

▶ PennDOT District 11 – Bridge Asset Management

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Talking Points

- History of the PennDOT District 11-0 Bridge Program
 - Bridge events and fiscal realities that led to strategies that improved the metrics of the District 11 bridge program
- Bridge Metrics/Programming Bridge Projects
 - Balancing project types along networks in order to improve our bridge conditions
 - Targeting investment to attack problem bridge types/length
- Moving Forward with Bridge Asset Management
 - Using the lessons learned and institutional knowledge to develop tools that assist in more efficient planning

History of Pittsburgh Bridges

- Many major structures in the area were built in the 1920's and 30's
 - Although rehabs were performed, little to no maintenance done for 50 years
- Early 1980's to 1990's almost all major river structures were rehabbed.
- During this time our district mainly programmed rehabs and replacements. We also performed some maintenance and minor preservation work through in-house crews, bridge maintenance and washing contracts, group painting projects, betterments (roadway projects w/ no Right-of-Way) and group roadway resurfacing projects.
 - Approximately \$40-45 million per year on bridges

Bridge Metrics

- 2000 – Started looking at our metrics more closely.
 - SD Deck Area = 32%
 - SD Bridges = 605
 - Posted Bridges = 62
 - 14 projects per year for about \$45 million

District 11-0 Bridge Metrics



Engineering District 11-0
Design Division
Bridge Management Unit
Performance Measures

April 11, 2017									
	GOAL	GOAL				CY	CY	CY	CY
	12/31/17	12/31/17	Apr	Mar	Feb	2016	2015	2014	2013
SD Deck Area									
Interstate	4.8%	10.5%	0.0%	0.0%	0.0%	0.0%	0.6%	1.2%	1.2%
NHS (Non-Interstate)	5.5%	22.9%	9.4%	9.6%	11.6%	11.5%	13.8%	13.7%	15.0%
Non-NHS, ADT > 2000	10.9%	23.5%	12.5%	12.5%	12.6%	12.6%	13.7%	15.0%	19.4%
Non-NHS, ADT < 2000	12.7%	39.7%	18.9%	18.9%	19.1%	19.3%	24.5%	28.4%	28.0%
Total - all BPNs	20.4%	20.4%	7.8%	7.9%	8.9%	8.9%	9.6%	10.1%	11.4%
Total SD Deck Area (1000 sf)	3,096	3,096	1,182	1,199	1,352	1,354	1,450	1,524	1,715
Total Deck Area (1000 sf)			15,171	15,169	15,141	15,146	15,162	15,077	15,068
Added (1000 sf)			1	0	0	42	81	11	155
Removed (1000 sf)			18	153	2	138	155	203	410
SD Bridge Count									
Interstate	6	23	0	0	0	0	2	5	5
NHS (Non-Interstate)	16	53	62	63	66	66	68	74	83
Non-NHS, ADT > 2000	102	248	101	102	102	102	123	131	139
Non-NHS, ADT < 2000	53	154	103	103	104	106	124	125	127
Total - all BPNs	177	478	266	268	272	274	317	335	354
Total # Bridges			1,802	1,803	1,799	1,800	1,803	1,803	1,806
% SD Bridges			14.76%	14.86%	15.12%	15.22%	17.58%	18.58%	19.60%
SD Bridges Added			1	0	0	20	15	11	17
SD Bridges Removed			3	4	2	63	33	30	41
Closed & Posted Bridges									
Posted Bridges Added			0	0	0	2	1	2	35
Posted Bridges Removed			0	0	0	14	5	3	3
Total Posted Bridges			41	41	41	41	53	57	58
Closed Bridges Added			0	0	0	1	0	0	0
Closed Bridges Removed			0	0	0	1	0	0	0
Total Closed Bridges			2	2	2	2	2	2	2
Maintenance Priority 0&1									
Maint Priority 0's Added			0	0	0				
Maint Priority 0's Removed			0	0	0				
Total Maint Priority 0's		0	0	0	0				
Maint Priority 1's Added			0 (2)	1 (2)	0 (2)				
Maint Priority 1's Removed			0 (0)	1 (0)	0 (0)				
Maint Priority 1's Deferred			15 (6)	15 (6)	16 (6)				
Active Maint Priority 1's		0	2 (20)	2 (20)	1 (20)				

Note: Only structural compliance maintenance items shown. Deck joints shown in red ().

- Monthly District Program Management Committee Meeting
- Stats broken down by SD Deck %, SD Numbers, Posted bridges, maintenance priorities



Significant Bridge Events/Policy Changes

- 2004 – FHWA allowed us to begin investing federal money on preservation projects (replacing joints, spot/zone painting, overlays, FC retrofits) – keeping good bridges good while doing rehabs and replacements became our focus
 - We looked to program SD bridges, major bridges needing preservations, posted bridges and bridges with low sufficiency ratings.
- PennDOT stopped designing capacity adding projects (extra lanes, larger structures) and focused on existing assets. We also looked at what was needed to improve our metrics.
 - Meeting the nationwide average of 10% SD – needed to program 195,000 SF per year of rehabs and replacements in addition to preservation work.

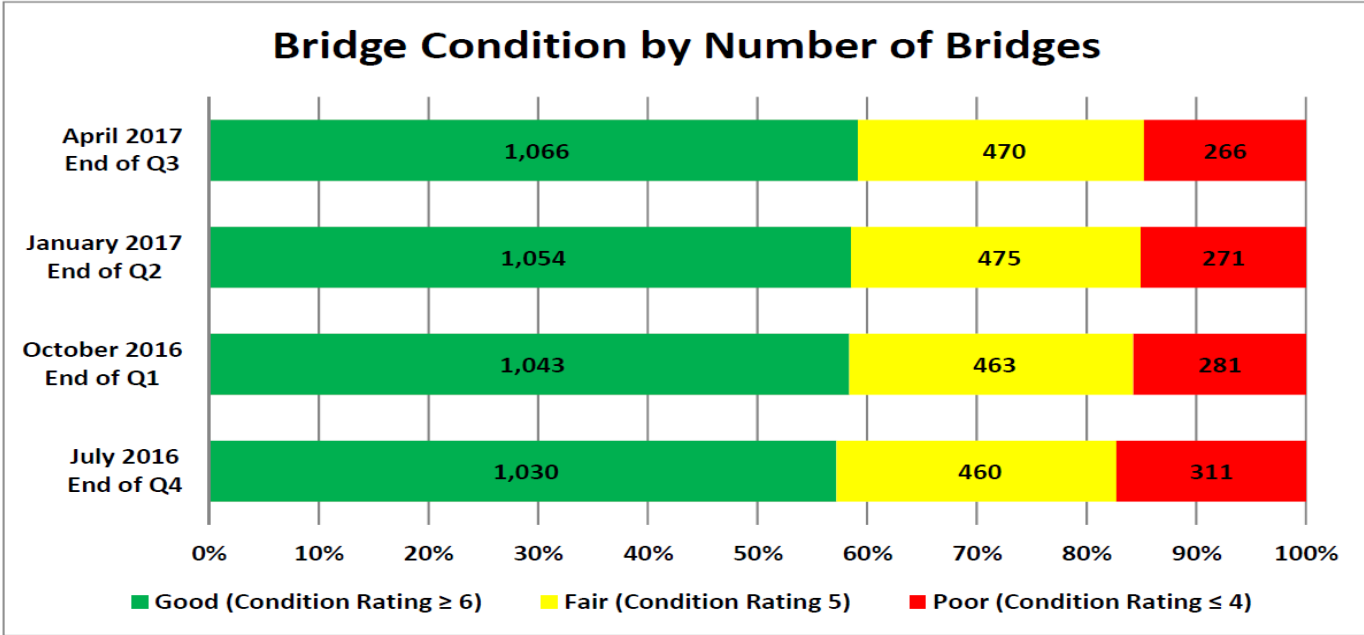
Significant Bridge Events/Policy Changes (cont.)

- 2006 – Lakevue Drive over I-70 collapse in Washington County, PA
- 2007 – I-35 W Collapse in Minnesota
 - Added the Risk Assessment tool – 365 items used to develop a risk assessment score. This produced a “worst bridge first” list.
 - We added a separate list for bridge preservation
- 2008 – Birmingham Bridge rocker bearing failure
 - Near Collapse of span over I-376
- 2008 thru 2012 – Accelerated Bridge Replacement program
 - 1100 replacements statewide
 - \$150 million per year within District 11 (50-130 bridge projects per year)
 - SD Deck Area = 12.74%
 - SD Bridges = 378 bridges
 - Posted Bridges = 26 bridges



Bridge Funding and Initiatives

- 2010 – Emphasis on reducing Priority 0 and 1 maintenance items
 - Reduced from 347 to 10 in one year using two maintenance contracts
 - Federal money for br.washing projects and washing on insp. contracts
- 2012 – Developed the bridge condition meter metric
 - Reduce bad bridges through rehabs and replacements
 - Maintain the “Fair” and “Good” categories through timely preservation

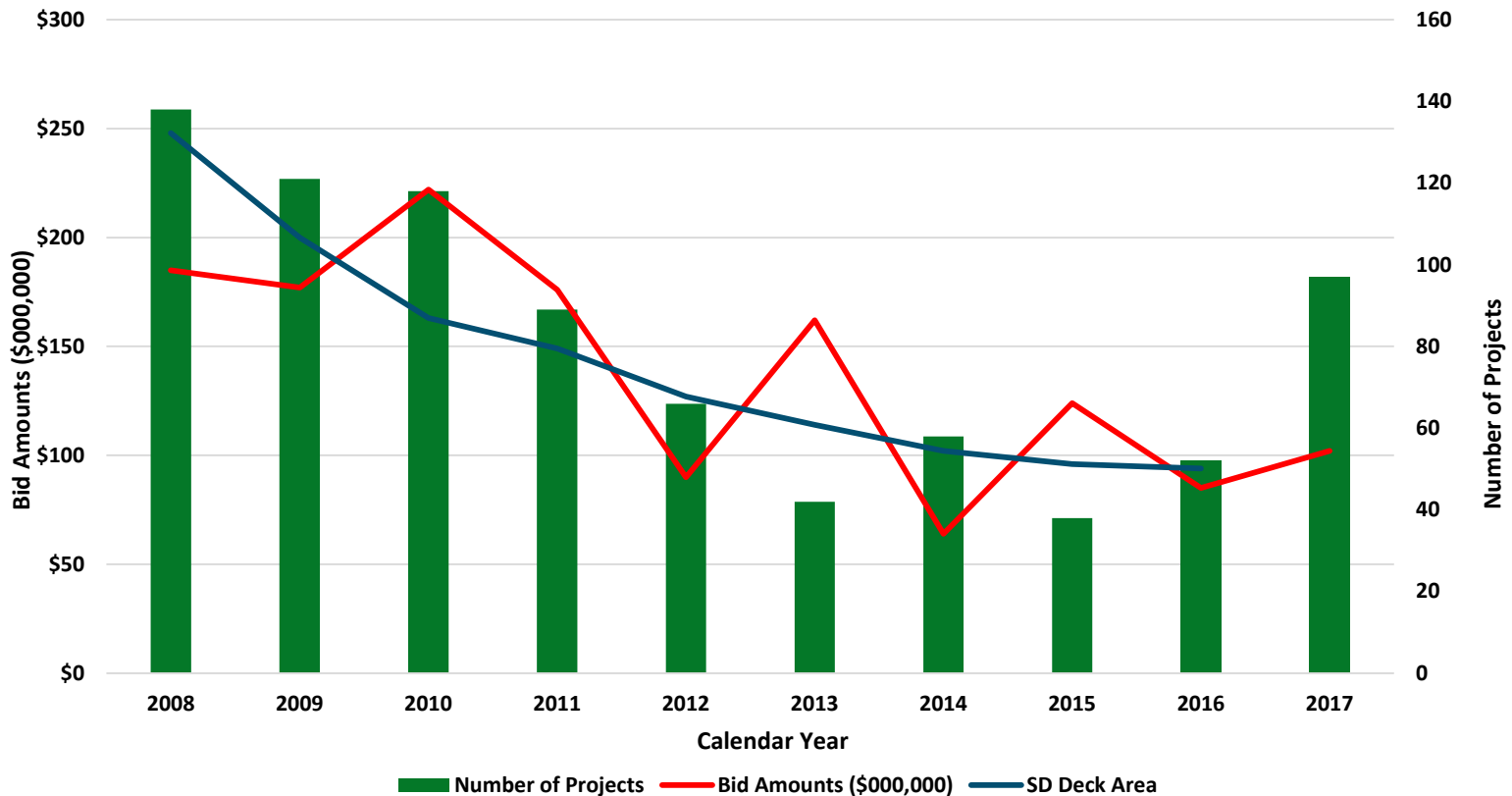


➤ Bridge Funding and Initiatives (cont.)

- In 2013, Risk based posting implemented in order to justify additional funding (80%-90% of OR depending on condition ratings)
 - Posted bridges increased from 24 to 60
- November 2013 – Act 89 was passed to increase investing on roads and bridges by \$51 million per year
- 2013 thru 2015 – Bridge Investment down to \$75 million per year due to roadway needs
 - 2016 Act 89 investment started to kick in and we saw a funding increase
- 2016 thru 2018 – Gov. Wolf initiative - Emphasis on reducing SD number
 - Resulted in lower investment in preservation
- P3 Project (2015 thru 2019)
 - 85 replacements in District 11, 558 statewide

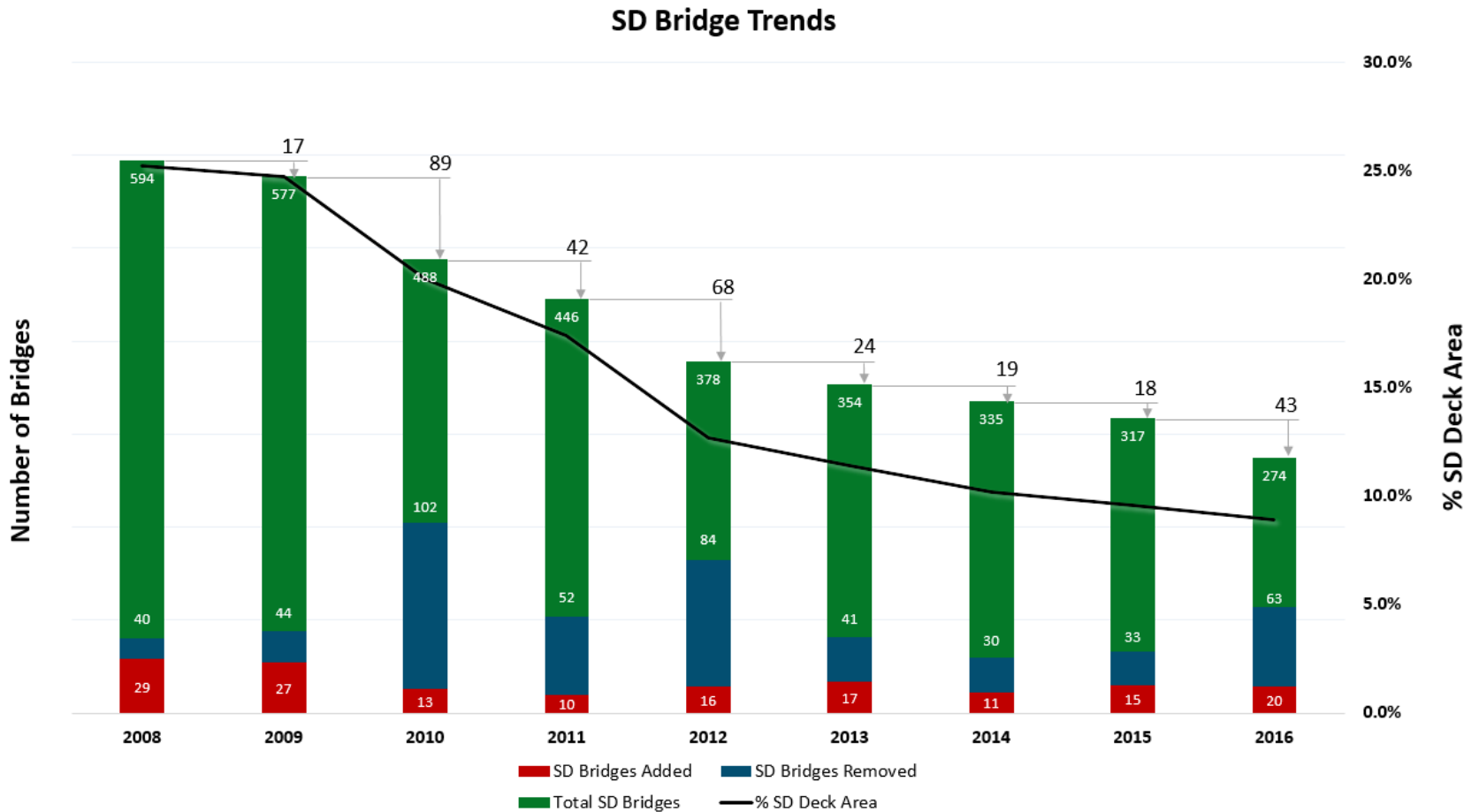
Bridge Funding History

Bridge Lets, Dollars Spent and SD Deck Area Per Calendar Year



- Higher lets and more dollars invested results in lower SD percentages(2017 projected projects)

District 11-0 Bridge Trends



- Results of funding and bridge initiatives
 - Decrease in SD number and deck area
 - SD Deck Area = 7.8%
 - SD Number = 266



How District 11 Determines Scope of Work

General guidance to develop an initial SOW

- Replacement
 - Deck, Superstructure and substructure rating of 4 or less
- Deck Replacement
 - Deck is 4 or less
 - Superstructure and substructure 5 or higher
- Super Replacement
 - Superstructure 4 or less
 - Substructure 5 or higher
- Preservation
 - All ratings 5 or higher

Future

- Bridge Asset Management Software (BAMS)
- Bridge Life Cycle Analysis (plan for every bridge)
- Increased emphasis on preservation
- Timely deck and joint replacements to prevent excessive deterioration of superstructure and substructure elements
- Maintenance crews are now able to focus on preventative maintenance since maintenance priority 0's and 1's and demand maintenance have decreased

Asset Management Strategies

- Bridge Asset Management Software
 - Using BAMS to predict deterioration
 - Improve timing of preservation and rehab projects based on cycles and condition of bridge
 - Choosing the correct treatment at the right time
 - Develop strategies based on funding scenarios

Deterioration Modeling – How long does a bridge stay in each condition state?

Superstructure Decay - District 11										
	9 → 4	9 → 3	9 → 8	8 → 7	7 → 6	6 → 5	5 → 4	4 → 3	3 → 2	2 → 1
Expected (yrs)	45.49	57.77	4.36	8.51	10.47	10.47	11.69	12.27	7.86	
Standard Deviation	11.36	12.78	2.07	5.01	5.98	5.46	5.85	5.84	4.26	0.00

▶ Bridge Life Cycle Analysis – Plan for Each Bridge

Structure Categories

- Major Structure (160 year life)
 - All structures 800' and greater with tooth dams
- Sub-major Structures (140 year life)
 - All other structures 800' and greater
- Other Bridges (120 year life)
 - Bridges between 30'-799'
- Small Bridges (100 year life)
 - All bridges less than 30'
- Culverts (100 year life)
 - Concrete, ConSpan and arches
- Metal Culverts (40 year life)

Major Structure Example

1st Treatment	Timing (years)	Cost/SF	2nd Treatment	Timing (years)	Cost/SF	3rd Treatment	Timing (years)	Cost/SF	4th Treatment	Timing (years)	Cost/SF
1st Treatment	Timing (years)	Cost/SF	2nd Treatment	Timing (years)	Cost/SF	3rd Treatment	Timing (years)	Cost/SF	4th Treatment	Timing (years)	Cost/SF
Latex, joints, spot paint	15	\$75	Latex overlay, joint, full paint	35	\$115	Deck replacement, super/sub repairs, bearing replacement	60	\$250			
Latex overlay, joints, full paint	95	\$138	replacement, super/sub repairs, bearings	120	\$300	replacement, full paint	135	\$95	Bridge replacement	160	\$800

- Timing
 - Joints and latex every 15 years
 - Full paint every 35 years
 - Deck replacement every 60 years
 - Repeat cycle

Findings (Plan for Each Bridge)

- Preventative maintenance is vital to extending joint, deck and paint life to meet goals
- In order to maintain this strategy we need to be investing approximately \$240 million per year between replacement, rehab, preservation and maintenance (design, utilities, R/W not included)
 - Currently we are investing about \$75 million per year on our capital program
 - Approximately \$3 million on maintenance
 - \$400 million on entire District program

SD by Bridge Length and Type

	Less than 30 Feet	Between 30 - 160 Feet	Between 160 - 500 Feet	Greater than 500 Feet
Number of Bridges	822	495	305	180
# SD Bridges	154	73	24	13
% SD	18.7%	14.7%	7.9%	7.2%
Deck Area	568,467	1,759,288	3,976,239	8,866,620
SD Deck Area	90,642	201,198	291,834	562,027
% SD Deck Area	16%	11%	7%	6%

	Concrete Bridge	Concrete Culvert	Other Bridge	Other Culvert	Other I Beams	P/S Box Beams	P/S I Beams	Steel Box Beams	Steel Complex	Steel Culvert	Steel I Beams
Number of Bridges	323	468	24	19	63	234	103	8	88	66	406
# SD Bridges	72	20	7	8	46	35	4	0	13	12	47
% SD	22.3%	4.3%	29.2%	42.1%	73.0%	15.0%	3.9%	0.0%	14.8%	18.2%	11.6%
Deck Area	790,674	426,550	22,826	11,459	46,234	1,247,209	1,430,914	486,358	4,362,750	36,316	6,309,326
SD Deck Area	113,023	12,811	6,036	3,089	27,103	156,005	51,252	-	447,167	9,538	319,677
% SD Deck Area	14.3%	3.0%	26.4%	27.0%	58.6%	12.5%	3.6%	0.0%	10.2%	26.3%	5.1%

- Closer examination of SD bridges
 - Reducing SD number (replacement of small bridges) without increasing SD Deck Area (preservation of larger structures)
 - Focus on improving the following bridge types: Concrete Slabs/T-beams, Encased I-beams, P/S box beams and Steel I-beams

District 11 Bridge Strategies

- Perform at least \$12.5 million per year in bridge preservation
 - We would like to aim for \$40 million or more
- Use preventative maintenance to reach life cycle goals of structures
 - Utilize in-house crews to help reach cycle goals
 - 60 year deck life
 - 35 year paint life
 - 15 year latex life
 - Joint sealing crews, epoxy/deck sealing crews, spot/zone painting crews

▶ Lessons Learned

- Over the last 17 years we have had a series of events and initiatives that allowed us to invest more money on bridges and improve our SD metrics since 2000
 - SD Deck Area: 32% to 7.8%
 - SD Numbers: 605 to 266
 - Posted Bridges: 62 to 41
- It's best to create a balanced program between preservation, rehab and replacement projects
 - This includes timely maintenance which is key to reaching cycle goals for various treatments (overlays, paint, joints, etc.)
- Reasonable and balanced goals between bridges and roadways
 - Concentrating too much on one hurts the other
- There is a need to constantly evaluate inspection practices due to unknown issues
 - P/S Adjacent Non-Composite Box Beams, T-beams with rebar deterioration, Rocker Bearings, Gusset Plates, etc.



Key Strategies

- Using BAMS and Plan for Each Bridge to help pick the right treatment at the right time
- Invest efficiently between maintenance, preservation, rehab and replacement in order to meet all metrics
 - Increase focus on preventative maintenance
- Targeted bridge selection and investment
 - Reducing SD number (replacement of small bridges) without increasing SD Deck Area (preservation of larger structures)
 - Focus on improving the following bridge types: Concrete Slabs/T-beams, Encased I-beams, P/S box beams and Steel I-beams
- Programming bridges to meet network goals

Network	SD Bridges	SD Bridges on TIP	SD Bridges on P3
Interstate	0	0	0
Other NHS	62	29	6
Non-NHS >2000 ADT	101	29	24
Other Non-NHS	103	28	24

Questions

