How We Use BrM: Minnesota DOT

BrM User Group Meeting

Minneapolis, MN

September 14, 2022

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Asset Management Engineer

Minnesota DOT | Bridge Office

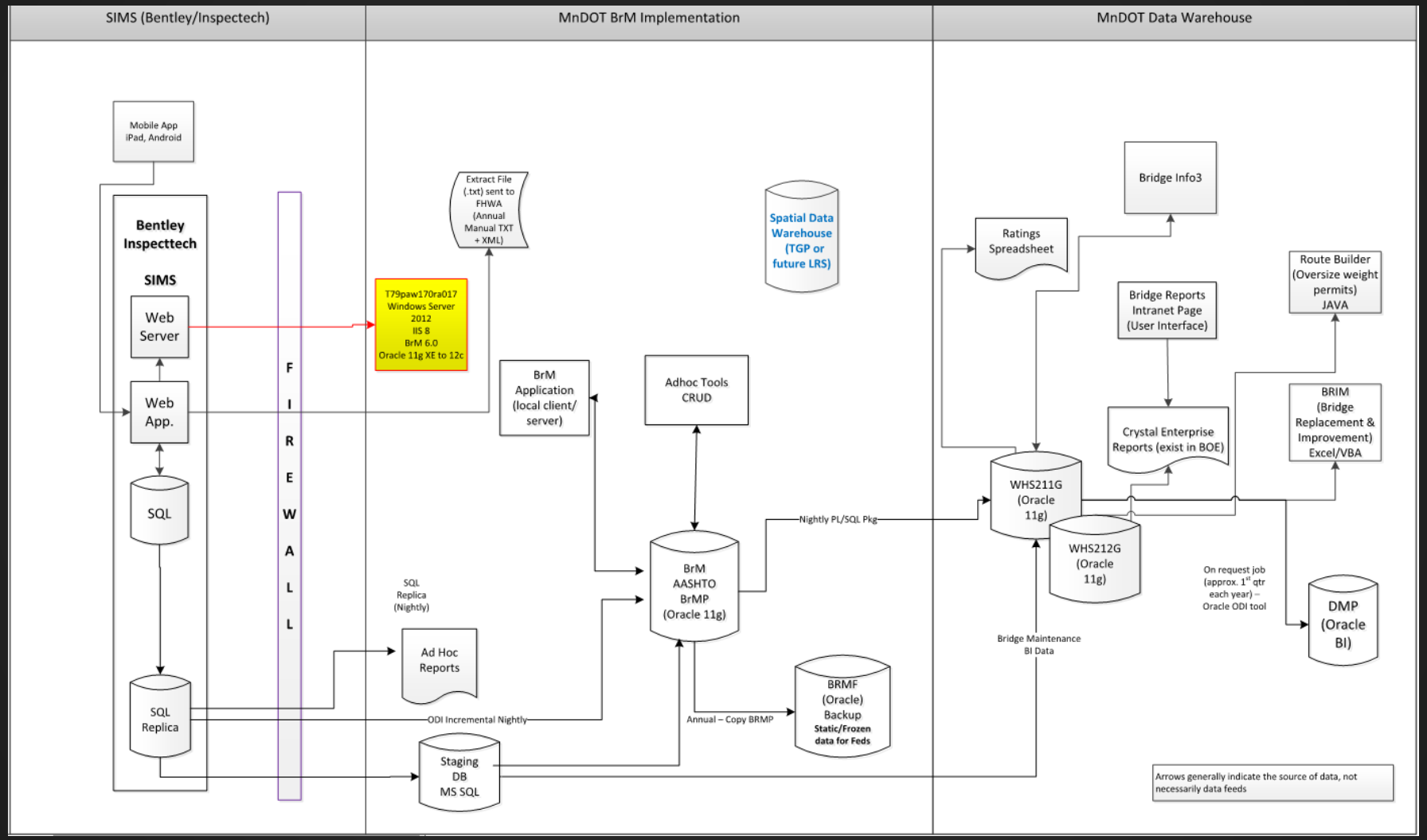
A little about myself

- Working in state government since 2004
- Started with MnDOT Bridge Office in 2009
  - 2009-2013 FC Inspections, NBIS Compliance
  - 2013 Bridge Inventory Unit
  - 2020 Asset Management
- Bachelors in Civil Engineering, Masters in Software Engineering
- Member of Task Force, Chair of Testing TAG
- 3 kids, 1 dog and 1 wife

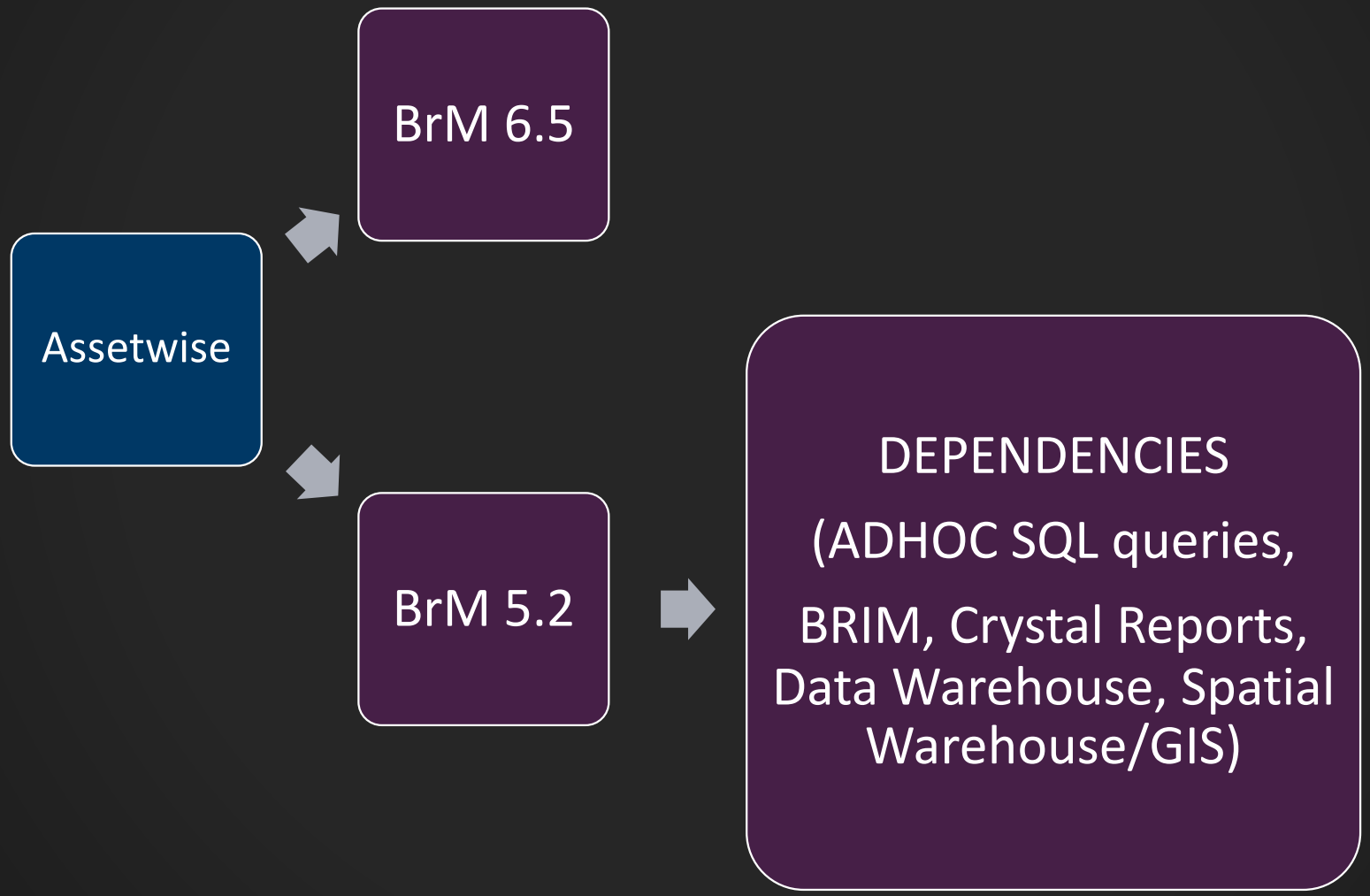
Where we've been

- BrM user since inception of Pontis
- Early 2000s tried software called BrINFO
- 2011
  - Adapted InspectTech for data collection
  - Created in-house tool "BRIM" for management
- Many existing integrations with BrM data

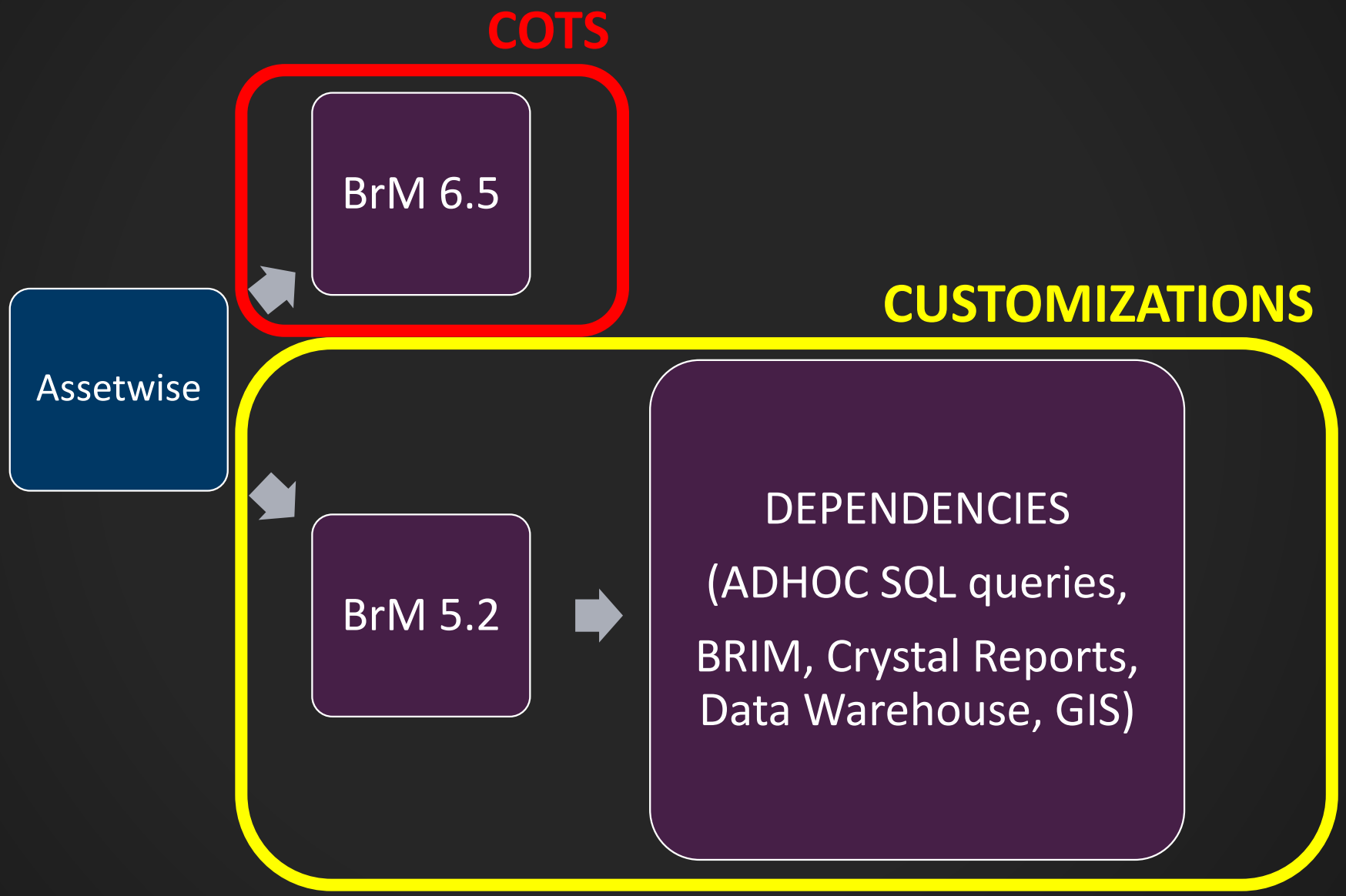
BrM is the backbone of MnDOT's BMS



Minnesota Bridge Data Flow Diagram Simplified

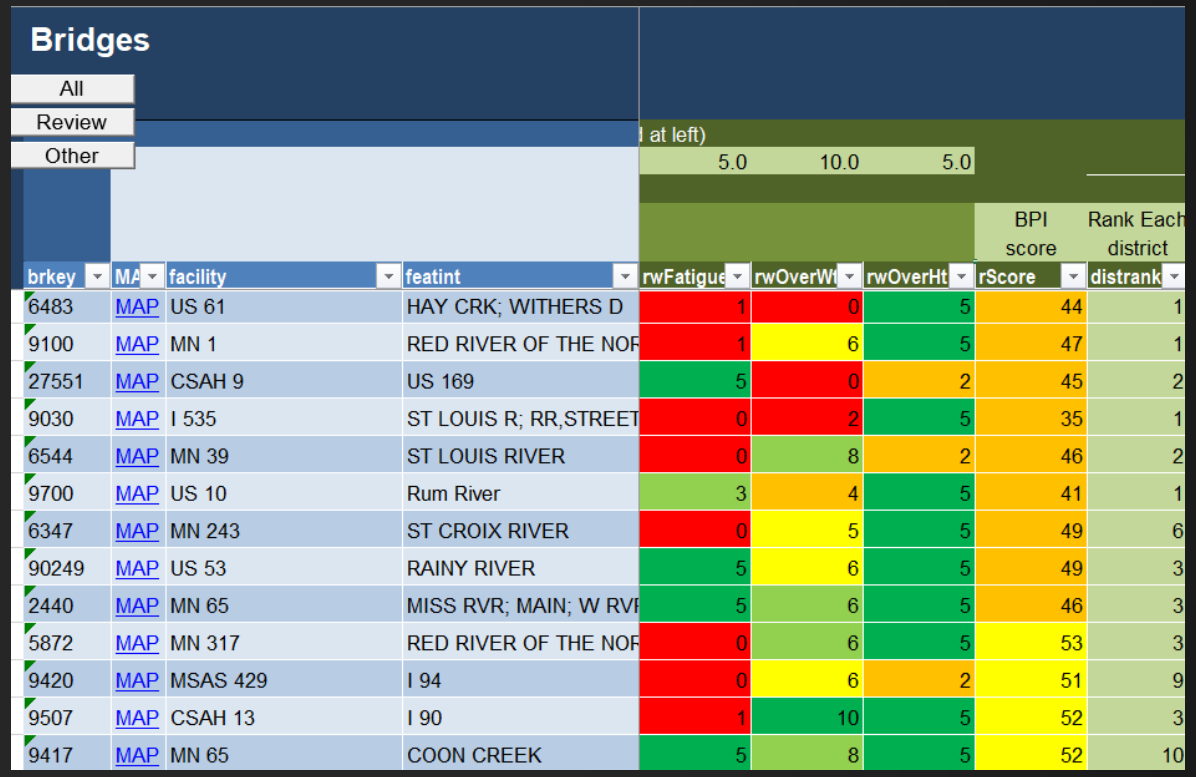


Minnesota Bridge Data Flow Diagram Simplified



BRIM – Bridge Replacement and Improvement Management

- VBA Enhanced Spreadsheet
- Used as a gateway for users to view bridge inspection/inventory data
- Completely customizable and familiar for engineers to use
- Held outside the land of IT (where hopes and dreams die)



Bridges

All
Review
Other

							BPI score	Rank Each district
brkey	MA	facility	featint	rwFatigue	rwOverWt	rwOverHt	rScore	distrank
6483	MAP	US 61	HAY CRK; WITHERS D	1	0	5	44	1
9100	MAP	MN 1	RED RIVER OF THE NOR	1	6	5	47	1
27551	MAP	CSAH 9	US 169	5	0	2	45	2
9030	MAP	I 535	ST LOUIS R; RR,STREET	0	2	5	35	1
6544	MAP	MN 39	ST LOUIS RIVER	0	8	2	46	2
9700	MAP	US 10	Rum River	3	4	5	41	1
6347	MAP	MN 243	ST CROIX RIVER	0	5	5	49	6
90249	MAP	US 53	RAINY RIVER	5	6	5	49	3
2440	MAP	MN 65	MISS RVR; MAIN; W RVR	5	6	5	46	3
5872	MAP	MN 317	RED RIVER OF THE NOR	0	6	5	53	3
9420	MAP	MSAS 429	I 94	0	6	2	51	9
9507	MAP	CSAH 13	I 90	1	10	5	52	3
9417	MAP	MN 65	COON CREEK	5	8	5	52	10

BRIM – Resilience Module

- Combines Inventory and Inspection Data in 11 different scaling tables
  - Structural condition, Scour, NSTM, Fatigue, Load Capacity, Clearance, Hydraulic Capacity
- Importance Factor
  - ADT, Bridge Length, Detour Length, Route On and Route Under
- Rolled up into a single score: Bridge Planning Index

		SUBSTRUCTURE CONDITION			
		Defect Element Reduction			
NBI Condition		0	1	2	3
N	Not applicable	100	100	100	100
9	Excellent	100	100	90	95
8	Very good	95	90	85	90
7	Good	90	85	80	75
6	Satisfactory	75	70	60	55
5	Fair	55	50	40	35
4	Poor	35	35	25	15
3	Serious	15	15	10	5
2	Critical	5	5	5	0
1	Imminent fail	0	0	0	0
0	Failed	0	0	0	0

Substructure Reduction Factor:

Case 3:
If substructure settlement/movement [884] is in CS4

Case 2:
If substructure settlement/movement [884] is in CS3

Case 1:
If substructure settlement/movement [884] is in CS2

Case 0:
If substructure settlement/movement [884] is in CS1 or isn't prese

Importance Factor - ADT			
I_{adt}	ADT Range		
1.2	50,000+		
1.15	25,000	-	49,999
1.1	12,000	-	24,999
1.05	6,000	-	11,999
1	0	-	5,999

ADT = Average Daily Traffic

NBI Item = 29

BRIM – Improvement Module

- Using inventory/inspection data identifies work type, year and cost
- Applied to entire inventory, establishes overall need
- Limited to deck centric work types

Indicated action

Year built	Deck type	Struct Deficient	Deck cond <= 5			Deck cond = 6		
			ADT>10k	4-10k	<4k	ADT>10k	4-10k	<4k
2005+	Any	OPM	ReOvly	ReOvly	ReOvly	ReOvly	ReOvly	ReOvly
1977-03	Has conc ovly	Replace	Redeck	Redeck	Redeck	ReOvly	ReOvly	ReOvly
(H)	No conc ovly	Replace	Redeck	Redeck	Redeck	Overlay	Overlay	Overlay
1970-76	Epoxy bars	Replace	Replace	Redeck	Redeck	Redeck	OPM	OPM
(J)	Has conc ovly	Replace	Replace	Redeck	Redeck	Replace	Redeck	Redeck
	No conc ovly	Replace	Replace	Redeck	Redeck	Replace	Redeck	Redeck
<1970	Yr deck 1977+	Replace	Replace	Replace	Replace	Replace	Replace	Replace
(K)	Yr deck <1977	Replace	Replace	Replace	Replace	Replace	Replace	Replace

Red cells indicate invalid actions (according to the list at right)

Indicated period

Year built	Deck type	Struct Deficient	Deck cond <= 5			Deck cond = 6		
			ADT>10k	4-10k	<4k	ADT>10k	4-10k	<4k
2005+	Any		2033-42	2033-42	2033-42	2043-48	2043-48	2043-48
1977-03	Has conc ovly	2027-32	2033-42	2033-42	2043-48	2027-32	2027-32	2033-42
(H)	No conc ovly	2027-32	2033-42	2033-42	2043-48	2027-32	2027-32	2033-42
1970-76	Epoxy bars	2027-32	2043-48	2027-32	2033-42	2043-48		
(J)	Has conc ovly	2027-32	2027-32	2027-32	2033-42	2033-42	2033-42	2043-48
	No conc ovly	2027-32	2027-32	2027-32	2033-42	2033-42	2027-32	2033-42
<1970	Yr deck 1977+	2027-32	2027-32	2027-32	2027-32	2027-32	2033-42	2043-48
(K)	Yr deck <1977	2027-32	2027-32	2027-32	2027-32	2027-32	2027-32	2033-42

BRIM – Expert Review Module

- Annual review period by District Bridge Engineers
- Override: action, year, cost
- Serves as consistent way to document intentions

		Engineer over-ride		Final decision		STIP	
Action	Period	Action	Period	Action	Period	Exclude costs?	CHIP
gridact	gridper	engract	engryea	action	period	exclcos	CHIP
Replace	2027-32			Replace	2027-32	*2023*	
Replace	2027-32		2027-32	Replace	2027-32		*2027*
Replace	2027-32			Replace	2027-32	*2024*	
Replace	2027-32		2027-32	Replace	2027-32		*2028*
Replace	2043-48			Replace	2043-48		
Replace	2027-32			Replace	2027-32	*2022*	
Replace	2027-32			Replace	2027-32	*2025*	
Replace	2033-42	OPM	2043-48	OPM	2043-48		
Replace	2027-32			Replace	2027-32	*2020*	

BRIM – Forecast Module

- Leverages the result of two research findings to predict Remaining Service Life of bridge deck
- Helpful in setting FHWA performance targets
- Used for TAMP
- Used for identifying funding gaps

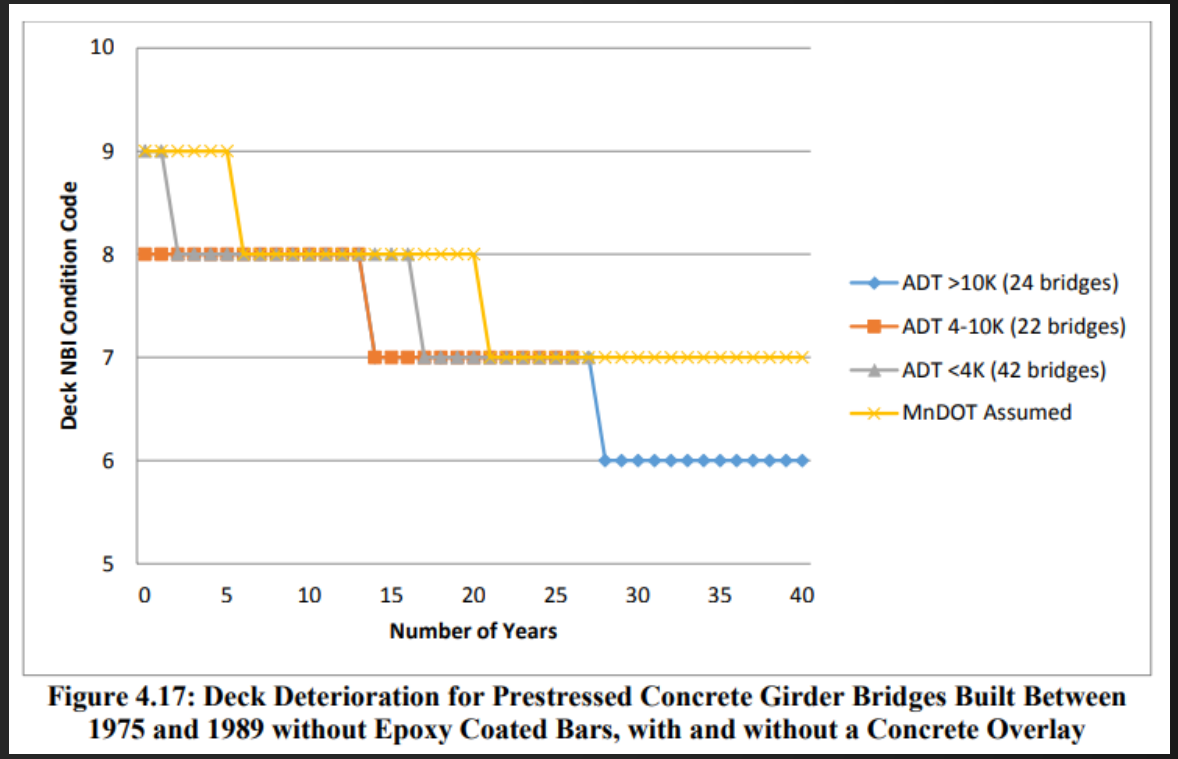


Figure 4.17: Deck Deterioration for Prestressed Concrete Girder Bridges Built Between 1975 and 1989 without Epoxy Coated Bars, with and without a Concrete Overlay

Added Procedurally Generated Tables and Views

```
SELECT
    BRKEY,
    INSPDATE
FROM INSPEVNT I
JOIN (
    SELECT
        BRIDGE_GD,
        MAX(INSPEVNT_GD)
            KEEP(DENSE_RANK FIRST
                ORDER BY INSPDATE DESC,
                    MODTIME DESC)
        AS MAX_INSPEVNT_GD
    FROM INSPEVNT
    GROUP BY BRIDGE_GD
) LATEST
    ON LATEST.MAX_INSPEVNT_GD = I.INSPEVNT_GD;
```

esults 1 ×

ELECT BRKEY, INSPDATE FROM INSPEVNT I JOIN | Enter a SQL expression to filter results (use Ctr

	BRKEY	INSPDATE
	L8901	2018-06-20 00:00:00
2	L1134	2017-10-19 00:00:00
3	91225	2018-08-21 00:00:00

```
SELECT
    BRKEY,
    INSPDATE
FROM INSPEVNT I
JOIN BRIDGE_SUMMARIES BS
    ON BS.MAX_INSPEVNT_GD = I.INSPEVNT_GD;
```

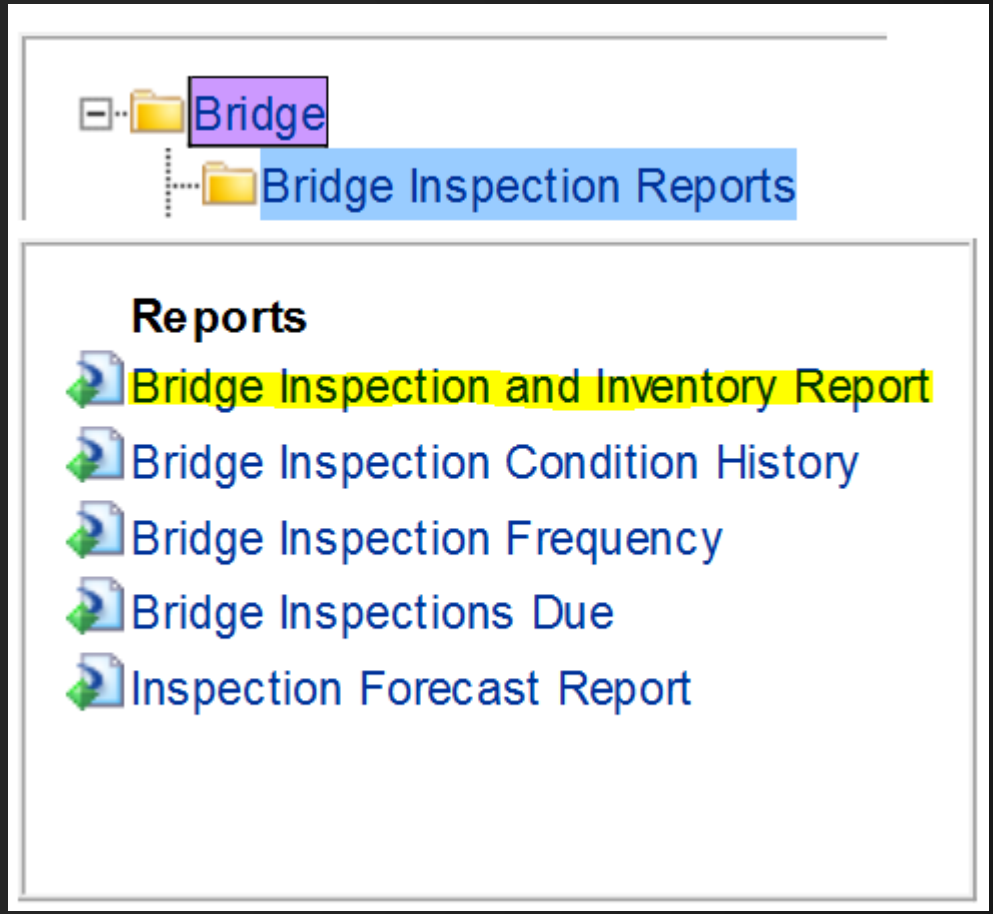
esults 1 ×

ELECT BRKEY, INSPDATE FROM INSPEVNT I JOIN | Enter a SQL expression to filter results (

	BRKEY	INSPDATE
1	L8901	2018-06-20 00:00:00
2	L1134	2017-10-19 00:00:00
3	91225	2018-08-21 00:00:00
4	8477	2018-10-22 00:00:00

Bridge Reports - Bridge Inspection and Inventory Report

- Summary of the most recent inventory and inspection
- Can bulk output population of bridges by number or inspection agency
- Can filter based on inspection due date
- Roadway clearance measurements dynamically update the diagram



MINNESOTA STRUCTURE INVENTORY REPORT

Bridge ID: 9030 **I 535 over ST LOUIS R; RR,STREET** Date: 06/26/2016

+ GENERAL +

Agency Br. No.	
District	1
Maint. Area	1A
County	69 - ST LOUIS
City	DULUTH
Township	
Desc. Loc.	1.3 SE OF JCT TH 35
Sect., Twp., Range	03 - 049N - 14W
Latitude	46d 44m 58.97s
Longitude	92d 06m 04.33s
Custodian	STATE HWY
Owner	STATE HWY
Inspection By	DISTRICT 1
Year Built	1961
MN Year Remodeled	1993
FHWA Year Reconstructed	1993
Bridge Plan Location	DISTRICT
Potential ABC	YES

+ STRUCTURE +

Service On	HIGHWAY
Service Under	HWY;RR;STREAM
Main Span Type	CSTL HIGH TRUSS
Main Span Detail	OPEN SPANDREL ARCH
Appr. Span Type	CSTL DECK GIRD
Appr. Span Detail	
Skew	
Culvert Type	
Barrel Length	

Number of Spans

MAIN: 3 APPR: 49 TOTAL: 52

Main Span Length	600.0 ft
Structure Length	7,980.0 ft
Deck Width	63.7 ft - Varies
Deck Material	C-I-P CONCRETE
Wear Surf Type	LOW SLUMP CONC
Wear Surf Install Year	1993
Wear Course/Fill Depth	0.17 ft
Deck Membrane	NONE
Deck Rebars	EPOXY COATED REBAR
Deck Rebars Install Year	1993
Structure Area	594,187 sq ft
Roadway Area	570,251 sq ft
Sidewalk Width - L/R	
Curb Height - L/R	
Rail Codes - L/R	22 22

+ ROADWAY +

Bridge Match ID (TIS)	1
Roadway O/U Key	1-ON
Route Sys/Nbr	ISTH 535

Roadway Name or Description

I 535

Roadway Function	MAINLINE
Roadway Type	2 WAY TRAF
Control Section (TH Only)	6981
Ref. Point	000+00.000
Date Opened to Traffic	06-01-1994
Detour Length	8 mi.
Lanes	4 Lanes ON Bridge
ADT (YEAR)	28,000 (2004)
HCADT	1,960
Functional Class.	URB/PR ART ISTH

+ RDWY DIMENSIONS +

If Divided	NB-EB	SB-WB
Roadway Width	29.3 ft	29.3 ft
Vertical Clearance	19.1 ft	19.1 ft
Max. Vert. Clear.	19.1 ft	19.1 ft
Horizontal Clear.	29.2 ft	29.2 ft
Lateral Clr. - Lt/Rt		
Appr. Surface Width	58.0 ft	
Bridge Roadway Width	58.6 ft	
Median Width on Bridge	2.0 ft	

+ MISC. BRIDGE DATA +

Structure Flared	YES
Parallel Structure	NONE
Field Conn. ID	RIVETED
Cantilever ID	PIN & HANGER

Foundations

Abut.	CONC - FTG PILE
Pier	CONC - FTG PILE
Historic Status	ELIGIBLE
On - Off System	ON

+ PAINT +

Year Painted	1993	Pct. Unsound	5 %
Painted Area			
Primer Type	ORGANIC ZINC		
Finish Type	URETHANE		

+ BRIDGE SIGNS +

Posted Load	NOT REQUIRED
Traffic	NOT REQUIRED
Horizontal	OBJECT MARKERS
Vertical	NOT REQUIRED

+ INSPECTION +

Deficient Status	S.D.
Sufficiency Rating	43.5
Last Inspection Date	07-16-2015
Inspection Frequency	12
Inspector Name	DISTRICT 1
Status	A-OPEN

+ NBI CONDITION RATINGS +

Deck 2 % UNSOUND	6
Superstructure	4
Substructure	6
Channel	7
Culvert	N

+ NBI APPRAISAL RATINGS +

Structure Evaluation	4
Deck Geometry	4
Underclearances	5
Waterway Adequacy	8
Approach Alignment	8

+ SAFETY FEATURES +

Bridge Railing	1-MEETS STANDARDS
GR Transition	1-MEETS STANDARDS
Appr. Guardrail	1-MEETS STANDARDS
GR Termini	1-MEETS STANDARDS

+ IN DEPTH INSP. +

Frac. Critical	Y	24 mo	07/2015
Underwater	Y	60 mo	09/2012
Pinned Asbly.	Y	48 mo	07/2013
Spec. Feat.			

+ WATERWAY +

Drainage Area	
Waterway Opening	99999 sq ft
Navigation Control	PERMIT REQD
Pier Protection	NOT REQUIRED
Nav. Vert./Horz. Clr.	120 ft 500.0 ft
Nav. Vert. Lift Bridge Clear.	
MN Scour Code	N-STBL;LIM SCOUR
Scour Evaluation Year	1992

+ CAPACITY RATINGS +

Design Load	HS 20
Operating Rating	HS 22.00
Inventory Rating	HS 13.20
Posting	
Rating Date	12-18-2013

Overweight Permit Codes

A: 1 B: 2 C: 2

MINNESOTA BRIDGE INSPECTION REPORT

Inspected by: DISTRICT 1

BRIDGE 9030 **I 535 OVER ST LOUIS R; RR,STREET** **INSP. DATE: 07-16-2015**

County: ST LOUIS
City: DULUTH
Township:
Section: 03 Township: 049N Range: 14W
Span Type: CSTL HIGH TRUSS
NBI Deck: 6 Super: 4 Sub: 6 Chan: 7 Culv: N

Location: 1.3 SE OF JCT TH 35
Route: ISTH 535 Ref. Pt.: 000+00.000
Control Section: 81 Maint. Area: 1A
Local Agency Bridge Nbr:

Length: 7,980.0 ft
Deck Width: 63.7 ft (Varies)
Rdwy. Area / Pct. Unsnd: 570,251 sq ft 2 %
Paint Area / Pct. Unsnd: 5 %
Culvert : N/A

Open, Posted, Closed: OPEN

Appraisal Ratings - Approach: 8 Waterway: 8
Required Bridge Signs - Load Posting: NOT REQUIRED
Horizontal: OBJECT MARKERS

MN Scour Code: N-STBL;LIM SCOUR
Traffic: NOT REQUIRED
Vertical: NOT REQUIRED

Def. Stat: S.D. Suff. Rate: 43.5

ELEM NBR	ELEMENT NAME	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4
800	CRITICAL DEFS OR SAFETY HAZARDS	07-16-2015	1 EA	1	0	0	0

Notes: 2014 No critical findings were identified during the 2014 routine and routine snooper inspection (North bound not inspected with snooper as of 7/16/2014).
[2015] No critical findings.

12	REINFORCED CONCRETE DECK	07-16-2015	594,187 SF	534,768	0	59,419	0

Notes: Transverse cracks with efflorescence at 1-30 ft intervals.
2011: Deck underside has numerous transverse cracks with efflorescence Total distressed area is less than 10% of the total deck area. (2012 Some leaching onto the girders and rusting. Under side of deck is map cracked 6 in. to 2 ft. squares. Span 24, 26, Hinge joints have chipped out fresh concrete on bottom flanges.)
2012/- Bottom of deck at truss see attached photos 35,38.
[2013] No change.
2014-Span 22 Between Girder A&D 2x4 lumber left in place near pin and hanger.
2014/- Typical cracking along centerline of main span (photos 151-154). Typical cracking of approach spans (photos 148, 149).
[2015] Deck underside has cracking with efflorescence every 3' - 10' throughout bridge - CS3 (approaching 10% of deck). Some map cracking in sporadic areas.

510	*WEARING SURFACE*	07-16-2015	570,251 SF	558,846	0	11,405	0

Notes: Low Slump Overlay with Epoxy Rebar Notes: 08-23-2010 Inspection performed by WisDOT. NBI ratings unchanged from MnDOT's 2009 inspection. Elements, quantities and CS may not reflect the 2010 WisDOT inspection - refer to WisDOT documentation. Spalling occurring along some of the moveable joints Span 6.
2007(PB): Overall, the the overlay is in very good condition. Minor scaling intermittently along bridge deck.
2011: The deck surface has many sealed transverse cracks, but otherwise is in good condition. Total distressed area is less than 2% of the deck surface. Application of gel seal to the deck was being done by D1 bridge crews at the time of inspection.
[2013]: Numerous new unsealed transverse cracks in deck since 2011. 2014 Removed notes
[2015] Top of deck in the north bound lanes has some dirt and debris along the fog lines and shoulder. Some map cracking in sporadic areas. Top of deck cracking .025-.035 wide at 4'-6' intervals with longitudinal cracking between joints;

810	CONC WEAR SURF-CRACKING SEALING	07-16-2015	0 LF	0	0	0	0

Notes: (2009, Deck cracks were sealed during this inspection. with 2501)
2011: Deck has numerous sealed transverse cracks. Gel seal was being applied to deck surface at the time of inspection.
2012/- Deck area at link joint 1-3A has longitudinal cracks at 1 to 2 ft. spacings with signs of map cracking developing. Typical spacing of transvers cracking in deck is 3-8 ft. Sizes .035-.040
[2013] New transverse cracks on top of deck have appeared since the last deck crack sealing in 2011 - CS2. 2014 No Change.
[2015] Top of deck cracking .025-.035 wide at 4'-6' intervals with longitudinal cracking between joints; needs sealing - CS3. SB lanes have 15,958 LF of longitudinal cracks; 32,552 LF of transverse cracks.

300	STRIP SEAL DECK JOINT	07-16-2015	817 LF	817	0	0	0

Notes: 2012 - New strip seals have been installed.
2014- No Change
[2015] Most north bound joints filled with dirt, with dirt build up on the deck at center rail. There is leakage at the median gap at the following locations: North Abutment, Spans 6, 33, 44, and 47, and South Abutment. See joint gap measurement attachment.

Roadway Clearance Report

Page No: 2

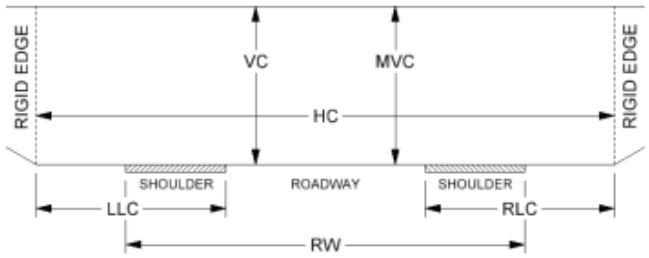
MINNESOTA STRUCTURE INVENTORY REPORT
Roadway Under Bridge

Bridge ID: 69879 — I 35 SB OFF RAMP TO GRAND AVE under I 35 NB — Date: 09/09/2022

+ FEATURES +			+ DIMENSIONS +			
Item Description	NBI (if appl)	Value	Item Description	Diagram Abbrev.	Values NB-EB	Values SB-WB *
Road Name		I 35 SB OFF RAMP TO GR	**Roadway Width**	RW	24.5 ft	
Functional Class.	26	URB/PR ART ISTH	**Vertical Clearance**	VC	18.0 ft	
ADT (YEAR)	29 (& 30)	7,900 (2002)	**Max. Vert. Clear**	MVC	18.0 ft	
HCADT	109	237	**Horizontal Clear**	HC	39.9 ft	
National Highway System	104	N	**Lateral Clr. - Lt**	LLC	48.9 ft	
Route Sys/Nbr (TIS)		ISTH 3971	**Lateral Clr. - Rt**	RLC	27.3 ft	
Ref. Point (TIS)		251+00.973	**Median Width**	MW	NA	
Detour Length	19	1 mi.				
Lanes	28B	1 Lane UNDER Bridge				
Control Section (TH Only)		6982				
Function	5C	RAMP/WYE				
Type	102	1 WAY TRAF				
Bridge Match ID		2				
Roadway Key	5A	A-UNDER (1ST)				

* Entered only if this record is for a divided roadway

UNDIVIDED HIGHWAY
1 WAY TRAFFIC



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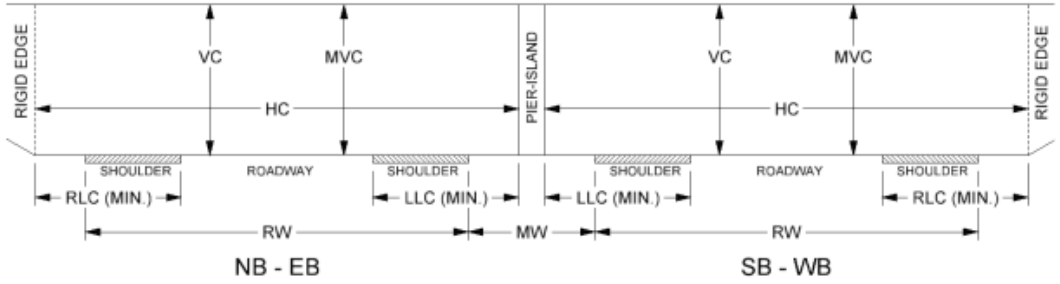
MINNESOTA STRUCTURE INVENTORY REPORT
Roadway Under Bridge

Bridge ID: 69879 — GRAND AVE (TH 23) under I 35 NB — Date: 09/09/2022

+ FEATURES +			+ DIMENSIONS +			
Item Description	NBI (if appl)	Value	Item Description	Diagram Abbrev.	Values NB-EB	Values SB-WB *
Road Name		GRAND AVE (TH 23)	**Roadway Width**	RW	26.0 ft	26.0 ft
Functional Class.	26	URB/MINOR ART	**Vertical Clearance**	VC	24.9 ft	24.9 ft
ADT (YEAR)	29 (& 30)	14,900 (2019)	**Max. Vert. Clear**	MVC	24.9 ft	24.9 ft
HCADT	109	596	**Horizontal Clear**	HC	53.3 ft	53.1 ft
National Highway System	104	N	**Lateral Clr. - Lt**	LLC	99.8 ft	
Route Sys/Nbr (TIS)		MNTH 23	**Lateral Clr. - Rt**	RLC	31.3 ft	
Ref. Point (TIS)		345+00.020	**Median Width**	MW	4.0 ft	
Detour Length	19	1 mi.				
Lanes	28B	4 Lanes UNDER Bridge				
Control Section (TH Only)		6910				
Function	5C	MAINLINE				
Type	102	2 WAY TRAF				
Bridge Match ID		4				
Roadway Key	5A	B-UNDER (2ND)				

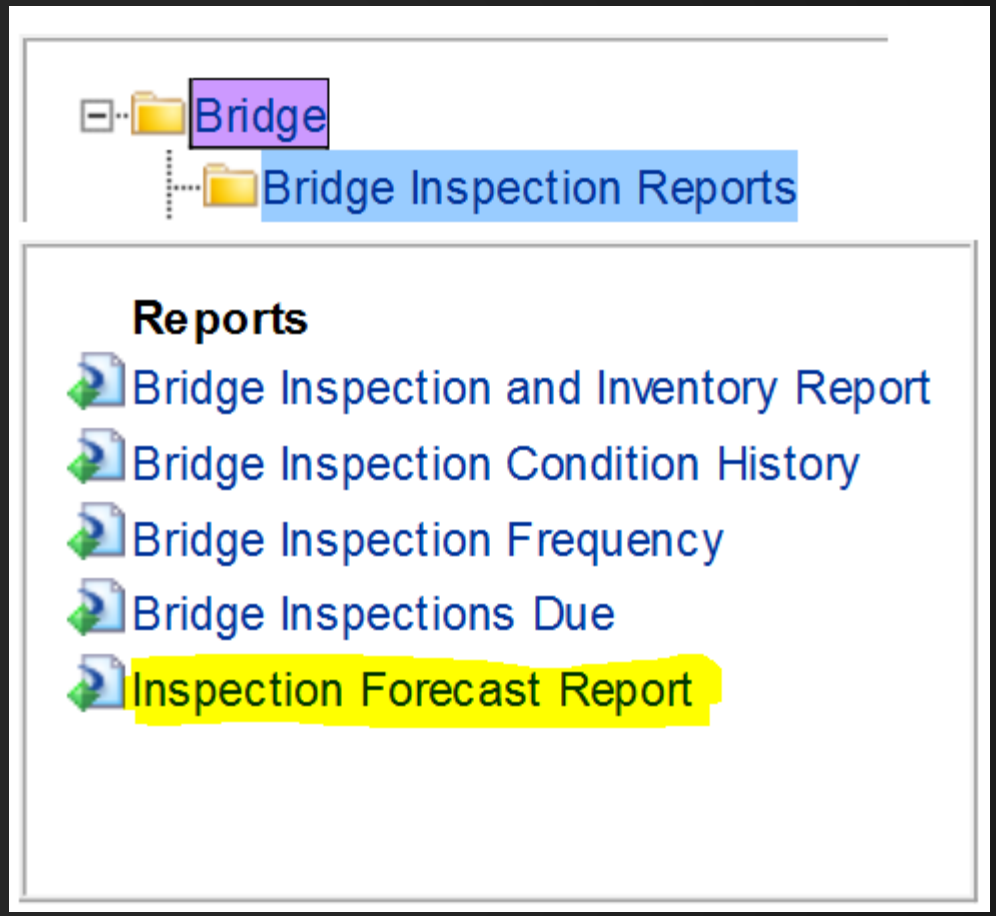
* Entered only if this record is for a divided roadway

DIVIDED HIGHWAY WITH MEDIAN OBSTRUCTION



Bridge Reports – Inspection Forecast Report

- Summary of inspections due by month
- Report ‘forecasts’ next due dates based on the assumptions:
  - Inspection frequency stays the same
  - Structure inspected on time
- Outputs handy table showing summary for next three years at end of report



Inspection Forecast Report

INSPECTION FORECAST REPORT FOR MNDOT DISTRICT 6

Printed: 9/9/2022

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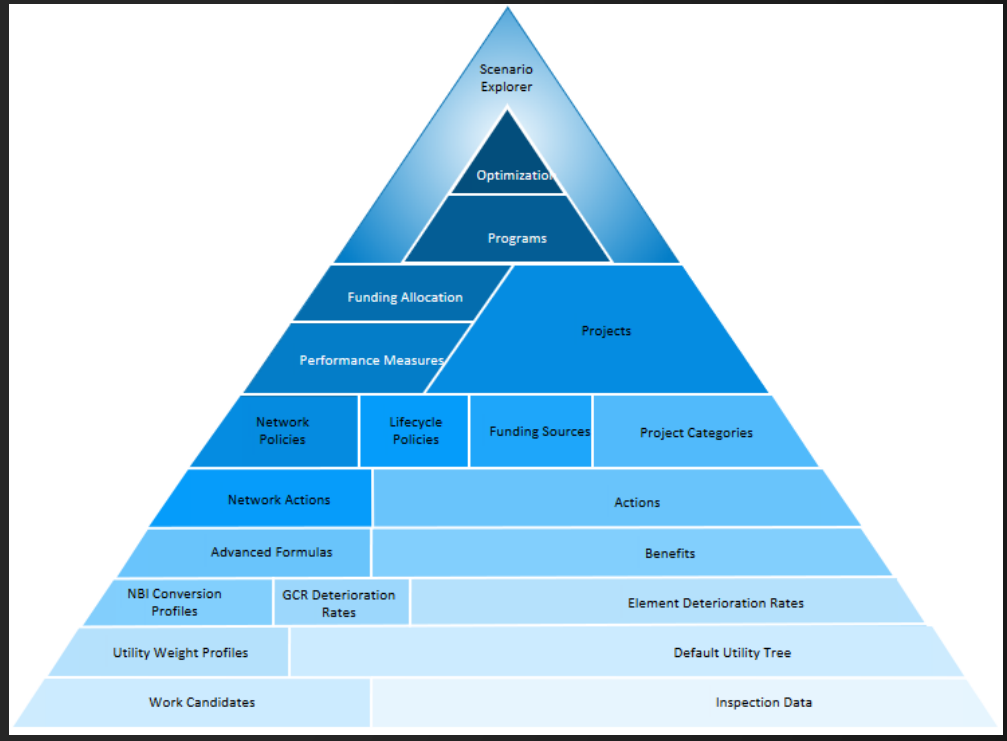
FORECAST SUMMARY

	Feb	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	0	0	0	2	57	127	68	57	3	1	315
2023	2	0	8	88	60	115	118	20	6	0	417
2024	0	2	57	87	88	127	68	57	1	1	488
2025	0	0	6	88	60	113	118	20	6	0	411

5658	RAILROAD over MN 3	CITY OF FARIBAULT	TH 3	000+00.524	12	1ST
9668	CSAH 11 over US 52	CITY OF PINE ISLAND	US 52	071+00.261	12	1ST

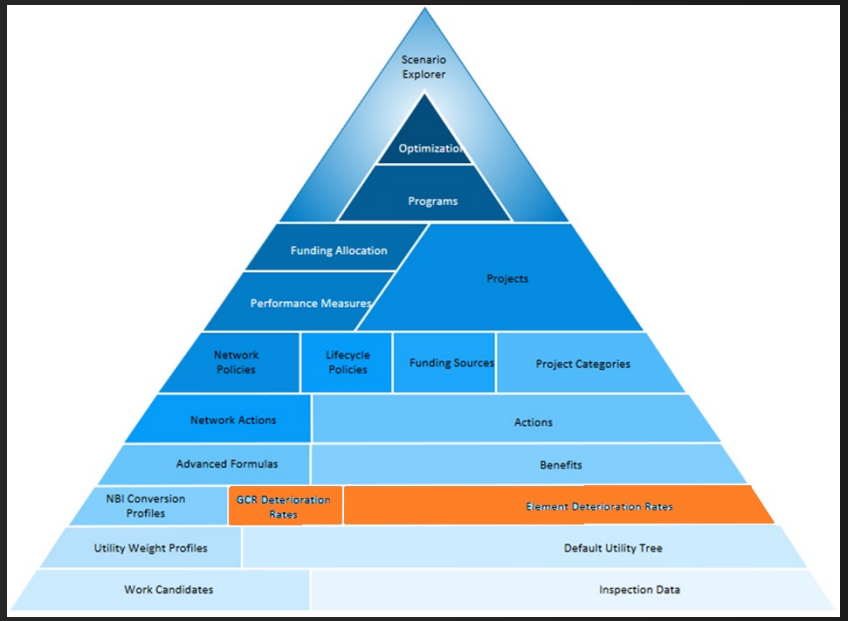
Back to the Future

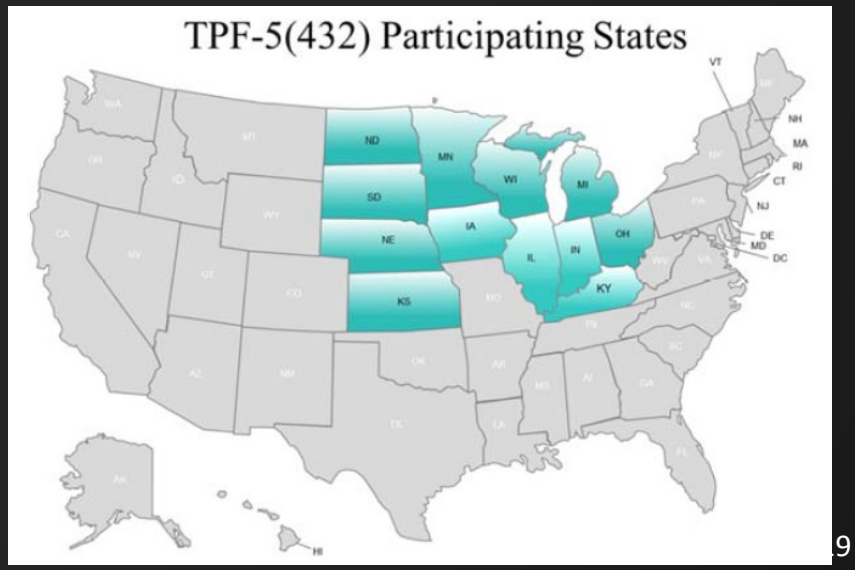
- BRIM has many advantages, but BrM has more than caught up
- Actively working to “migrate” existing practices into modules within BrM
- MnDOT in engaged in couple initiatives to help us climb the Great BrM Pyramid



Deterioration Modeling

- Deterioration modeling is one of the first objectives
- TPF-5(432): Bridge Element Deterioration for Midwest States
  - DOTs pool resources and historic bridge data
  - Develop reliable deterioration curves
    - Component NBI ratings
    - NBE, BME, and ADE

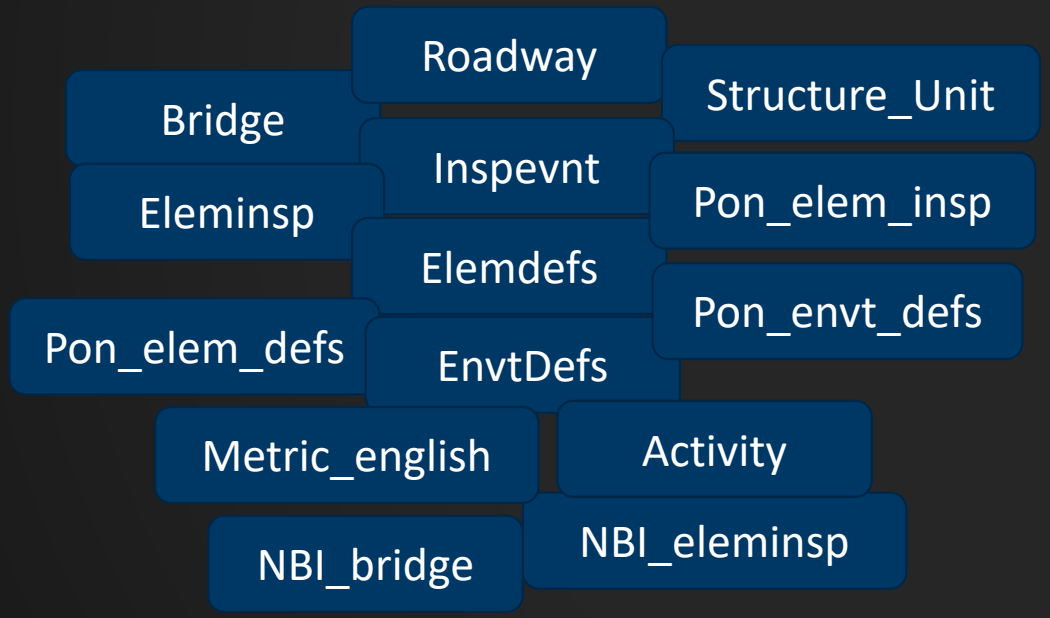




Analysis Database

Data Screening

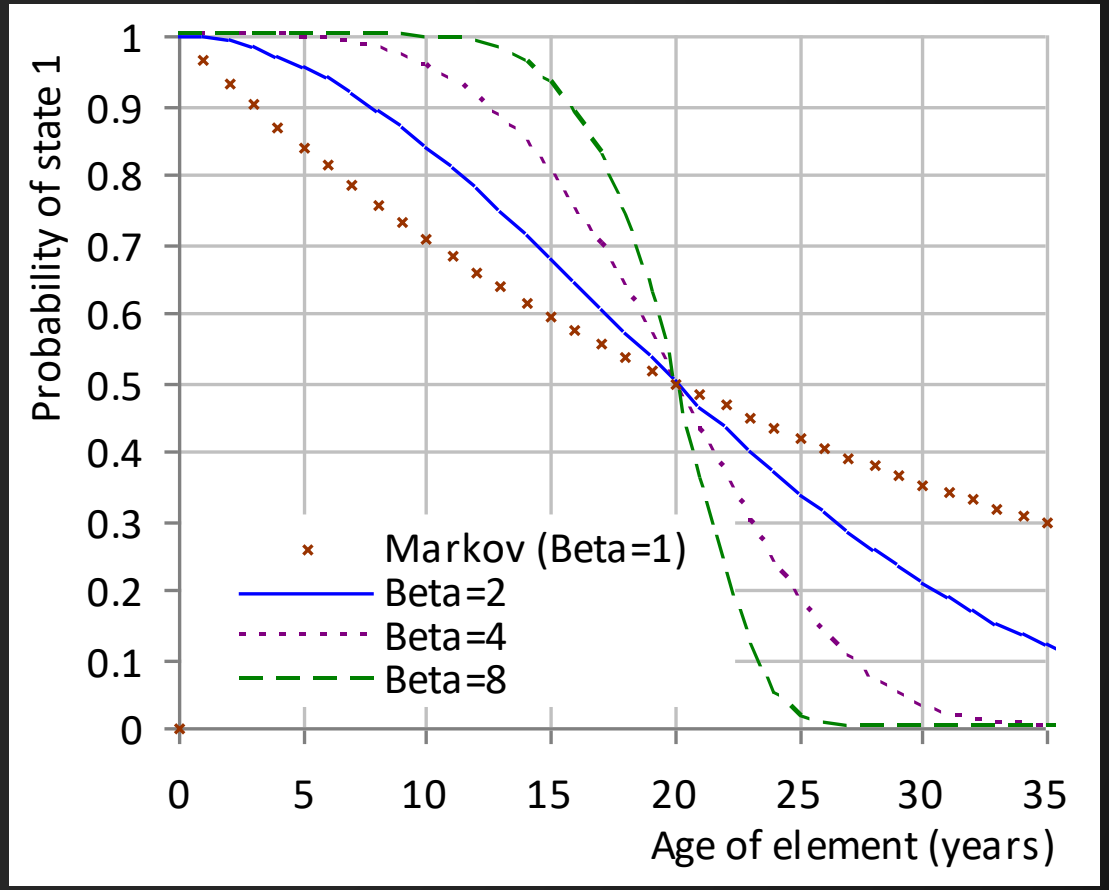
- Tables needed



- Filtering
  - A guidance to discern if inspection data is inappropriate for use in modeling
  - Adding a column in each spreadsheet to mark if a record is valid or not
  - Validation focuses on missing records, non-standard environment class, negative condition state quantities.

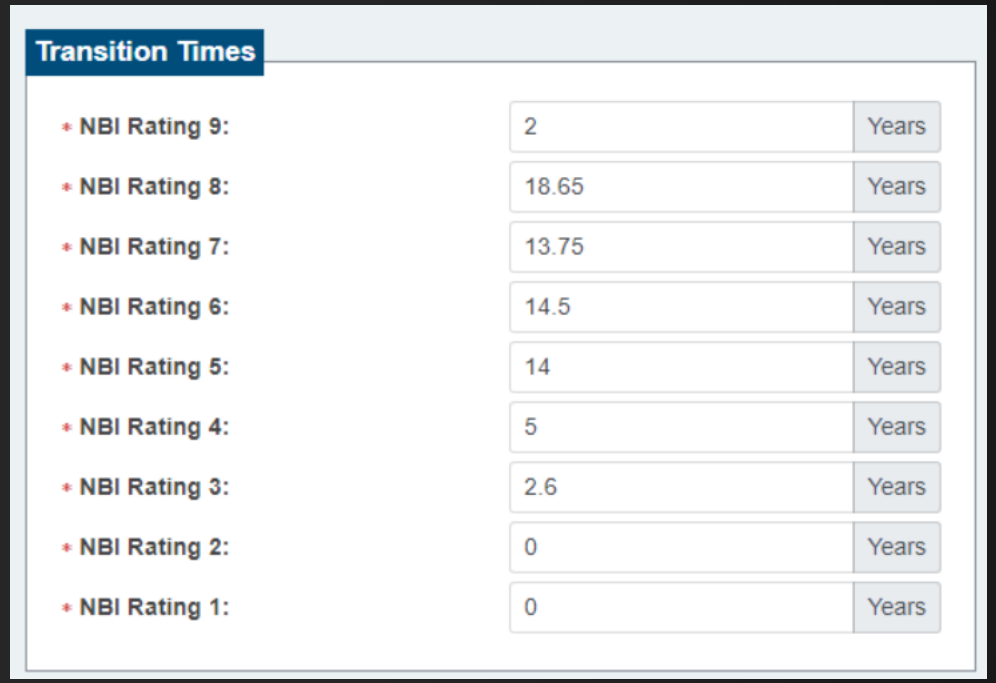
Deterioration Curve Approach

- Markov Model
  - Estimation and validation data sets side-by-side, final result a combination
- Weibull Shaping Parameters
  - Models the onset of deterioration
- Action effectiveness
  - Finds the transition probability matrix that best explains improvement in RC Deck condition after major preservation



GCR Results into BrM

State	Pop	9	8	7	6	5	4	3	2	1
IA	2,595	2.4	4.7	8.2	9.7	16.8	16.2	999.0	999.0	999.0
IL	5,870	0.9	3.8	6.3	6.5	5.8	9.9	11.7	999.0	999.0
IN	3,988	1.6	3.2	7.3	10.0	14.2	72.5	18.2	8.4	999.0
KS	2,732	999.0	3.6	17.2	8.6	14.6	28.8	999.0		
KY	4,820	0.8	3.8	7.7	10.1	11.3	19.4	44.6	999.0	999.0
MI	3,923	0.8	2.7	4.6	5.9	6.1	8.9	230.4	999.0	
MN	2,437	1.2	3.7	10.6	12.6	11.1	999.0	54.1	999.0	
ND	623	2.1	8.6	13.7	13.5	21.1	999.0	999.0	999.0	
NE	2,030	3.2	6.4	10.2	9.6	23.4	18.6	999.0		
OH	10,338	2.4	4.4	6.3	9.9	7.2	13.7	69.4	999.0	
SD	1,140	0.6	2.3	5.1	7.2	6.2	7.1	15.4	999.0	
WI	4,451	0.7	3.1	6.4	6.0	9.6	14.8	14.7	999.0	
All		**1.8**	**3.8**	**7.3**	**8.3**	**8.8**	**13.0**	**24.3**	**176.8**	**999.0**
Pop	44,946	2,134	8,427	16,784	9,877	3,624	1,307	2,529	256	8



Element Results into BrM

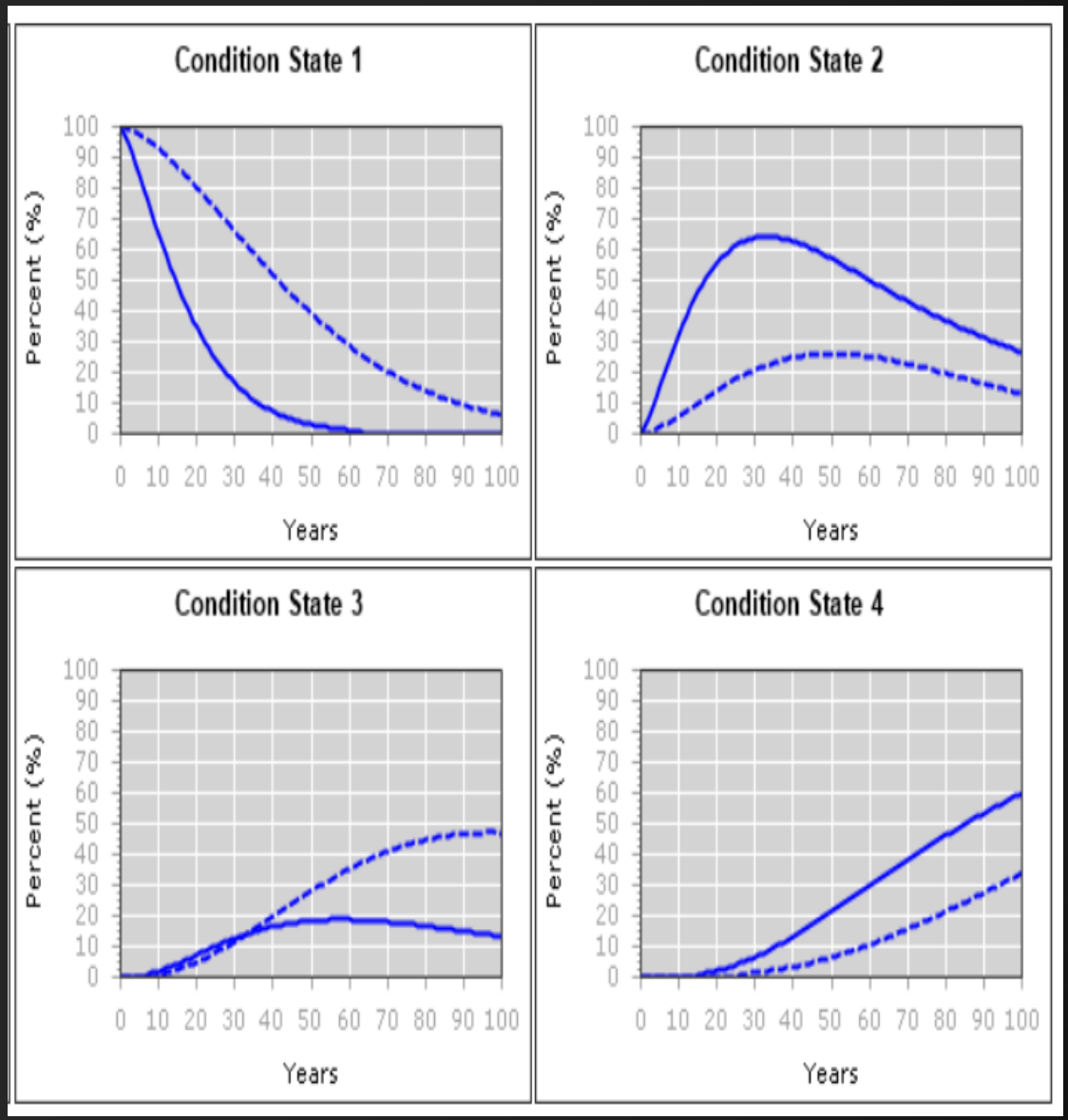
State	Population	1->2	2->3	3->4
IA	4,073	247.2	39.8	61.7
IL	2,129	20.8	20.9	2.3
IN	244	187.7	101.0	999.0
KS	1,462	260.3	51.4	127.7
KY	878	13.4	19.8	33.1
MI	3,411	21.5	19.3	182.5
MN	**2,550**	**41.4**	**15.3**	**51.8**
ND	1,041	33.1	24.1	42.0
NE	2,236	78.8	14.5	999.0
OH	1,733	49.6	27.6	38.1
SD	1,300	30.8	14.4	132.4
WI	4,706	69.3	19.8	27.6
All	25,764	43.6	19.7	24.8

Model Parameters

Median years in CS1:	14.42	Shaping parameter:	1.3
Median years in CS2:	42	Formula:	
Median years in CS3:	14.86		

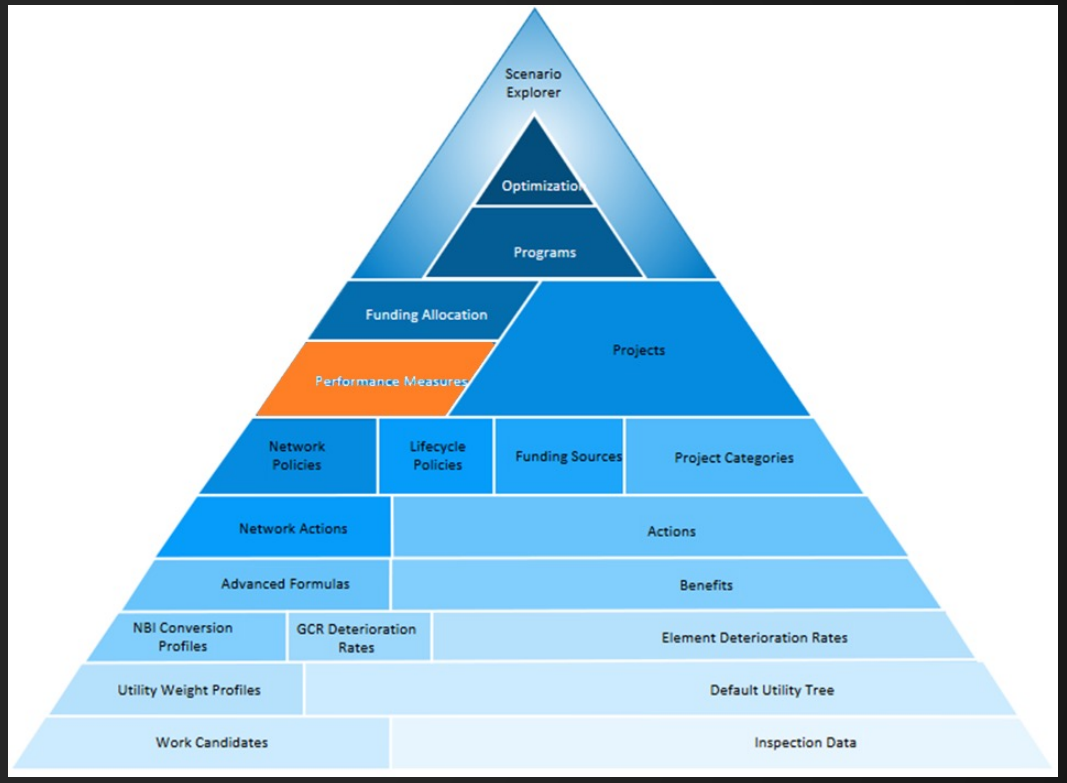
Model Parameters

Median years in CS1:	41.4	Shaping parameter:	1.58
Median years in CS2:	15.3	Formula:	
Median years in CS3:	51.8		



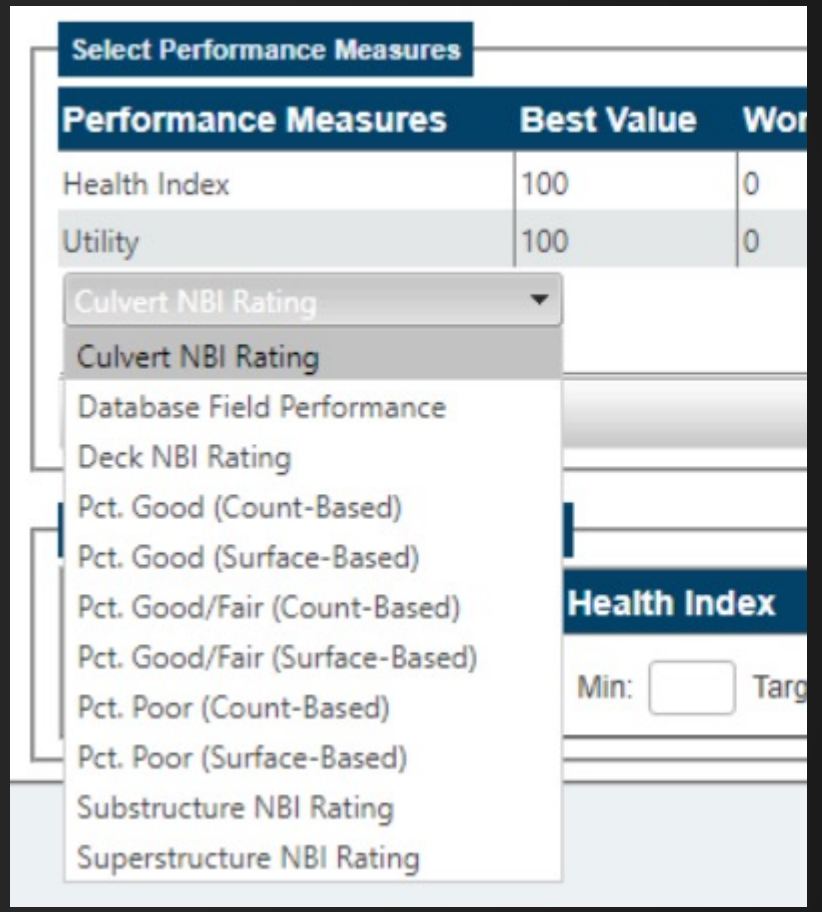
Performance Measures

- All States are required to establish performance targets based on GCR
- Many issues with this
  - Smaller fixes may not due justice
  - Broad stroke of GCR data
  - Small defect may control
- Minnesota has launched a research effort to establish element level performance targets



Element level performance targets

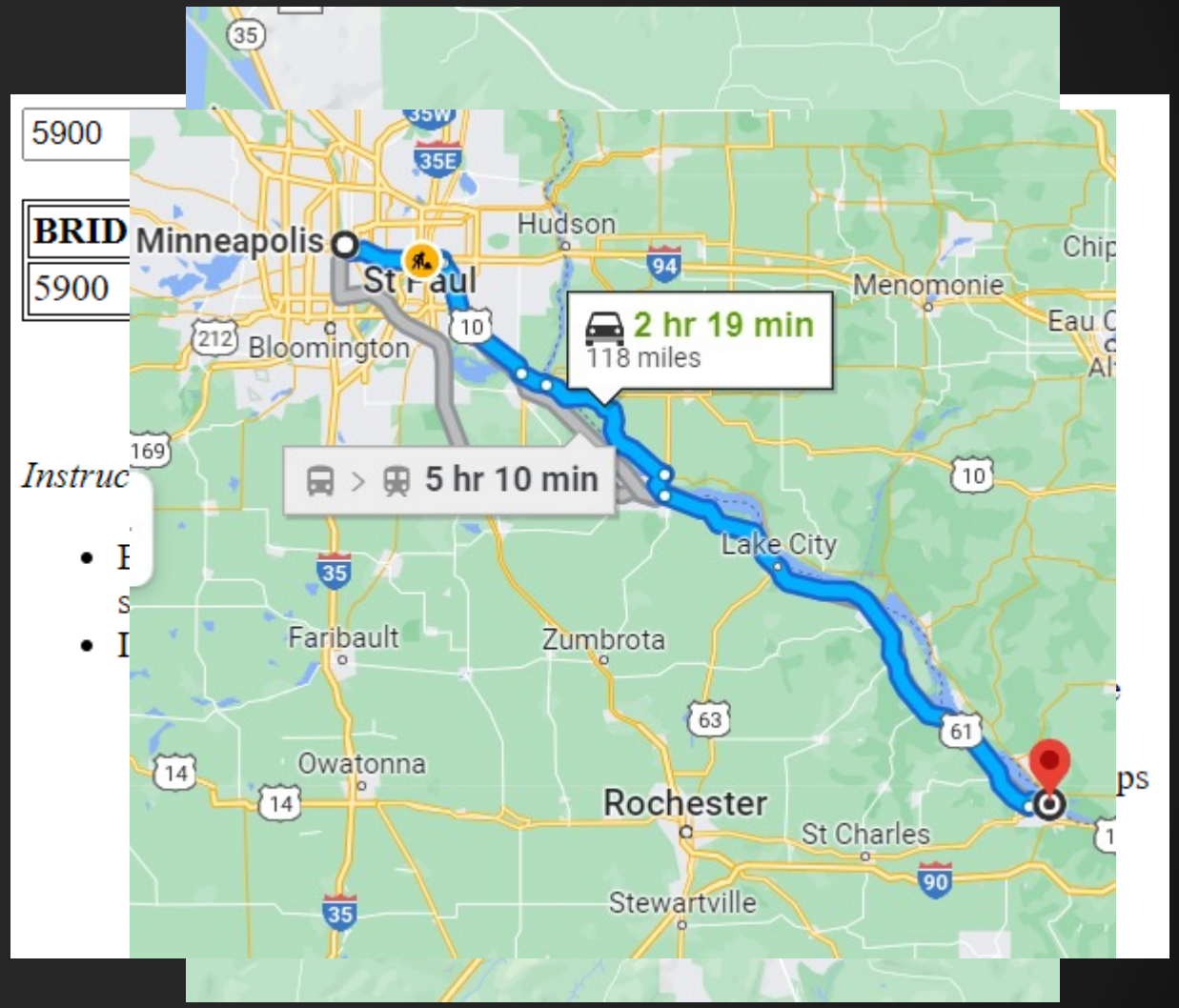
- Emphasize the elements and other factors that highlight the best cost/benefit opportunities for maximizing the life of a bridge.
- Guide the decision process for selecting the right maintenance and preservation action at the right time.



Mobile Bridge Map

https://brmp.dot.state.mn.us/mbmp/

- Tool to allow users to quickly access native mobile maps
- Can quickly benefit from 3rd party app features
- Can also access latest inventory/inspection report



Engagement

- AASHTOware is software for the states, by the states
- BrM Officer Positions
- BrM Technical Advisory Groups
  - Database - Craig Nazareth (Rhode Island) craig.nazareth@dot.ri.gov
  - Optimizer - Beckie Curtis (Michigan) curtisr4@michigan.gov
  - Testing - David Hedeen (Minnesota) david.hedeen@state.mn.us

How We Use BrM: Minnesota DOT

BrM User Group Meeting

Minneapolis, MN

September 14, 2022

David Hedeen, P.E.

Asset Management Engineer

Minnesota DOT | Bridge Office