



Illinois Department of Transportation

To: Masood Ahmad Attn: Dave Broviak
From: Jack A. Elston By: Michael Brand *Michael Brand*
Subject: Pavement Design Approval
Date: April 7, 2021

Route: IL 47 Job No.: P-93-039-08
Section: (109,110)R Contract No.: 66825
County: Kendall Target Letting: FY 2025
Limits: IL 71 to Caton Farm Road south of Yorkville

We have reviewed the updated pavement design for the above referenced project which was submitted on March 26, 2021. The project will reconstruct IL 47 to provide two lanes in each direction.

The pavement design compared full-depth HMA and JPCP pavements. The life-cycle cost analysis showed the costs of these options to be within 10% of each other; and as such, alternate bidding will be used.

In summary, the approved pavement designs are as follows:

IL 47 – Reconstruction – Alternate Bid

Flexible Alternate

11.75" full-depth HMA
with HMA Shlds. or C&G
12" Aggregate Subgrade

Rigid Alternate

10" JPCP
with tied PCC Shlds. or C&G
4" Stabilized Subbase
12" Aggregate Subgrade

If you have any questions, please contact Mike Brand at (217) 782-7651.



Illinois Department of Transportation

Memorandum

To: Jack Elston Attn: Mike Brand
From: Masood Ahmad By: Dave Broviak
Subject: Pavement Design Approval *
Date: March 26, 2021

* FAP 326 (IL 47)
Section (109,110)R
Kendall County
Job Number P-93-039-08
Contract No. 66825

Attached for approval is the pavement design for IL 47 from IL 71 to Caton Farm Road south of Yorkville. Please review the design which recommends 10 inches of Jointed Portland Cement Concrete Pavement (JPCP). Construction of this project is currently anticipated in FY 2025. This pavement design is to update a previously approved design which has expired.

JPCP is the preferred pavement type based on life-cycle cost in the attached analysis. The results of the mechanistic pavement design indicate that 10 inches of JPCP or 11.75 inches full-depth Hot Mix Asphalt (HMA) is required. Construction of JPCP has an annual life-cycle cost of \$165,991 per mile while the HMA pavement has an annual life-cycle cost of \$166,393 per mile, which makes JPCP approximately 0.2% less costly. This project is suitable for the alternative pavement bidding process because the life-cycle cost difference is less than 10%.

Calculations to determine pavement thicknesses and life-cycle costs are attached for review.

The project involves replacing the existing two-lane section with a four and five-lane section from Caton Farm Road to IL 71. The design is for four and five lanes with auxiliary lanes as needed. The five-lane section with a bi-directional turn lane will have tied curb and gutter. The four-lane section will have 8-foot paved shoulders. The estimated quantity of new pavement is 147,414 square yards.

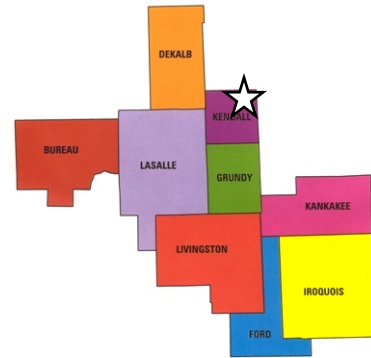
The pavement design was designed using Chapter 54 of the Bureau of Design & Environment manual, current as of January 2021. The following facts and assumptions were used in the design:

- Jointed Plain Concrete Pavement constructed with B-6.24 combination curb and gutter. Stabilized subbase was calculated in the life-cycle cost.
- Design Traffic was based on 2045 projections.
- Design Period of 20 years.
- Poor sub-grade.
- PG grade 70-28 for top lift of binder and PG 76-28 for the surface course.
- PG 64-22 for the lower binder lifts.
- Rubblization and unbonded overlay were not considered because most of the new pavement is on a shifted alignment.

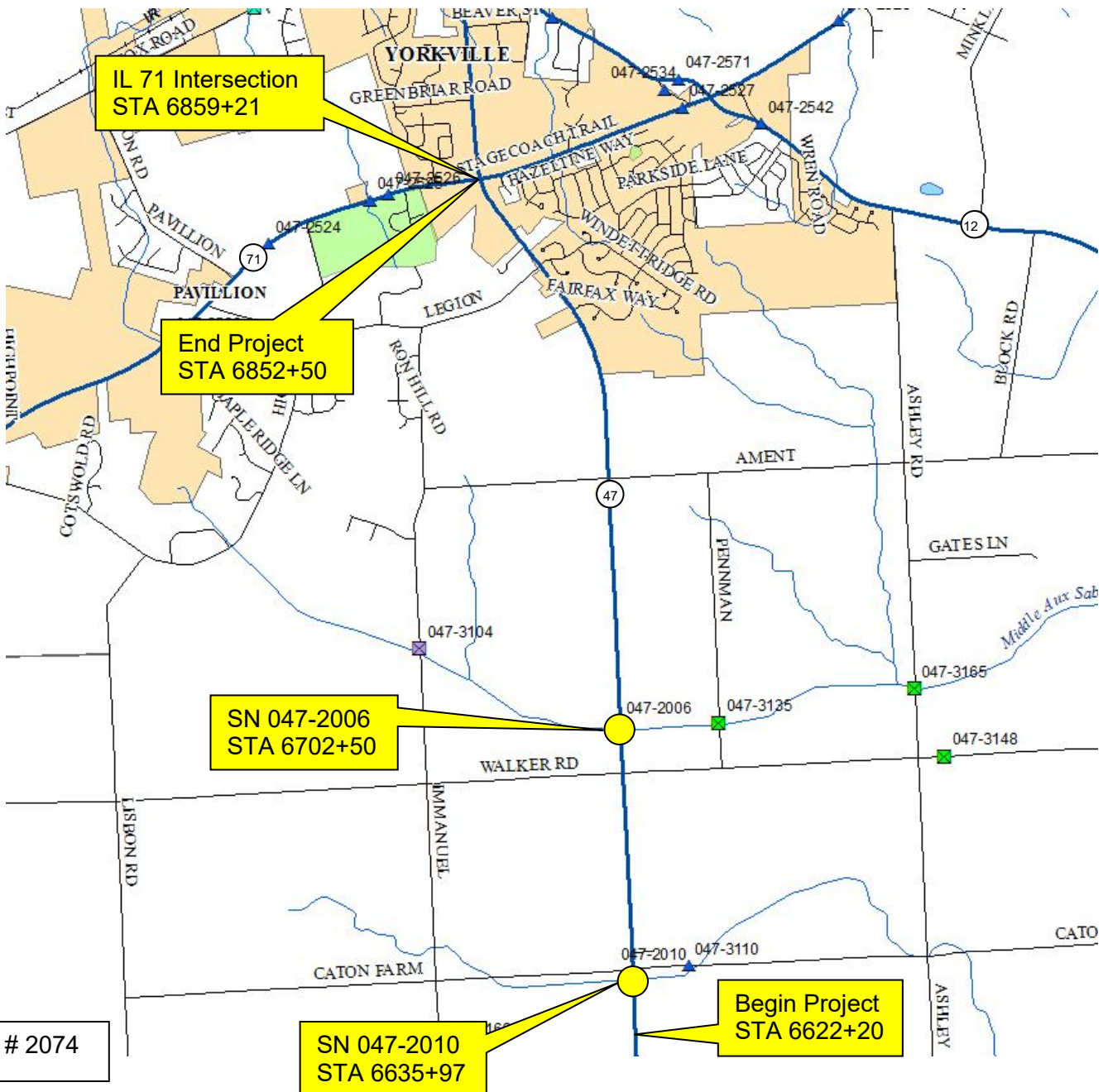
If you have any questions, please contact Joe Kannel at (81) 434-8454.

Project Location Map

FAP 326 (IL 47)
Section (109, 110)R
Kendall County
Caton Farm Road to IL 71 in Yorkville
P-93-039-08 4.4 miles of adding lanes
Contract 66825 D3#2074 File #1931



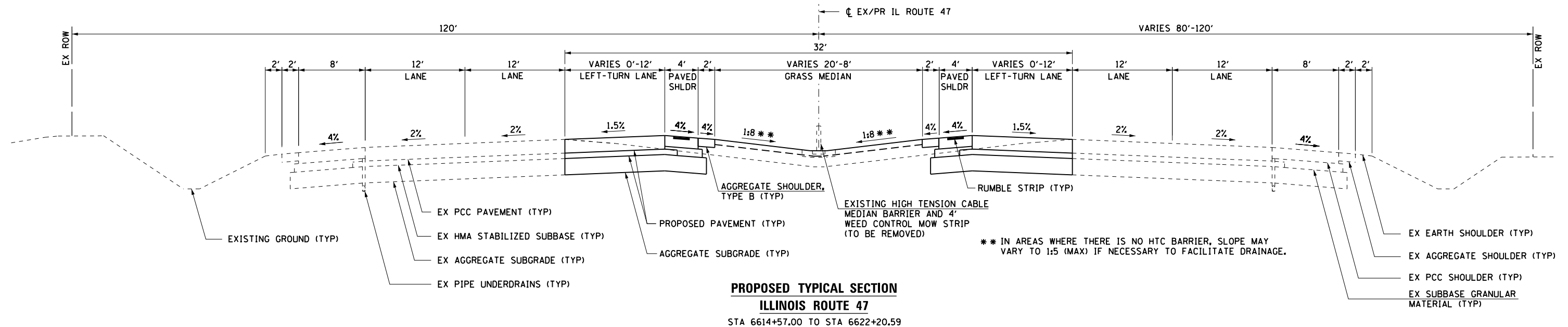
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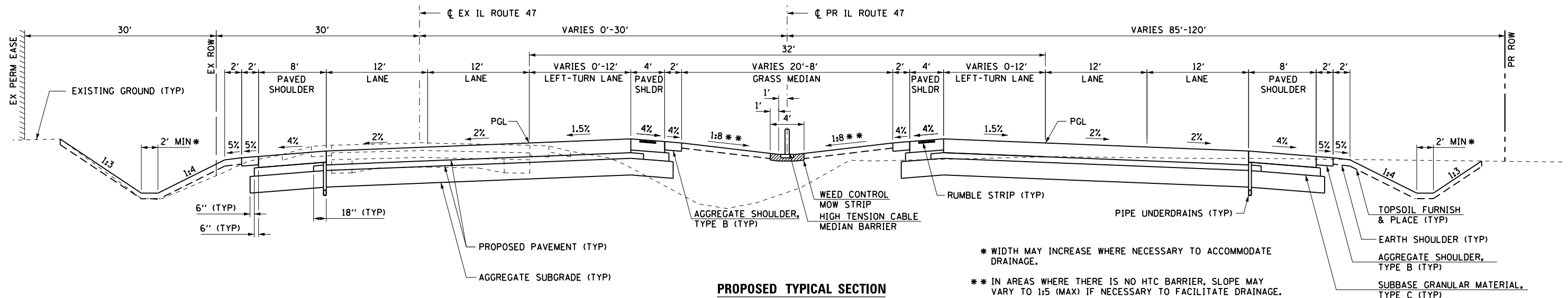
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 HRG PROJ. CONTACT: A. SIMMONS
 FILE NAME: D:\66625-sh1-ty1-04.dgn
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 PLOT DATE: 9/25/2015



**PROPOSED TYPICAL SECTION
 ILLINOIS ROUTE 47**
 STA 6614+57.00 TO STA 6622+20.59



**PROPOSED TYPICAL SECTION
 ILLINOIS ROUTE 47**
 STA 6622+20.59 TO STA 6703+30.21

* WIDTH MAY INCREASE WHERE NECESSARY TO ACCOMMODATE DRAINAGE.
 ** IN AREAS WHERE THERE IS NO HTC BARRIER, SLOPE MAY VARY TO 1:5 (MAX) IF NECESSARY TO FACILITATE DRAINAGE.

NOTE:
 CABLE BARRIER AND MOWING STRIP SHALL BE PROVIDED ONLY WHERE GRASS MEDIAN IS 20' WIDE. IT SHALL NOT EXTEND INTO TURN LANES OR TAPERS.

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 PLOT DATE = 9/25/2015

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ILLINOIS DEPARTMENT OF TRANSPORTATION

**TYPICAL SECTIONS
 ILLINOIS ROUTE 47**

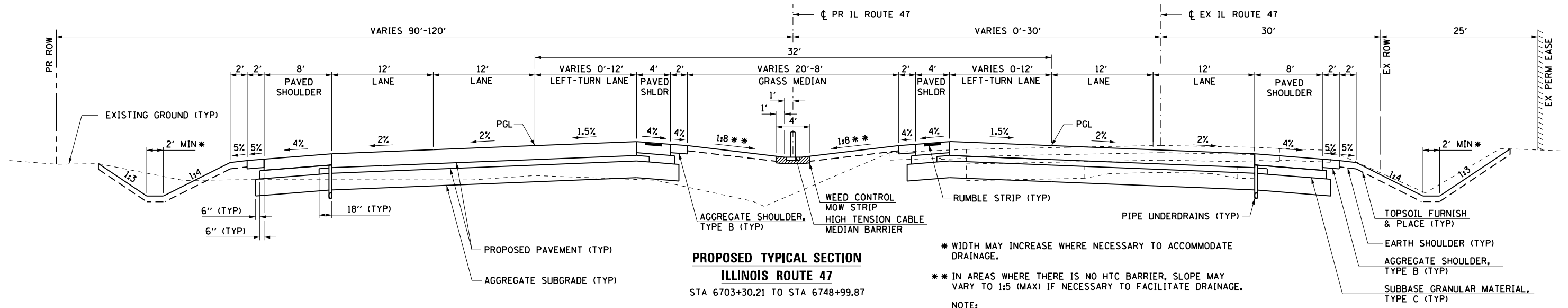
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CONTRACT NO.				
FED. ROAD DIST. NO. ILLINOIS FED. AID PROJECT				

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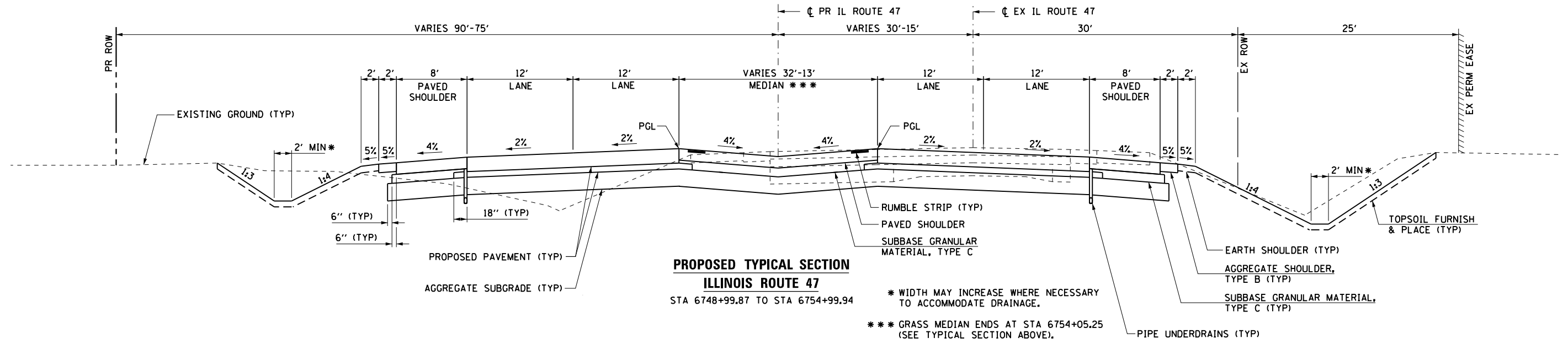
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HRG PROJECT NO.: 8900046
 HRG PROJ. CONTACT: A. SIMMONS
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PROPOSED TYPICAL SECTION
ILLINOIS ROUTE 47
 STA 6703+30.21 TO STA 6748+99.87

* WIDTH MAY INCREASE WHERE NECESSARY TO ACCOMMODATE DRAINAGE.
 ** IN AREAS WHERE THERE IS NO HTC BARRIER, SLOPE MAY VARY TO 1:5 (MAX) IF NECESSARY TO FACILITATE DRAINAGE.
 NOTE: CABLE BARRIER AND MOWING STRIP SHALL BE PROVIDED ONLY WHERE GRASS MEDIAN IS 20' WIDE. IT SHALL NOT EXTEND INTO TURN LANES OR TAPERS.



PROPOSED TYPICAL SECTION
ILLINOIS ROUTE 47
 STA 6748+99.87 TO STA 6754+99.94

* WIDTH MAY INCREASE WHERE NECESSARY TO ACCOMMODATE DRAINAGE.
 *** GRASS MEDIAN ENDS AT STA 6754+05.25 (SEE TYPICAL SECTION ABOVE).

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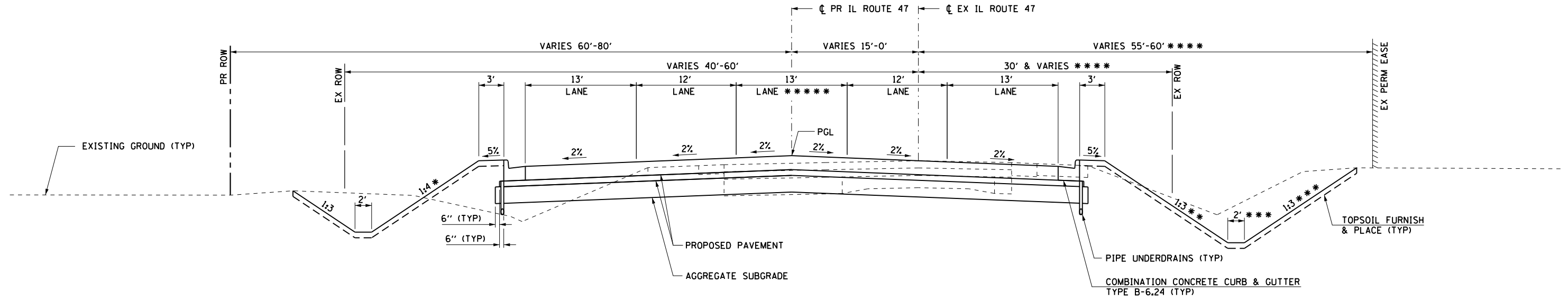
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 ILLINOIS ROUTE 47

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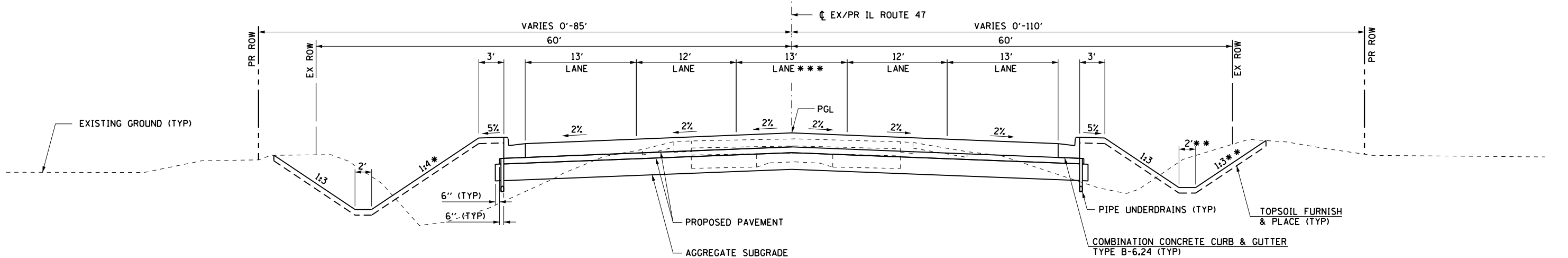
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**PROPOSED TYPICAL SECTION
 ILLINOIS ROUTE 47**
 STA 6754+99.94 TO STA 6809+01.72

- * SLOPE IS 1:3 FROM STA 6761+00 TO STA 6768+20 AND FROM STA 6806+50 TO STA 6812+50.
- ** SLOPE VARIES FROM 1:4 TO 1:5 SOUTH OF AMENT ROAD (STA 6754+99.94 TO STA 6768+20.00).
- *** NO DITCH OR BACKSLOPE FROM STA 6762+00 TO STA 6765+50.
- **** NO EXISTING EASEMENT STA 6792+93.85 TO STA 6797+70.72 (EXISTING ROW VARIES FROM 60' TO 91' IN THIS AREA).
- ***** BI-DIRECTIONAL TURN LANE, LEFT-TURN LANES, & STRIPED MEDIANS.



**PROPOSED TYPICAL SECTION
 ILLINOIS ROUTE 47**
 STA 6809+01.72 TO STA 6852+25.00

- * SLOPE IS 1:3 FROM STA 6806+50 TO STA 6812+50 AND FROM STA 6831+50 TO STA 6840+00.
- ** NO DITCH OR BACKSLOPE FROM STA 6817+20 TO STA 6823+00.
- *** BI-DIRECTIONAL TURN LANE, LEFT-TURN LANES, & STRIPED MEDIANS.

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ILLINOIS DEPARTMENT OF TRANSPORTATION

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**TYPICAL SECTIONS
 ILLINOIS ROUTE 47**

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	(109, 110) R	KENDALL	12	6
CONTRACT NO.				
FED. ROAD DIST. NO. ILLINOIS FED. AID PROJECT				

PROJECT AND TRAFFIC INPUTS

(Enter Data in Gray Shaded Cells)

Route: **FAP 326 (IL 47)** Comments: **Redesign - Original Design 2015.**
 Section: **(109,110)R** Contract **66825**
 County: **Kendall** Design Date: **01/20/2021** **JEK**
 Location: **IL 71 to Caton Farm Road** Modify Date:

<-- BY	ADT	Year
Current:	6,850	2017
Future:	8,768	2045

Facility Type: **Other Marked State Route**
 # of Lanes = **4**

Road Class: **I**
 Subgrade Support Rating (SSR): **Poor**
 Construction Year: **2026**
 Design Period (DP) = **20** years

	Structural Design Traffic			% of ADT in Design Lane
	Minimum ADT	Actual ADT	Actual % of Total ADT	
PV =	0	5,918	72.6%	P = 32%
SU =	250	685	8.4%	S = 45%
MU =	750	1,549	19.0%	M = 45%
Struct. Design ADT =	8,152 (2036)			

TRAFFIC FACTOR CALCULATION

FLEXIBLE PAVEMENT		RIGID PAVEMENT	
Cpv =	0.15	Cpv =	0.15
Csu =	132.5	Csu =	143.81
Cmu =	482.53	Cmu =	696.42
TF flexible (Actual) =	7.55 (Actual ADT)	TF rigid (Actual) =	10.60 (Actual ADT)
TF flexible (Min) =	3.56 (Min ADT Fig. 54-2.C)	TF rigid (Min) =	5.02 (Min ADT Fig. 54-2.C)

NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS

Full-Depth HMA Pavement	JPC Pavement
Use TF flexible = 7.55	Use TF rigid = 10.60
PG Grade Lower Binder Lifts = PG 64-22 (Fig. 53-4.O)	Edge Support = Tied Shoulder or C&G
HMA Mixture Temp. = 75.5 deg. F (Fig. 54-5.C)	Rigid Pavt Thick. = 10.00 in. (Fig. 54-4.E)
Design HMA Mixture Modulus (E _{HMA}) = 680 ksi (Fig. 54-5.D)	
Design HMA Strain (ε _{HMA}) = 68 (Fig. 54-5.E)	
Full Depth HMA Design Thickness = 11.75 in. (Fig. 54-5.F)	
Limiting Strain Criterion Thickness = 14.75 in. (Fig. 54-5.I)	
Use Full-Depth HMA Thickness = 11.75 inches	
	CRCP Pavement
	Use TF rigid = 10.60
	IBR value = 3
	CRCP Thickness = 9.00 in. (Fig. 54-4.M)

TF MUST BE > 60 FOR CRCP

RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS

HMA Pavement Over Rubblized PCC	Unbonded Concrete Overlay
Use TF flexible = 7.55	Review 54-4.03 for limitations and special considerations.
HMA Overlay Design Thickness = 9.00 in. (Fig. 54-5.U)	
Limiting Strain Criterion Thickness = 10.75 in. (Fig. 54-5.V)	
Use HMA Overlay Thickness = 9.00 inches	JPCP Thickness = NA inches

CONTACT RESEARCH FOR ASSISTANCE

DESIGN TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN

Class I Roads	Class II Roads	Class III Roads	Class IV Roads
4 lanes or more Part of a future 4 lanes or more One-way Streets with ADT > 3500	2 lanes with ADT > 2000 One way Street with ADT <= 3500	2 Lanes (ADT 750 -2000)	2 Lanes (ADT < 750)

Facility Type	Min. Str. Design Traffic (Fig 54-2.C)		
	PV	SU	MU
Interstate or Freeway	0	500	1500
Other Marked State Route	0	250	750
Unmarked State Route	No Min	No Min	No Min

Class Table for One-Way Streets	
ADT	Class
0 - 3500	II
>3501	I

Class	Traffic Factor ESAL Coefficients			
	Rigid (Fig. 54-4.C)		Flexible (Fig. 54-5.B)	
	Csu	Cmu	Csu	Cmu
I	143.81	696.42	132.50	482.53
II	135.78	567.21	112.06	385.44
III	129.58	562.47	109.14	384.35
IV	129.58	562.47	109.14	384.35

Class Table for 2 or 3 lanes (not future 4 lane & not one-way street)	
ADT	Class
0 - 749	IV
750 - 2000	III
>2000	II

Number of Lanes	Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-2.B)					
	Rural			Urban		
	P	S	M	P	S	M
1 Lane Ramp	100%	100%	100%	100%	100%	100%
2 or 3	50%	50%	50%	50%	50%	50%
4	32%	45%	45%	32%	45%	45%
6 or more	20%	40%	40%	8%	37%	37%

LIFE-CYCLE COST ANALYSIS: NEW CONSTRUCTION / RECONSTRUCTION

HMA_SD

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE

03/26/21

FULL-DEPTH HMA PAVEMENT

Standard Design

ROUTE SECTION COUNTY LOCATION FACILITY TYPE PROJECT LENGTH # OF CENTERLINES # OF LANES # OF EDGES LANE WIDTH - AVERAGE SHOULDER WIDTH

PAVEMENT THICKNESS (FLEXIBLE) SHOULDER THICKNESS HMA OVERLAY THICKNESS

FLEX PAVEMENT TRAFFIC FACTORS MINIMUM ACTUAL USE

HMA COST PER TON UNIT PRICE HMA SURFACE HMA TOP BINDER HMA LOWER BINDER HMA BINDER HMA SHOULDER

INITIAL COSTS ITEM THICKNESS 100% QUANTITY UNIT UNIT PRICE COST

HMA SHOULDER CURB & GUTTER SUBBASE GRAN MATL TY C IMPROVED SUBGRADE

Note: * Denotes User Supplied Quantity FLEXIBLE CONSTRUCTION INITIAL COST FLEXIBLE CONSTRUCTION ANNUAL COST PER MILE

MAINTENANCE COSTS: ITEM THICKNESS MATERIAL T UNIT COST ROUTINE MAINTENANCE ACTIVITY

FLEXIBLE TOTAL LIFE-CYCLE COST \$17,775,455 FLEXIBLE TOTAL ANNUAL COST PER MILE \$166,393

FULL-DEPTH HMA PAVEMENT HMA PAVEMENT OVER RUBBLIZED PCC PAVEMENT

MAINTENANCE COSTS: YEAR 5 YEAR 10 YEAR 15 YEAR 20 YEAR 25 YEAR 30 YEAR 35 YEAR 40

ROUTINE MAINTENANCE ACTIVITY 17.43 Lane Miles 0.00 \$0 \$0 MAINTENANCE LIFE-CYCLE COST \$4,474,107 MAINTENANCE ANNUAL COST PER MILE \$41,881

PCC PAVEMENT

JPCP

JPCP

MAINTENANCE AND REHABILITATION ACTIVITY SCHEDULE

03/26/21

ROUTE SECTION COUNTY LOCATION FACILITY TYPE PROJECT LENGTH # OF CENTERLINES # OF LANES # OF EDGES LANE WIDTH - AVERAGE SHOULDER WIDTH

PAVEMENT THICKNESS (RIGID) SHOULDER THICKNESS HMA OVERLAY THICKNESS

RIGID PAVEMENT TRAFFIC FACTORS MINIMUM ACTUAL USE

INITIAL COSTS ITEM THICKNESS 100% QUANTITY UNIT UNIT PRICE COST

JPC PAVEMENT PAVEMENT REINFORCEMENT STABILIZED SUBBASE PCC SHOULDERS CURB & GUTTER

Note: * Denotes User Supplied Quantity RIGID CONSTRUCTION INITIAL COST RIGID CONSTRUCTION ANNUAL COST PER MILE

MAINTENANCE COSTS: ITEM THICKNESS MATERIAL T UNIT COST ROUTINE MAINTENANCE ACTIVITY

RIGID TOTAL LIFE-CYCLE COST \$17,732,483 RIGID TOTAL ANNUAL COST PER MILE \$165,991

JOINTED PLAIN CONCRETE PAVEMENT UNBONDED JOINTED PLAIN CONCRETE OVERLAY

MAINTENANCE COSTS: YEAR 10 YEAR 15 YEAR 20 YEAR 25 YEAR 30 YEAR 35 YEAR 40

ROUTINE MAINTENANCE ACTIVITY 17.43 Lane Miles \$0.00 \$0 \$0 MAINTENANCE LIFE-CYCLE COST \$2,696,438 MAINTENANCE ANNUAL COST PER MILE \$25,241

RECONSTRUCTION - HMA OVER RUBBLIZED PAVEMENT

RECONSTRUCTION - PCC UNBONDED OVERLAY

LIFE-CYCLE COST ANALYSIS: NEW DESIGN

Calculated / Revised: 1/2021 8:24 AM

CONSTRUCTION INITIAL COST PRESENT WORTH ANNUAL COST PER MILE MAINTENANCE LIFE-CYCLE COST PRESENT WORTH ANNUAL COST PER MILE

TOTAL	LIFE-CYCLE COST	PRESENT WORTH	\$17,732,483	\$17,775,455
		ANNUAL COST PER MILE	\$165,991	\$166,393

LIFE-CYCLE COST ANALYSIS: FINAL SUMMARY

LOWEST COST OPTION	=====>	JPCP	\$165,991	
OTHER OPTIONS (LOWEST TO HIGHEST):	TYPE / PERCENTAGE	HMA	\$166,393	0.2%

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