

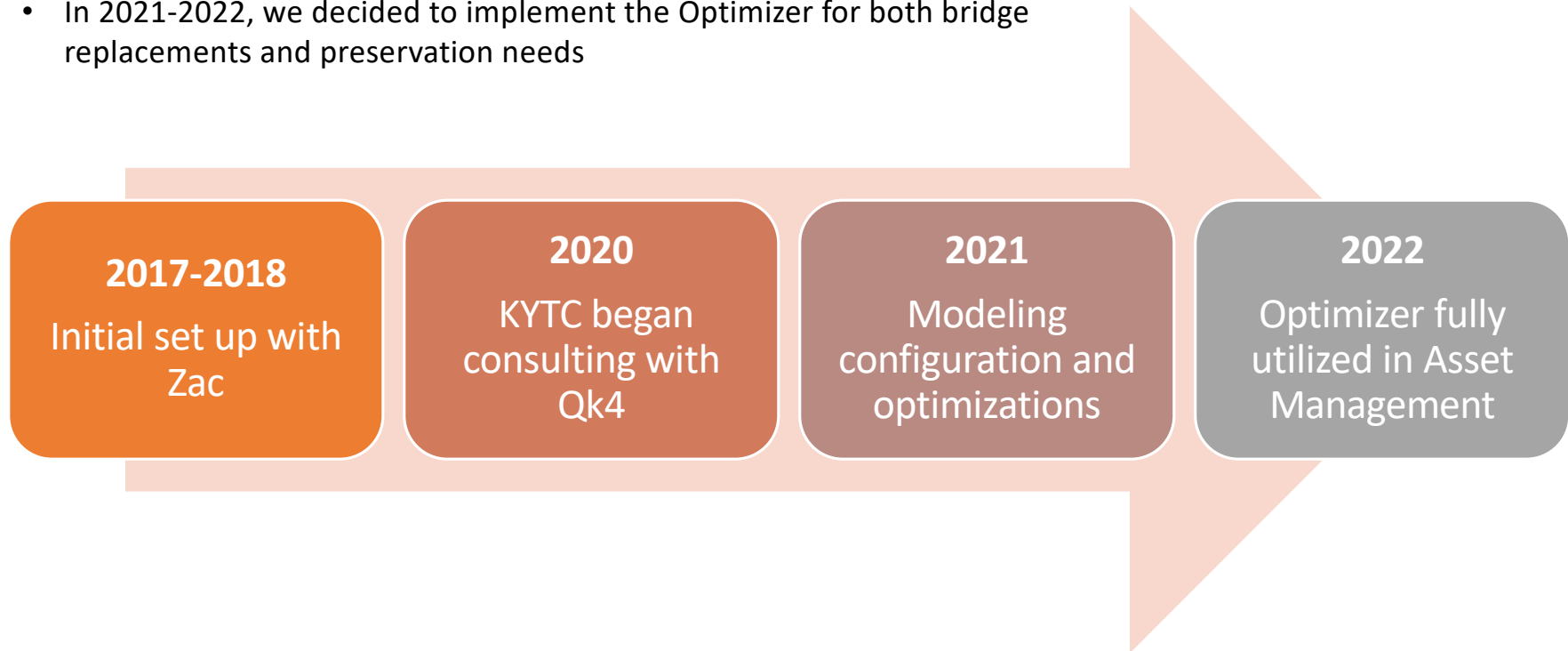


LCCA Analysis Experiences

Katherine Edmunds, Asset Manager, Bridge Maintenance

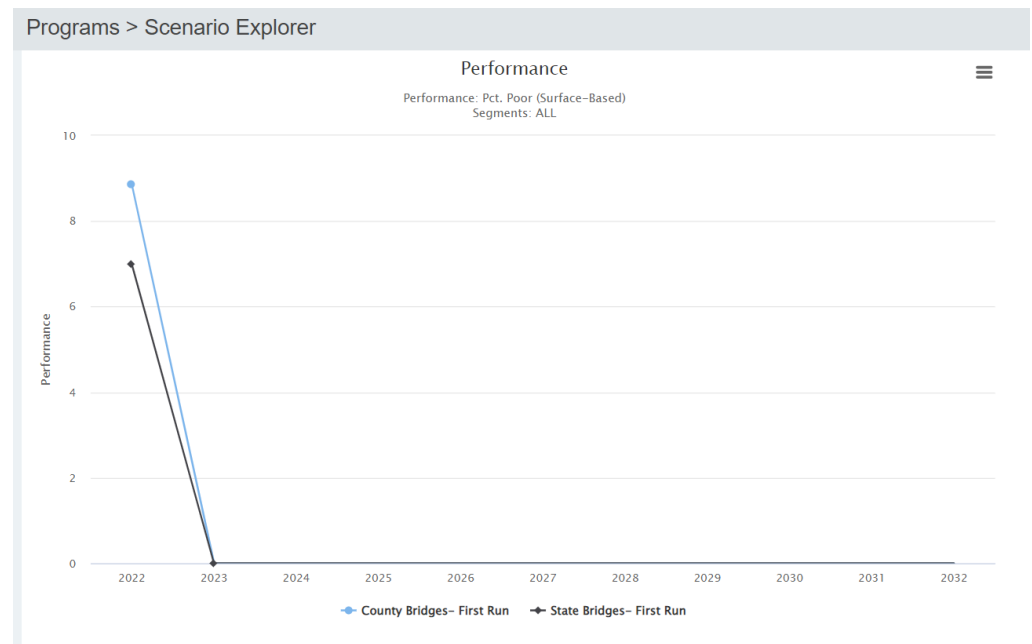
History and Timeline

- KYTC initial vision in 2017 was a complete preservation approach
- Our vision shifted towards recommending bridge replacements in 2020
- In 2021-2022, we decided to implement the Optimizer for both bridge replacements and preservation needs



Today (2023)

- BrM optimization tools are being used for project scoping, funding management and analysis, and “fun runs”
- Working on SNBI implementation and how that will affect optimizer tools



ANALYSIS ^

WORK CANDIDATES ∨

UTILITY VALUE

LCCA

BULK UTILITY

Analysis > LCCA



My reaction...

The Task and First Attempt

- Future maintenance and lifecycle costs of bridges along an Interstate corridor

	A	B	C	D	E	F	G
1				Routine Maintenance		No Maintenance	
2				Remaining Life (Years)	Total LCC	Remaining Life (Years)	Replacement Cost
3		3 Steel		0	\$ 37,639,876.97	77	\$ 16,598,538.34
4		3 Steel		59	\$ 31,940,821.98	30	\$ 19,801,976.60
5		4 Steel Continuous		42	\$ 21,560,648.51	21	\$ 22,468,189.20
6		4 Steel Continuous		55	\$ 49,122,720.18	36	\$ 83,402,889.82
7		6 P/S Conc Continuous		40	\$ 34,809,106.00	32	\$ 32,864,087.15
8		4 Steel Continuous		58	\$ 6,474,963.38	32	\$ 10,939,590.70
9		3 Steel		37	\$ 18,315,161.30	14	\$ 14,869,053.70
10		4 Steel Continuous		39	\$ 14,458,974.91	25	\$ 11,004,056.03
11		4 Steel Continuous		56	\$ 7,691,147.74	34	\$ 11,542,527.96
12		4 Steel Continuous		41	\$ 15,295,423.06	19	\$ 11,410,920.91
13		3 Steel		32	\$ 31,457,265.66	19	\$ 20,209,128.09
14		3 Steel		51	\$ 1,094,233.91	35	\$ 1,013,774.10
15		3 Steel		68	\$ 3,697,129.23	33	\$ 3,002,924.70
16		3 Steel		37	\$ 3,646,279.40	22	\$ 3,009,905.16
17		4 Steel Continuous		55	\$ 8,091,199.87	33	\$ 12,242,216.35
18		2 Concrete Continuous		16	\$ 12,923,433.71	25	\$ 11,475,495.13
19		2 Concrete Continuous		33	\$ 8,486,849.95	25	\$ 7,972,905.51
20		4 Steel Continuous		62	\$ 7,259,555.17	35	\$ 8,809,442.07

Second Attempt

....all of my optimization work thus far has been to advocate for routine maintenance. This time, I needed to find a way to advocate for replacement...

- Build and No-Build scenarios
 - Build: replace bridge now
 - No-Build: continue maintaining, future replacement plan
- Project Scopes: Full replacement, superstructure replacement, deck replacement



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Creation of Lifecycle Plans part 1: **Create/Edit Plan**

Create/Edit Plan			
* Name:	<input type="text"/>	Set as Current Plan:	<input type="checkbox"/>
* Start Year:	<input type="text" value="2023"/>	* Analysis Length:	<input type="text" value="30"/> <input type="text" value="Years"/>
* Inflation Estimation Method:	<input type="text" value="Fixed Inflation Rate"/> ▾	* Inflation %:	<input type="text" value="0"/> <input type="text" value="%"/>
* Nominal Discount Rate:	<input type="text" value="0"/> <input type="text" value="%"/>		
* NBI Deterioration Method:	<input type="text"/> ▾		
* Utility Weight Profile:	<input type="text"/> ▾		
Estimate Functional User Cost:	<input type="checkbox"/>		
* Element Deterioration Profile:	<input type="text" value="-- none --"/> ▾		
* Condition Based On Inspection:	<input type="text" value="2023-09-12 (GJYA)"/> ▾	* Residual Value Calculation:	<input type="text"/> ▾

Creation of Lifecycle Plans part 1:

Create/Edit Plan

Create/Edit Plan

* Name: 056B00183N Rep Only

* Start Year: 2024

* Inflation Estimation Method: Fixed Inflation Rate

* Nominal Discount Rate: 0 %

* NBI Deterioration Method: NBI Converter

* Utility Weight Profile: SYP 2024

Estimate Functional User Cost:

* Element Deterioration Profile: KYTC LCCA Det. Profile

* Condition Based On Inspection: 2022-12-12 (TXBJ)

Set as Current Plan:

* Analysis Length: 30 Years

* Inflation %: 0 %

Deck NBI Converter Profile: Kentucky Training - 2021 Deck

Substructure NBI Converter Profile: Kentucky Training - 2021 Sub

Superstructure NBI Converter Profile: Kentucky Training - 2021 Super

Culvert NBI Converter Profile: Kentucky Training - 2021 Culvert

* Residual Value Calculation: Remaining Life

Updated by Katherine Caldwell on 5/31/2023

Notes: Generated by Caldwell, Katherine on 04/26/2023

This estimation method will take longer than the other residual value calculation methods.

Creation of Lifecycle Plans part 2: Optimization

Optimization

Optimizer Database Connection: pontis

Download Optimization Log: [Download Log](#)

* Optimization Start Year:

* Minimum Deferment: Years

Include User Costs in Optimization:

* Save Optimization As:

Assign Network Policies

Available Network Policies

- KYTC Deck Replace
- KYTC Epoxy & Combinations
- KYTC Latex Overlay
- KYTC Replace Bridge
- KYTC Sub Repair Only
- KYTC Super Repair
- KYTC Superstructure Replace
- Omit From Optimization Testing
- Paint Super/Sub
- Preserve Super / Sub
- Rehab Culvert



Selected Network Policies

Assign LCCA Policies

Available LCCA Policies

- Culvert policy
- Deck Policy
- KYTC Bridge Overall (2024)
- KYTC Bridge Rehab (2024)
- KYTC Culvert LCCA Policy
- KYTC Replacement LCCA Policy
- KYTC Sub LCCA Policy
- Structure Overall
- Substructure Policy
- Superstructure Policy



Selected LCCA Policies

- 1. KYTC Bridge Replacement (2024)
- 2. KYTC Super LCCA Policy
- 3. KYTC Deck LCCA Policy

Optimization Progress

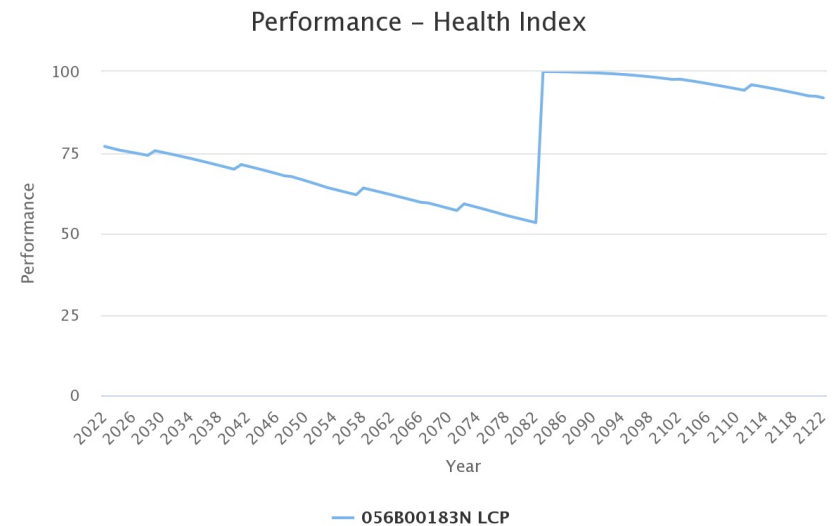
Completed

Raw Results

056B00183N - 056B00183N LCP Actions															
Locked	Year #	Year	Action(s)	Action(s) Added As	Agency Cost			Functional + Action User Cost			Total Cost			Utility	
					2023 \$	Inflated \$	PV \$	2023 \$	Inflated \$	PV \$	2023 \$	Inflated \$	PV \$	Start	End
	1	2024	Paint-Structural	LCCA Policy	\$1,705,620.00	\$1,756,788.60	\$1,722,341.76	\$0.00	\$0.00	\$0.00	\$1,705,620.00	\$1,756,788.60	\$1,722,341.76	54.67	54.67
	6	2029	Joints-Replace	LCCA Policy	\$1,361,500.00	\$1,625,702.20	\$1,443,577.03	\$0.00	\$0.00	\$0.00	\$1,361,500.00	\$1,625,702.20	\$1,443,577.03	50.28	51.96
	18	2041	Deck Repair	LCCA Policy	\$1,401,923.37	\$2,386,680.69	\$1,671,056.86	\$0.00	\$0.00	\$0.00	\$1,401,923.37	\$2,386,680.69	\$1,671,056.86	50.20	57.79
	25	2048	Joints-Replace	LCCA Policy	\$1,361,500.00	\$2,850,678.65	\$1,737,576.64	\$0.00	\$0.00	\$0.00	\$1,361,500.00	\$2,850,678.65	\$1,737,576.64	46.18	47.03
	30	2053	Paint-Structural	LCCA Policy	\$1,705,620.00	\$4,139,987.42	\$2,285,566.53	\$0.00	\$0.00	\$0.00	\$1,705,620.00	\$4,139,987.42	\$2,285,566.53	42.41	42.41
	35	2058	Deck Repair	LCCA Policy	\$1,834,479.54	\$5,161,973.09	\$2,581,129.09	\$0.00	\$0.00	\$0.00	\$1,834,479.54	\$5,161,973.09	\$2,581,129.09	37.83	49.40
	44	2067	Joints-Replace	LCCA Policy	\$1,361,500.00	\$4,998,682.27	\$2,091,452.35	\$0.00	\$0.00	\$0.00	\$1,361,500.00	\$4,998,682.27	\$2,091,452.35	41.63	42.48
	49	2072	Deck Repair	LCCA Policy	\$1,837,068.44	\$7,818,966.42	\$2,963,063.31	\$0.00	\$0.00	\$0.00	\$1,837,068.44	\$7,818,966.42	\$2,963,063.31	37.75	49.32
	55	2078	Paint-Structural	LCCA Policy	\$1,705,620.00	\$8,668,214.28	\$2,916,890.94	\$0.00	\$0.00	\$0.00	\$1,705,620.00	\$8,668,214.28	\$2,916,890.94	41.69	41.69
	60	2083	Bridge-Replacement	LCCA Policy	\$17,206,507.00	\$101,373,910.05	\$30,896,970.07	\$0.00	\$0.00	\$0.00	\$17,206,507.00	\$101,373,910.05	\$30,896,970.07	41.18	92.08
	79	2102	Joints-Replace	LCCA Policy	\$1,361,500.00	\$14,065,604.36	\$2,942,692.13	\$0.00	\$0.00	\$0.00	\$1,361,500.00	\$14,065,604.36	\$2,942,692.13	71.15	72.38
	84	2107	Paint-Structural	LCCA Policy	\$1,538,240.00	\$18,422,602.25	\$3,490,893.08	\$0.00	\$0.00	\$0.00	\$1,538,240.00	\$18,422,602.25	\$3,490,893.08	62.82	62.82
	89	2112	Deck Repair	LCCA Policy	\$1,489,904.10	\$20,685,751.96	\$3,550,226.21	\$0.00	\$0.00	\$0.00	\$1,489,904.10	\$20,685,751.96	\$3,550,226.21	61.80	69.54
	98	2121	Joints-Replace	LCCA Policy	\$1,361,500.00	\$24,664,122.39	\$3,542,002.26	\$0.00	\$0.00	\$0.00	\$1,361,500.00	\$24,664,122.39	\$3,542,002.26	61.15	62.12
Subtotal						\$63,835,438.28			\$0.00		\$63,835,438.28				
65 years until next replacement				Residual Value ((Remaining Life=65)/(Service Life=103))											
Life Cycle Costs						Agency Life Cycle Cost \$35,309,687.16		User Life Cycle Cost \$0.00			Total Life Cycle Cost \$35,309,687.16				

Raw Results cont.

Year #	Year	Action(s)	Action(s) Added As	2023 \$
1	2024	Paint-Structural	LCCA Policy	\$1,705,620.00
6	2029	Joints-Replace	LCCA Policy	\$1,361,500.00
18	2041	Deck Repair	LCCA Policy	\$1,401,923.37
25	2048	Joints-Replace	LCCA Policy	\$1,361,500.00
30	2053	Paint-Structural	LCCA Policy	\$1,705,620.00
35	2058	Deck Repair	LCCA Policy	\$1,834,479.54
44	2067	Joints-Replace	LCCA Policy	\$1,361,500.00
49	2072	Deck Repair	LCCA Policy	\$1,837,068.44
55	2078	Paint-Structural	LCCA Policy	\$1,705,620.00
60	2083	Bridge-Replacement	LCCA Policy	\$17,206,507.00
79	2102	Joints-Replace	LCCA Policy	\$1,361,500.00
84	2107	Paint-Structural	LCCA Policy	\$1,538,240.00
89	2112	Deck Repair	LCCA Policy	\$1,489,904.10
98	2121	Joints-Replace	LCCA Policy	\$1,361,500.00



What I didn't like

- This is a poor bridge, on an interstate. It should be replaced ASAP.
- Even with maintenance, it wouldn't make it 60 years
- This just begins to scrape the surface of actions to maintain a bridge

Burning question: why is this bridge not being replaced until year 60?

Year #	Year	Action(s)	Action(s) Added As	2023 \$
1	2024	Replacement	LCCA Policy	\$1,705,620.00
6	2029	Joints-Replace	LCCA Policy	\$1,361,500.00
18	2041	Deck Repair	LCCA Policy	\$1,401,923.37
25	2048	Joints-Replace	LCCA Policy	\$1,361,500.00
30	2053	Paint-Structural	LCCA Policy	\$1,705,620.00
35	2058	Deck Repair	LCCA Policy	\$1,834,479.54
44	2067	Joints-Replace	LCCA Policy	\$1,361,500.00
49	2072	Deck Repair	LCCA Policy	\$1,837,068.44
55	2078	Paint-Structural	LCCA Policy	\$1,705,620.00
60	2083	Bridge Replacement	LCCA Policy	\$17,200,507.00
79	2102	Joints-Replace	LCCA Policy	\$1,361,500.00
84	2107	Paint-Structural	LCCA Policy	\$1,538,240.00
89	2112	Deck Repair	LCCA Policy	\$1,489,904.10
98	2121	Joints-Replace	LCCA Policy	\$1,361,500.00

Joint Repair
Deck Overlay
Paint Sub

“Finalized Results” – Build Scenario

Scope Kentucky/Brooke				
056B00183N Full Replacement				
Deck Area=	49,791 sf			
Build Scenario #1				
Year	Description	Unit Cost	Cost	
1	Full Replacement		\$ 22,754,487.00	
10	Epoxy Overlay, Joint Reseal, Paint Substructure under Joints	Epoxy: \$30/sf, Joint Reseal: \$700ea, Paint Sub: \$21/sf		
20	Epoxy Overlay, Joint Reseal, Paint Substructure under Joints	Epoxy: \$30/sf, Joint Reseal: \$700ea, Paint Sub: \$21/sf		
25	Paint Steel Beams	\$21/sf		
30	Bridge Preservation: Latex/Epoxy Overlay, Joint Replacement, Paint Substructure under Joints	Epoxy: \$30/sf, Latex: \$45/sf, Joint Replace: \$700ea, Paint Sub: \$21/sf		

Conclusions and Recommendations

- LCCA Analysis is a great tool to use when analyzing specific bridges.
 - Important assets, key bridges
- The tool itself easy to use, as it mostly mimics the Network Optimizer
- 20 bridges in one sitting was a lot. If I could go back, I would have used LCCA Analysis for select ones and spent more time in the settings.
- Establish a good, concise naming system for your LCCA Plans

**Katherine Edmunds, Asset
Manager, UAS PM**
Katherine.Caldwell@ky.gov
502-229-7443

