Life Cycle Cost Analysis
2025

July 23, 2025
Revised: March 18, 2026

Developed By:
Pavement Analysis and Evaluation Section
Materials Control, Soils & Testing Division
West Virginia Division of Highways

1.0. Introduction

In an effort to encourage pavement competition in West Virginia, the Division of Highways (DOH) has elected to use the Alternate Design Alternate Bid (ADAB) process as outlined in Design Directive (DD) 648 (December 2024) to assist with non-project specific cost evaluation. The Design Directives can be found online on the Materials Division's website at the following link:

https://transportation.wv.gov/highways/mcst/Pages/specifications.aspx

2.0. Alternate Design Alternate Bid of Pavements

As discussed in DD 648, the ADAB process uses the A + B + C method. Factor A is the contractor's bid on the Letting day. Factor B is the number of days to construct the initial pavement and is not normally added to the contractor's bid. Factor B may be used on projects that consist of total pavement reconstruction in order to capture the user costs associated with the initial construction. This time factor is usually zero (0) because most projects are on new alignments, and traffic is not impeded during the initial construction of a project. Factor C is the Net Present Value (NPV) of all future maintenance and rehabilitation costs, known as the Life Cycle Cost Factor (C Factor). The lowest bidder is identified by adding A+C.

The C factor is governed by our DD 647. Each different pavement type and maintenance program is used to calculate a different C factor for the specific pavement and maintenance program to be used. For this general Life Cycle Cost Analysis, two pavement types were considered, full depth asphalt and plain jointed concrete pavement. Two scenarios of asphalt maintenance and rehabilitation were considered, and one scenario for the Portland cement concrete (PCC) pavement.

3.0. Life Cycle Cost Analysis

To determine the performance-based cost of a general section of roadway all maintenance, rehabilitation, and preservation work done during the expected life of the roadway must be considered in addition to the initial cost of construction. In accordance with WV DD-647, this process was done using WV DOH historical project costs and FHWA's RealCost 3.0 software.

3.1. Initial Costs

When using RealCost, the software must include an initial cost of construction. The contractor's bid amount is entered as zero since the goal is calculation of future costs.

3.2. Net Present Values

Preservation, maintenance, and rehabilitation costs were established as inputs for the life-cycle cost analysis. For concrete preservation, concrete pavement repair (CPR) projects were analyzed. Outlier projects, projects under 1 mile in length and projects dated less than 2015 were removed from calculating the average cost. It was established that a value of $321,000 per lane-mile would be used.

The same process was also followed for micro surfacing, ultra thin overlay and high performance thin overlays (asphalt preservation) projects and mill and fill projects (rehabilitation). The resulting values established were $87,000 per lane-mile for asphalt preservation and $228,000 per lane-mile for 2" mill and fill, and $398,000 per lane-mile for 4" mill and fill. The timing for these treatments is based on data, experience, and discussions with the districts and Industry.

It was also established that a routine maintenance cost of $15,000 per lane-mile on a 4-year cycle be used on asphalt and $30,000 per lane-mile on an 8-year cycle for concrete to account for maintenance-type work (e.g. crack sealing, minor patching, etc.).

Additional inputs for the LCCA include:

1. Using a 50-year analysis life. DD-648 requires at least 40 years, previous LCCA calculations for the WV DOH have used 50 years.
2. A discount rate of 1.4%. The Office of Management and Budget Circular A-94 was revised in 2024. The document states that programs with durations longer than 30 years may use the 30-year interest rate. Due to previous discount rates being negative, a five-year rolling average was used instead. A copy of OMB Circular A-94 as well as the discount rates of previous years can be found in. Attachment 4.

The preservation, maintenance, and rehabilitation costs used to establish the inputs for the life-cycle cost analysis are listed in Attachment 1. All of this information was entered into the RealCost 3.0 software for analysis. Inputs for each pavement and maintenance type can be seen in Attachment 2. The calculations and results of the life-cycle cost analysis can also be found in Attachment 3. After the analysis, the recommended C factors are:

Table 3.1

Calculated C Factors (Rounded)

Activity	Life Cycle Cost Factor (per lane mile)
Asphalt with Preservation	$608,000
Concrete with CPR	$515,000
Asphalt with Mill and Fill	$716,000

4.0. Conclusion

As this analysis is not project specific, no pavement and maintenance type will be recommended. Per DD 648, if the difference in the total NPV between the lowest two alternates is greater than 20 percent, the alternate with the lower total NPV only is selected for bidding. The designer shall eliminate any pavement alternate that is considered, in the designer's judgment, to be impracticable for the project. Otherwise, alternate pavement designs will be included in the bidding documents and a life-cycle cost adjustment factor "C" will be included in the schedule of prices for each alternate.

Attachments:

1. WV DOH Historical Project Costs
2. RealCost 3.0 Inputs
3. Calculated C Factors
4. OMB Circular No. A-94 and Discount Rates

Attachment 1:

WV DOH Historical Project Costs

Preservation **Average: $87,000**

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2015001610	ALT 10 - CEDAR CREST	1536312	1.75	2	3.5	CapeUltra-Thin	$217,129.29	$62,036.94
2016001226	CHEAT RD MICROSEAL	1635436	2.19	2	4.38	CapeUltra-Thin	$259,801.88	$59,315.50
2016001218	FLEMINGTON ROAD	1635428	1.5	2	3	CapeUltra-Thin	$218,824.93	$72,941.64
2015001400	MELISSA - BARBOURSVILLE	1531412R1	2.56	2	5.12	CapeUltra-Thin	$447,746.68	$87,450.52
2017000021	NEW HILL RD	1700526	2.11	2	4.22	CapeUltra-Thin	$328,563.96	$77,858.76
2016001221	ROMINES MILL RD - WV 20 MICROSURFACE	1635431	4.65	2	9.3	CapeUltra-Thin	$798,587.37	$85,869.61
2017000020	ROWLESBURG - KINGWOOD RD	1700525	4	2	8	CapeUltra-Thin	$542,489.00	$67,811.13
2015001602	SALT ROCK - SMITH CREEK	1536306R1	2.13	2	4.26	CapeUltra-Thin	$344,823.55	$80,944.50
2016001220	SHINNSTON - ENTERPRISE ROAD	1635430R1	3.05	2	6.1	CapeUltra-Thin	$442,340.65	$72,514.86
2015001398	WAYNE COUNTY LINE - WV 10	1531408	4.36	2	8.72	CapeUltra-Thin	$501,699.79	$57,534.38
2015001449	CSX O/P BR - MILTON	1532343	5.04	4	20.16	HPTO	$1,950,543.22	$96,753.14
2015001437	FIFTH STREET - HAL GREER	1532331	2.26	4	9.04	HPTO	$1,020,058.22	$112,838.30
2015001438	KY STATE LINE - KENOVA	1532332	1.15	4	4.6	HPTO	$609,982.04	$132,604.79
2017000037	31ST STREET	1700530	2.71	4	10.84	Micro Surface (Double)	$1,220,221.90	$112,566.60
2019000089	BIRCH RIVER - BRAXTON CO	2019000089	3.07	4	12.28	Micro Surface (Double)	$1,256,081.51	$102,286.77
2018000249	BRADLEY - MT HOPE RD + 1	1804526	3.42	4	13.68	Micro Surface (Double)	$953,222.53	$69,680.01
2016001227	BRIDGEPORT - BRUSHYFORK	1635437	1.46	2	2.92	Micro Surface (Double)	$224,800.09	$76,986.33
2018000217	CLINTONVILLE - ALTA RD	1803827	3	4	12	Micro Surface (Double)	$581,670.03	$48,472.50
2018000252	DEERWALK - SAND HILL	1804529	5.13	4	20.52	Micro Surface (Double)	$1,396,468.98	$68,054.04
2023280030	GOODWINS CHAPEL - VA STATE LINE	2023280030	7.15	4	28.6	Micro Surface (Double)	$2,937,628.00	$102,714.27
2015001445	I 70, DALLAS PIKE MICROSURFACING	1532339	2.98	4	11.92	Micro Surface (Double)	$886,669.81	$74,385.05
2017000086	MARRTOWN - 7TH ST. RESURFACING	1701827R1	3.16	4	12.64	Micro Surface (Double)	$1,596,385.36	$126,296.31
2017000217	MINERAL WELLS - STAUNTON RESURFACING	1703733R1	3.22	4	12.88	Micro Surface (Double)	$1,086,392.44	$84,347.24
2018000817	MINGO CO LINE - HOLDEN	1818427R1	2.78	4	11.12	Micro Surface (Double)	$1,391,045.98	$125,094.06
2018000216	N. MARTINSBURG - SPRING MILLS	1803826R1	3.3	4	13.2	Micro Surface (Double)	$989,987.02	$74,999.02
2020000524	PEACH TREE ORCHARD - MUDDLETY	2020000524R1	1.93	4	7.72	Micro Surface (Double)	$1,037,394.90	$134,377.58
2020000513	SAM BLACK - RUSTY BRIDGE	2020000513	2.45	4	9.8	Micro Surface (Double)	$1,294,462.79	$132,088.04
2020000483	STONEY GAP-COURTHOUSE RD	2020000483	4.71	4	18.84	Micro Surface (Double)	$1,868,898.24	$99,198.42
2019000088	US 52 - MERCER MALL RD + 3	2019000088	3.15	4	12.6	Micro Surface (Double)	$1,098,300.15	$87,166.68
2018000184	VIRGINIA LINE - US 52	1803728	2.9	4	11.6	Micro Surface (Double)	$1,062,817.30	$91,622.18
2016001212	3RD AVENUE	1634725R2	1.61	3	4.83	Ultra-Thin	$587,949.89	$121,728.76
2017000042	ADAMS AVENUE	1700535	1.07	4	4.28	Ultra-Thin	$319,986.25	$74,763.14
2017000040	CEREDO - KENOVA	1700533	2.94	3	8.82	Ultra-Thin	$1,160,167.40	$131,538.25

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2015001427	CHAPMANVILLE - BOONE COUNTY LINE	1532227	2.86	4	11.44	Ultra-Thin	$1,627,229.72	$142,240.36
2016000006	CHAPMANVILLE - STRIKER FORK	1536317	2.3	2	4.6	Ultra-Thin	$373,595.23	$81,216.35
2015001532	ELKVIEW - WALGROVE	1534124	2.9	2	5.8	Ultra-Thin	$261,735.78	$45,126.86
2015001428	ESTEP - TURTLETOWN	1532228	2.85	4	11.4	Ultra-Thin	$1,345,346.01	$118,012.81
2015001415	FOUNTAIN PLACE - LOGAN	1532113	2.27	4	9.08	Ultra-Thin	$589,537.40	$64,927.03
2015001443	I 470, BETHLEHEM MICROSURFACING	1532337	2.82	4	11.28	Ultra-Thin	$816,183.00	$72,356.65
2015001444	I 70, MIDDLE CREEK MICROSURFACING	1532338R1	5.68	4	22.72	Ultra-Thin	$1,296,366.69	$57,058.39
2015001533	KELLYS CREEK - SISSONVILLE	1534123	3.65	2	7.3	Ultra-Thin	$273,938.41	$37,525.81
2015001516	KOPPERSTON - BOLT ROAD	1526008	5.75	2	11.5	Ultra-Thin	$924,453.76	$80,387.28
2015000798	MCCAULEY - SINKS/MICROSURFACE	1508308	3.42	4	13.68	Ultra-Thin	$909,153.68	$66,458.60
2020000063	OHIO RIVER-MARRTOWN	2020000063	4.34	4	17.36	Ultra-Thin	$2,262,959.00	$130,354.78
2015001529	RED HOUSE HILL	1534104R1	3.18	2	6.36	Ultra-Thin	$234,986.29	$36,947.53
2019000094	SAULSBURY - MINERAL WELLS	2019000094	4.53	4	18.12	Ultra-Thin	$1,400,046.90	$77,265.28
2015001439	STAUNTON AVENUE - 7TH STREET RESURFACING	1532333R1	2.14	4	8.56	Ultra-Thin	$920,200.80	$107,500.09
2015001495	WALLBACK - LEFT HAND RESURFACING	1533408R2	8.35	2	16.7	Ultra-Thin	$591,992.36	$35,448.64

2" PWL **Average: $228,000**

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2015001431	ARNOLD CREEK - SMITHBURG	1532325	4.08	4	16.32	PWL/ThinOverlay	$2,092,626.96	$128,224.69
2020000544	BEAR RUN-ELLENBORO	2020000544	5.31	4	21.24	PWL/ThinOverlay	$5,764,599.35	$271,402.98
2015001426	CANEY - CHAPMANVILLE	1532226	2.61	4	10.44	PWL/ThinOverlay	$3,171,569.41	$303,790.17
2020000822	CHARLES TOWN - HALLTOWN	2020000822	2.35	4	9.4	PWL/ThinOverlay	$1,264,873.35	$134,560.99
2015000338	CRAWLEY CRK - CANEY BRANCH	1509202	3.44	4	13.76	PWL/ThinOverlay	$3,599,425.95	$261,586.19
2017000085	DALLISON - DEER WALK	1701826	1.83	4	7.32	PWL/ThinOverlay	$1,099,950.60	$150,266.48
2019000285	EAST PARK - EAST FAIRMONT	2019000285	2.09	4	8.36	PWL/ThinOverlay	$2,112,403.63	$252,679.86
2020000459	ELLENBORO-PENNSBORO	2020000459	3.21	4	12.84	PWL/ThinOverlay	$3,486,086.00	$271,502.02
2017000485	ELM GROVE - TRIADELPHIA	1705903R1	2.42	3	7.26	PWL/ThinOverlay	$1,540,288.15	$212,160.90
2017001522	GLEN DALE RESURFACING	1731832	1.63	2	3.26	PWL/ThinOverlay	$950,419.68	$291,539.78
2015001440	GOSHEN RD - UFFINGTON BRIDGE	1532334R1	3.73	4	14.92	PWL/ThinOverlay	$2,593,587.43	$173,832.94
2020000051	GRAND CENTRAL AVE	2020000051	2.99	4	11.96	PWL/ThinOverlay	$2,898,089.60	$242,315.18
2020000062	GREENWOOD-ARNOLDS RUN	2020000062	4.37	4	17.48	PWL/ThinOverlay	$3,388,543.62	$193,852.61
2020000515	HART'S RUN - TUCKAHOE	2020000515	1.59	4	6.36	PWL/ThinOverlay	$2,428,649.43	$381,863.12
2017000088	HOOKERSVILLE - POWELL MTN. ROAD	1701829	4.21	4	16.84	PWL/ThinOverlay	$3,779,588.67	$224,441.13
2012001472	INTERSTATE 81/RESURFACING	1234711R1	3.7	4	14.8	PWL/ThinOverlay	$2,440,384.08	$164,890.82
2020000473	INWOOD - TABLERS STATION	2020000473	2.67	4	10.68	PWL/ThinOverlay	$2,420,372.44	$226,626.63
2020000542	JACKSON CO LI-ROCKPORT	2020000542	3.38	4	13.52	PWL/ThinOverlay	$2,510,212.85	$185,666.63
2017000087	LEWISBURG ROAD	1701828	2.44	4	9.76	PWL/ThinOverlay	$2,346,833.62	$240,454.26
2015001441	LOST CREEK - QUIET DELL	1532335	4.49	4	17.96	PWL/ThinOverlay	$2,587,823.41	$144,088.16
2019000096	LUXEMBURG RD-BAKER	2019000096R1	5	4	20	PWL/ThinOverlay	$3,979,853.70	$198,992.69
2015001436	MARYLAND ROAD	1532330	2.03	5	10.15	PWL/ThinOverlay	$1,384,566.99	$136,410.54
2020000059	MILLER RDG MEADOW RIVER	2020000059	2.93	4	11.72	PWL/ThinOverlay	$3,238,020.46	$276,281.61
2020000134	N RIVER RDLUXEMBURG	2020000134	3.04	4	12.16	PWL/ThinOverlay	$1,941,553.42	$159,667.22
2017000209	OAKWOOD RD. - WV 61	1703725	1.24	4	4.96	PWL/ThinOverlay	$1,875,995.73	$378,224.95
2015000339	PARKERSBURG - DRY RUN	1509201	2.01	4	8.04	PWL/ThinOverlay	$1,588,011.50	$197,513.87
2020000539	PENNSBORO-GREENWOOD	2020000539	3.12	4	12.48	PWL/ThinOverlay	$2,424,438.03	$194,265.87
2019001270	RABBIT HILL-CROSS CREEK RD	2019001270	1.35	4	5.4	PWL/ThinOverlay	$1,336,843.69	$247,563.65
2020000488	REST AREA - INWOOD	2020000488R1	2.78	4	11.12	PWL/ThinOverlay	$2,682,766.31	$241,255.96
2015000320	ROCKPORT - SAULSBURY RESURFACING	1508402	4.77	4	19.08	PWL/ThinOverlay	$2,780,002.20	$145,702.42

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2015001447	SAM BLACK CHURCH - CLINTONVILLE	1532341	2.46	4	9.84	PWL/ThinOverlay	$2,438,096.58	$247,774.04
2019000091	SINKS BRIDGE-WARDENSVILLE	2019000091R1	1.98	4	7.92	PWL/ThinOverlay	$1,504,878.00	$190,009.85
1611810	TEAYS VALLEY - CROSS LANES	1611810R1	9.11	2	18.22	PWL/ThinOverlay	$4,356,957.27	$239,130.48
2015000260	TUPPERS CRK - FAIRPLAIN	1507851	10.76	4	43.04	PWL/ThinOverlay	$12,070,744.66	$280,454.10
2015000336	US 50 - WV 31	1508401	7.4	4	29.6	PWL/ThinOverlay	$4,008,082.05	$135,408.18
2015000925	WALLBACK - BIG OTTER	1520101	2.67	4	10.68	PWL/ThinOverlay	$2,472,031.51	$231,463.62
2015001442	WINCHESTER AVE - KING ST	1532336	1	6	6	PWL/ThinOverlay	$614,947.53	$102,491.26
2020000087	WOLF SUMMIT - ADAMSTON ROAD	2007000	6.38	4	25.52	PWL/ThinOverlay	$7,029,318.70	$275,443.52
2019000087	WSS - VIRGINIA LINE	2019000087	2.42	4	9.68	PWL/ThinOverlay	$3,795,380.71	$392,084.78
2023340022	YOUNGS MONUMENT-BIRCH RIVER ROAD	2023340022	4.87	5	24.35	PWL/ThinOverlay	$9,478,437.59	$389,258.22

4" PWL **Average: $398,000**

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2019000093	BURNSVILLE - WESTON RD	2019000093	3.55	4	14.2	PWL/ThickOverlay	$4,660,390.05	$328,196.48
2023430009	WOOD COUNTY - BEAR RUN	2023430009	8.04	4	32.16	PWL/ThickOverlay	$14,984,984.00	$465,951.00

CPR **Average: $321,000**

Proj Key	Name	Project ID	Length	Lanes	Lane Miles	Treatment	Bid Cost	Bid Cost / LM
2017000944	MT PLEASANT ESTATES REHABILITATION	1722608	1.11	2	2.22	CPR	$848,800.80	$382,342.70
2017000225	AIRPORT RD - GLADE CREEK BR	1703830R1	5.49	5	27.45	CPR	$4,179,798.86	$152,269.54
2019000092	BRAGG - SANDSTONE RD	2019000092	4.87	5	24.35	CPR	$3,087,499.65	$126,796.70
2020000448	DAVIS CR-OAKWOOD	2020000448	2.24	4	8.96	CPR	$6,275,600.35	$700,401.82
2017001666	HARMON CREEK - PENNSYLVANIA STATE LINE	2017001666	2.71	4	10.84	CPR	$5,422,568.47	$500,236.94
2019001341	I-77-AIRPORT RD	2019001341	4.1	4	16.4	CPR	$5,382,600.00	$328,207.32
2017001423	MONONGALIA BLVD - STEWARTSTOWN RD	1729232	2.76	4	11.04	CPR	$4,402,943.68	$398,817.36
2015000711	WEIRTON - HARMON CREEK	1505802	1.96	4	7.84	CPR	$2,774,021.93	$353,829.33
2021000027	GREEN SULPHUR - DAWSON	2021000027	6	5	30	CPR	$4,736,400.00	$157,880.00
2015001432	BUCKHANNON - ELKINS ROAD	1532326	4.52	4	18.08	CPR	$1,915,080.51	$105,922.59

Attachment 2:

RealCost 3.0 Inputs

Probabilistic Life Cycle Cost Analysis Worksheet

INPUT WORKSHEET

1. Economic Variables

Description	Value
Value of Time for Passenger Cars ($/hour)	
Value of Time for Single Unit Trucks ($/hour)	
Value of Time for Combination Trucks ($/hour)	

2. Analysis Options

Description	Value
Include User Costs in Analysis	No
Include User Cost Remaining Life Value	No
Use Differential User Costs	No
User Cost Computation Method	Calculated
Include Agency Cost Remaining Life Value	No
Traffic Direction	Both
Analysis Period (Years)	50
Beginning of Analysis Period	2026
Discount Rate (%)	1.4
Number of Alternatives	3

3. Project Details

Description	Value
State Route	
Project Name	2025 Life Cycle Cost
Region	
County	
Analyzed By	Kiana Welch
Mileposts	NA
Begin	
End	
Length of Project (miles)	0
Comments	

4. Traffic Data

Description	Value
AADT Construction Year (total for both directions)	
Cars as Percentage of AADT (%)	100
Single Unit Trucks as Percentage of AADT (%)	
Combination Trucks as Percentage of AADT (%)	
Annual Growth Rate of Traffic (%)	
Speed Limit Under Normal Operating Conditions (mph)	
No of Lanes in Each Direction During Normal Conditions	
Free Flow Capacity (vphpl)	
Rural or Urban Hourly Traffic Distribution	
Queue Dissipation Capacity (vphpl)	
Maximum AADT (total for both directions)	
Maximum Queue Length (miles)	

5. Construction

Description	Value
Alternative 1	Asphalt w/Preservation & Mill&Fill
Number of Activities	6

Description	Value
Activity 1	HMA New Construction
Agency Construction Cost ($1000)	0
User Work Zone Costs ($1000)	
Work Zone Duration (days)	120
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	50
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 2	Preservation (10)
Agency Construction Cost ($1000)	87
User Work Zone Costs ($1000)	
Work Zone Duration (days)	5
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	8
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		

Third period of lane closure		

Description	Value
Activity 3	Preservation (18)
Agency Construction Cost ($1000)	87
User Work Zone Costs ($1000)	
Work Zone Duration (days)	5
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	8
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 4	4" Mill&Fill (26)
Agency Construction Cost ($1000)	398
User Work Zone Costs ($1000)	
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Probabilistic Life Cycle Cost Analysis Worksheet

Description	Value
Activity 5	Preservation (36)
Agency Construction Cost ($1000)	87
User Work Zone Costs ($1000)	
Work Zone Duration (days)	5
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	8
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 6	Preservation (44)
Agency Construction Cost ($1000)	87
User Work Zone Costs ($1000)	
Work Zone Duration (days)	5
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	8
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Probabilistic Life Cycle Cost Analysis Worksheet

Description	Value
Alternative 2	Concrete w/CPR
Number of Activities	3

Description	Value
Activity 1	PCC New Construction
Agency Construction Cost ($1000)	0
User Work Zone Costs ($1000)	
Work Zone Duration (days)	120
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	26
Activity Structural Life (years)	50
Maintenance Frequency (years)	8
Agency Maintenance Cost ($1000)	30
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 2	CPR & Diamond Grind (26)
Agency Construction Cost ($1000)	321
User Work Zone Costs ($1000)	
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	14
Activity Structural Life (years)	
Maintenance Frequency (years)	8
Agency Maintenance Cost ($1000)	30
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Probabilistic Life Cycle Cost Analysis Worksheet

Description	Value
Activity 3	CPR & Diamond Grind (40)
Agency Construction Cost ($1000)	321
User Work Zone Costs ($1000)	
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	14
Activity Structural Life (years)	
Maintenance Frequency (years)	8
Agency Maintenance Cost ($1000)	30
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Probabilistic Life Cycle Cost Analysis Worksheet

Description	Value
Alternative 3	Asphalt w/Mill&Fill
Number of Activities	5

Description	Value
Activity 1	HMA New Construction
Agency Construction Cost ($1000)	0
User Work Zone Costs ($1000)	NA
Work Zone Duration (days)	120
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	15
Activity Structural Life (years)	50
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 2	2" Mill&Fill (15)
Agency Construction Cost ($1000)	228
User Work Zone Costs ($1000)	NA
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Probabilistic Life Cycle Cost Analysis Worksheet

Description	Value
Activity 3	2" Mill&Fill (25)
Agency Construction Cost ($1000)	$228.00
User Work Zone Costs ($1000)	NA
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 4	2" Mill&Fill (35)
Agency Construction Cost ($1000)	$228.00
User Work Zone Costs ($1000)	NA
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Description	Value
Activity 5	2" Mill&Fill (45)
Agency Construction Cost ($1000)	$228.00

Probabilistic Life Cycle Cost Analysis Worksheet

User Work Zone Costs ($1000)	NA
Work Zone Duration (days)	30
No of Lanes Open in Each Direction During Work Zone	1
Activity Service Life (years)	10
Activity Structural Life (years)	
Maintenance Frequency (years)	4
Agency Maintenance Cost ($1000)	15
Work Zone Length (miles)	
Work Zone Speed Limit (mph)	
Work Zone Capacity (vphpl)	
Traffic Hourly Distribution	Week Day 1

Inbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	**Start**	**End**
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Outbound Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)	**Start**	**End**
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Attachment 3:

Calculated C Factors

Probabilistic Life Cycle Cost Analysis Worksheet

Table 1. Cost Result Summary

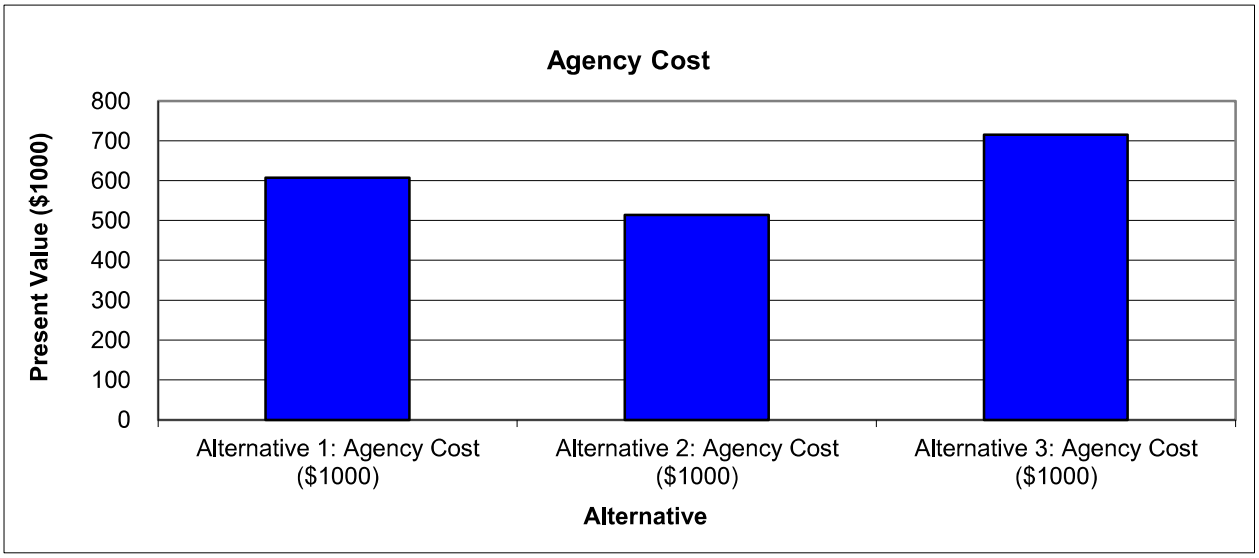
Description	Alternative 1: Agency Cost ($1000)	Alternative 1: User Cost ($1000)	Alternative 2: Agency Cost ($1000)	Alternative 2: User Cost ($1000)	Alternative 3: Agency Cost ($1000)	Alternative 3: User Cost ($1000)
Undiscounted Sum	*$866.00*	*$0.00*	*$792.00*	*$0.00*	*$1,062.00*	*$0.00*
NPV	**$607.18**	**$0.00**	**$514.13**	**$0.00**	**$715.04**	**$0.00**
EUAC	$16.97	$0.00	$14.37	$0.00	$19.98	$0.00

Lowest NPV Agency Cost	Alternative 2
Lowest NPV User Cost	Alternative 1

Table 2. Expenditure Stream

Year	Alternative 1: Agency Cost ($1000)	Alternative 1: User Cost ($1000)	Alternative 2: Agency Cost ($1000)	Alternative 2: User Cost ($1000)	Alternative 3: Agency Cost ($1000)	Alternative 3: User Cost ($1000)
2026	-	-	-	-	-	-
2027	-	-	-	-	-	-
2028	-	-	-	-	-	-
2029	-	-	-	-	-	-
2030	$15.00	-	-	-	$15.00	-
2031	-	-	-	-	-	-
2032	-	-	-	-	-	-
2033	-	-	-	-	-	-
2034	$15.00	-	$30.00	-	$15.00	-
2035	-	-	-	-	-	-
2036	$87.00	-	-	-	-	-
2037	-	-	-	-	-	-
2038	-	-	-	-	$15.00	-
2039	-	-	-	-	-	-
2040	$15.00	-	-	-	-	-
2041	-	-	-	-	$228.00	-
2042	-	-	$30.00	-	-	-
2043	-	-	-	-	-	-
2044	$87.00	-	-	-	-	-
2045	-	-	-	-	$15.00	-
2046	-	-	-	-	-	-
2047	-	-	-	-	-	-
2048	$15.00	-	-	-	-	-
2049	-	-	-	-	$15.00	-
2050	-	-	$30.00	-	-	-
2051	-	-	-	-	$228.00	-
2052	$398.00	-	$321.00	-	-	-
2053	-	-	-	-	-	-
2054	-	-	-	-	-	-
2055	-	-	-	-	$15.00	-
2056	$15.00	-	-	-	-	-
2057	-	-	-	-	-	-
2058	-	-	-	-	-	-
2059	-	-	-	-	$15.00	-
2060	$15.00	-	$30.00	-	-	-
2061	-	-	-	-	$228.00	-
2062	$87.00	-	-	-	-	-
2063	-	-	-	-	-	-
2064	-	-	-	-	-	-
2065	-	-	-	-	$15.00	-
2066	$15.00	-	$321.00	-	-	-
2067	-	-	-	-	-	-
2068	-	-	-	-	-	-
2069	-	-	-	-	$15.00	-
2070	$87.00	-	-	-	-	-
2071	-	-	-	-	$228.00	-
2072	-	-	-	-	-	-
2073	-	-	-	-	-	-
2074	$15.00	-	$30.00	-	-	-
2075	-	-	-	-	$15.00	-
2076	-	-	-	-	-	-
-	-	-	-	-	-	-

Probabilistic Life Cycle Cost Analysis Worksheet



Attachment 4:

OMB Circular No. A-94 and Discount Rates

APPENDIX C
(Revised November 14, 2024)

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Effective Dates. This appendix is updated annually. This version of the appendix is valid for calendar year 2025. A copy of the updated appendix can be obtained in electronic form through the OMB home page at https://www.whitehouse.gov/wp-content/uploads/2025/01/CircularA-94AppendixC.pdf. The text of the Circular is found at https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-94.pdf, and a table of past years' rates is located at https://www.whitehouse.gov/wp-content/uploads/2025/01/CircularA-94DiscountHistory.pdf. Updates of the appendix are also available upon request from OMB's Office of Economic Policy (a94@omb.eop.gov).

Nominal Discount Rates. A forecast of nominal or market interest rates for calendar year 2025 based on the economic assumptions for the 2026 Budget is presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
3.7	3.8	3.9	4.1	4.4	4.4

Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions for the 2026 Budget is presented below. These real rates are to be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1.5	1.6	1.8	1.9	2.2	2.3

Analyses of projects with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Projects with durations longer than 30 years may use the 30-year interest rate.

November 14, 2024

APPENDIX C

BUDGET ASSUMPTIONS
Nominal Treasury Interest Rates for Different Maturities
(from the annual budget assumptions for the first year of the budget forecast)

Calendar Year	3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1979	9.7	9.2	9.1	9.0	N/A	8.9
1980	10.9	10.6	10.6	10.6	N/A	10.4
1981	13.4	12.8	12.6	12.2	N/A	11.8
1982	12.8	13.1	13.2	13.3	N/A	13.0
1983	9.5	9.8	10.0	10.2	N/A	10.3
1984	9.8	10.0	10.1	10.3	N/A	10.4
1985	10.3	10.7	10.8	11.0	N/A	11.0
1986	8.6	8.8	8.8	8.9	N/A	9.1
1987	6.3	6.5	6.6	6.7	N/A	7.0
1988	7.3	7.7	7.8	8.0	N/A	8.1
1989	7.8	8.1	8.2	8.3	N/A	8.2
1990	7.4	7.5	7.6	7.7	N/A	7.8
1991	7.2	7.4	7.4	7.5	N/A	7.7
1992	6.1	6.5	6.7	7.0	N/A	7.1
1993	5.6	6.0	6.3	6.7	N/A	6.8
1994	5.0	5.3	5.5	5.7	N/A	5.8
1995	7.3	7.6	7.7	7.9	N/A	8.1
1996	5.4	5.5	5.5	5.6	N/A	5.7
1997	5.8	5.9	6.0	6.1	N/A	6.3
1998	5.6	5.7	5.8	5.9	N/A	6.1
1999	4.7	4.8	4.9	4.9	N/A	5.0
2000	5.9	6.0	6.0	6.1	N/A	6.3
2001	5.4	5.4	5.4	5.4	N/A	5.3
2002	4.1	4.5	4.8	5.1	N/A	5.8
2003	3.1	3.6	3.9	4.2	N/A	5.1
2004	3.0	3.7	4.2	4.6	5.4	5.5
2005	3.7	4.1	4.4	4.6	5.2	5.2
2006	4.7	4.8	4.9	5.0	5.3	5.2
2007	4.9	4.9	4.9	5.0	5.1	5.1
2008	4.1	4.3	4.4	4.6	4.9	4.9
2009	2.7	3.3	3.7	4.2	4.7	4.5
2010	2.3	3.1	3.5	3.9	4.4	4.5
2011	1.4	1.9	2.4	3.0	3.9	4.2
2012	1.6	2.1	2.5	2.8	3.5	3.8
2013	0.5	1.1	1.5	2.0	2.7	3.0
2014	1.0	1.9	2.5	3.0	3.6	3.9
2015	1.7	2.2	2.5	2.8	3.1	3.4
2016	2.0	2.4	2.7	2.9	3.2	3.5
2017	1.4	1.7	1.9	2.1	2.5	2.8
2018	2.3	2.5	2.6	2.6	2.8	3.0
2019	3.3	3.3	3.4	3.4	3.5	3.6
2020	1.6	1.7	1.8	2.0	2.3	2.4
2021	0.2	0.3	0.6	0.8	1.5	1.7
2022	1.3	1.6	1.9	2.1	2.5	2.6
2023	4.0	3.8	3.8	3.9	4.2	4.2
2024	4.5	4.4	4.4	4.4	4.7	4.7
2025	3.7	3.8	3.9	4.1	4.4	4.4

Real Treasury Interest Rates

Calendar Year	3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1979	2.8	3.4	4.1	4.6	N/A	5.4
1980	2.1	2.4	2.9	3.3	N/A	3.7
1981	3.6	3.9	4.3	4.4	N/A	4.8
1982	6.1	7.1	7.5	7.8	N/A	7.9
1983	4.2	4.7	5.0	5.3	N/A	5.6
1984	5.0	5.4	5.7	6.1	N/A	6.4
1985	5.9	6.5	6.8	7.1	N/A	7.4
1986	4.6	5.1	5.6	5.9	N/A	6.7
1987	2.8	3.1	3.5	3.8	N/A	4.4
1988	3.5	4.2	4.7	5.1	N/A	5.6
1989	4.1	4.8	5.3	5.8	N/A	6.1
1990	3.2	3.6	3.9	4.2	N/A	4.6
1991	3.2	3.5	3.7	3.9	N/A	4.2
1992	2.7	3.1	3.3	3.6	N/A	3.8
1993	3.1	3.6	3.9	4.3	N/A	4.5
1994	2.1	2.3	2.5	2.7	N/A	2.8
1995	4.2	4.5	4.6	4.8	N/A	4.9
1996	2.6	2.7	2.8	2.8	N/A	3.0
1997	3.2	3.3	3.4	3.5	N/A	3.6
1998	3.4	3.5	3.5	3.6	N/A	3.8
1999	2.6	2.7	2.7	2.7	N/A	2.9
2000	3.8	3.9	4.0	4.0	N/A	4.2
2001	3.2	3.2	3.2	3.2	N/A	3.2
2002	2.1	2.8	3.0	3.1	N/A	3.9
2003	1.6	1.9	2.2	2.5	N/A	3.2
2004	1.6	2.1	2.4	2.8	3.4	3.5
2005	1.7	2.0	2.3	2.5	3.0	3.1
2006	2.5	2.6	2.7	2.8	3.0	3.0
2007	2.5	2.6	2.7	2.8	3.0	3.0
2008	2.1	2.3	2.4	2.6	2.8	2.8
2009	0.9	1.6	1.9	2.4	2.9	2.7
2010	0.9	1.6	1.9	2.2	2.7	2.7
2011	0.0	0.4	0.8	1.3	2.1	2.3
2012	0.0	0.4	0.7	1.1	1.7	2.0
2013	-1.4	-0.8	-0.4	0.1	0.8	1.1
2014	-0.7	0.0	0.5	1.0	1.6	1.9
2015	0.1	0.4	0.7	0.9	1.2	1.4
2016	0.3	0.6	0.8	1.0	1.2	1.5
2017	-0.5	-0.3	0.0	0.1	0.5	0.7
2018	0.6	0.6	0.7	0.7	0.9	1.0
2019	1.3	1.3	1.3	1.4	1.5	1.5
2020	-0.4	-0.3	-0.2	0.0	0.3	0.4
2021	-1.8	-1.6	-1.4	-1.1	-0.5	-0.3
2022	-1.2	-0.6	-0.3	0.0	0.4	0.5
2023	1.2	1.3	1.4	1.5	2.0	2.0
2024	2.2	2.2	2.2	2.3	2.5	2.5
2025	1.5	1.6	1.8	1.9	2.2	2.3

APPENDIX D

Real Discount Rates

Years	Risk-Free Rate	Social Discount Rate	
1972-1991	N/A	10.0	Note: This rate appeared in the main Circular.
1992-2022	N/A	7.0	Note: This rate appeared in the main Circular.
2023-2025	2.0	3.1	