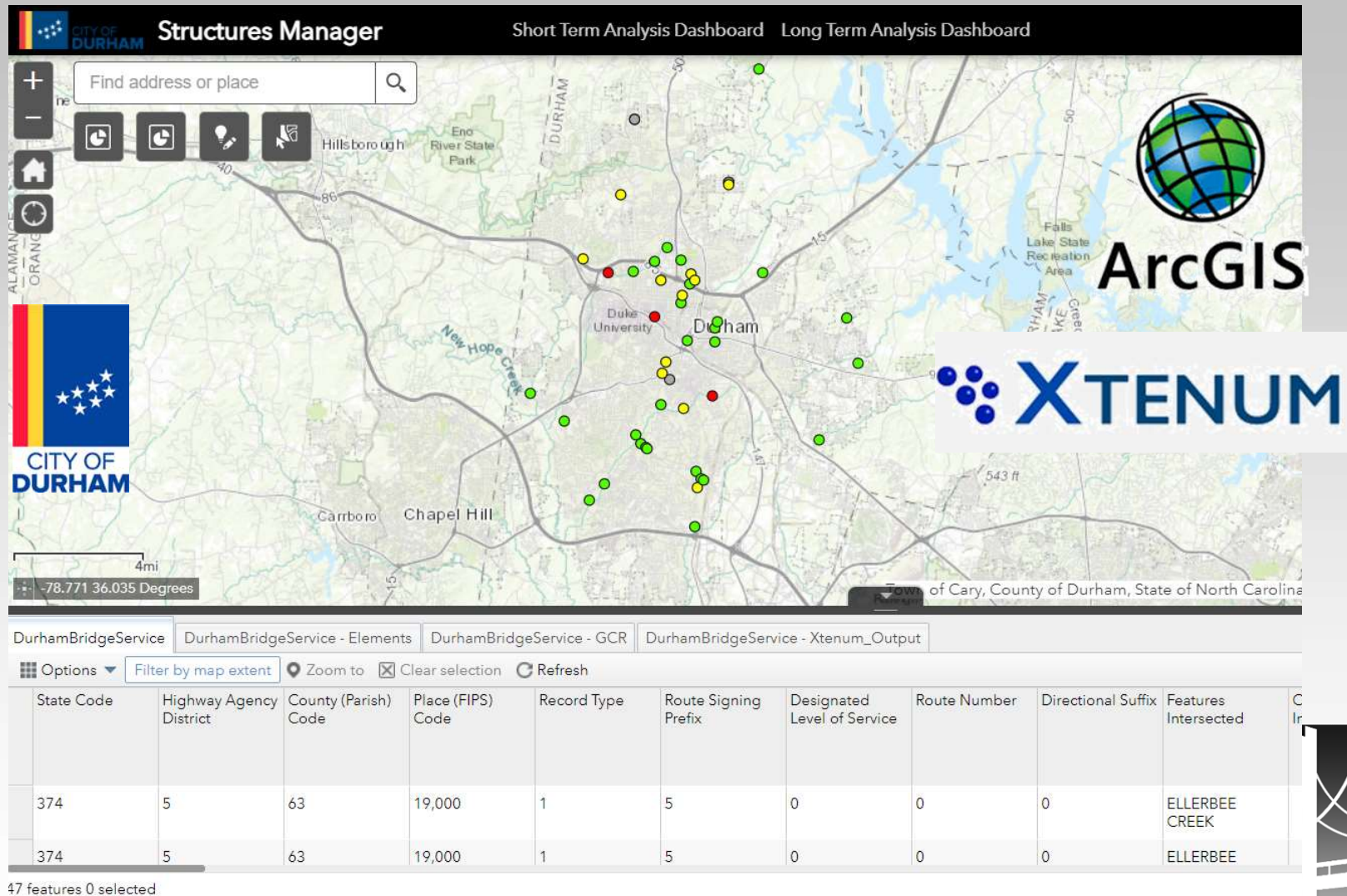
Bridge Maintenance Basics Training Day

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Advanced BMS – City of Durham, NC



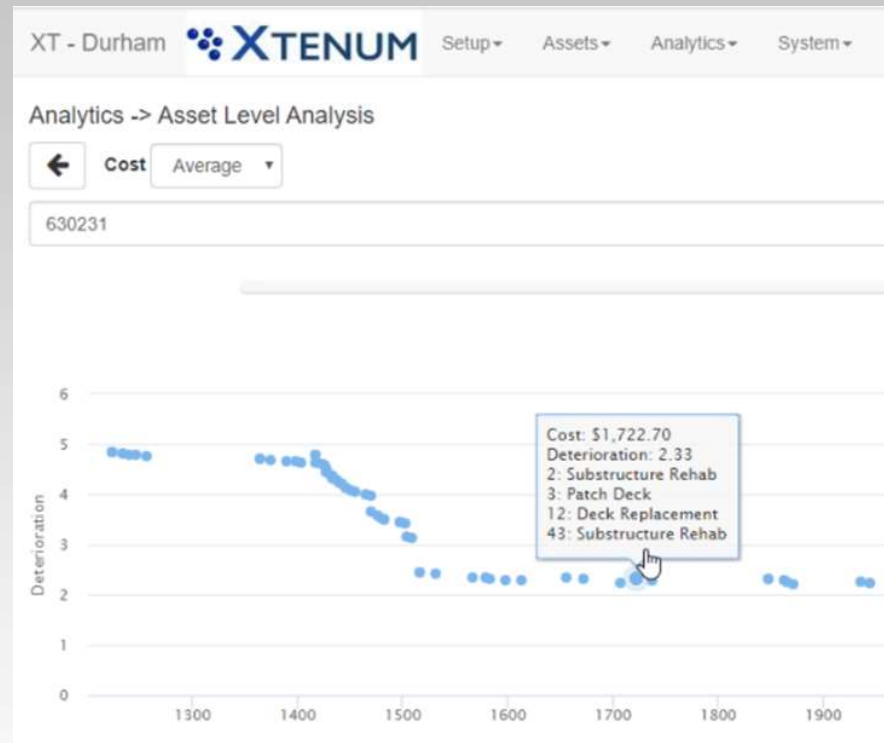
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Xtenum – Optimization Program

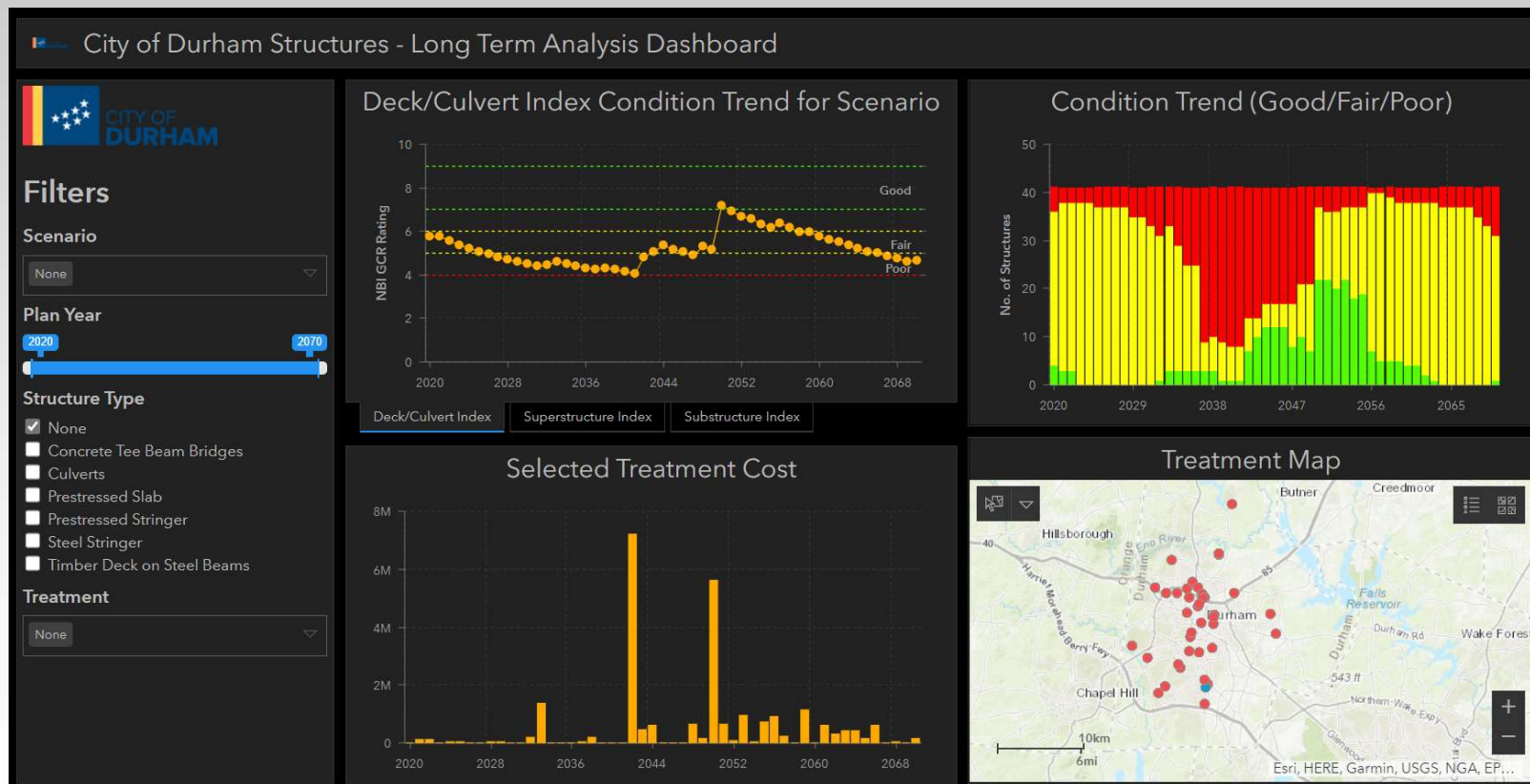
XTenum will provide an optimum lifecycle management plan for each structure



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Advanced BMS – City of Durham, NC

Long-term Analysis (Optimization) Dashboard



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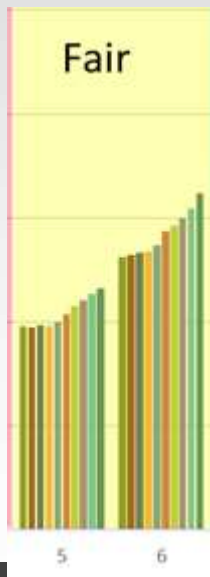
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State of Good Repair

- Reach a sustainable steady state of network bridge condition where goals are achieved, risk is acceptable, and level of service is sufficient.

Value of Preservation



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Thank You!
😊
Questions?



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