



Illinois Department of Transportation

To: Paul Loete, P.E. Attn: District Two
From: John Baranzelli
Subject: Pavement Design
Date: December 5, 2013

A handwritten signature in black ink, appearing to be 'J. Baranzelli', enclosed in a hand-drawn oval.

FAP Route 301 (US 20)
Jo Daviess County
From Logemann Road to South Park Road/Rush Street

The project, submitted to BDE by memo dated September 17, 2013, will reconstruct US 20. Based on life cycle costs favoring the flexible design by more than 10%, the district proposes to use an HMA design. BDE has reviewed this request and concur.

The approved pavement design is as follows:

US 20 (Pavement Reconstruction)

9.5 inches of Full-Depth HMA Pavement with HMA Shoulders
2 inches HMA Surface Course, Mix "D", N70
2.5 inches HMA Binder Course, IL-19.0, N70
5 inches HMA Leveling Binder, IL-19.0, N70
12 inches Aggregate Subgrade Improvement

If you have any questions, please contact Paul Niedernhofer at (217) 524-1651.



Illinois Department of Transportation

Memorandum

To: John Baranzelli Attn: Paul Niedernhofer
From: Paul Loete, P.E. By: Masood Ahmad
Subject: Pavement Design
Date: September 17, 2013

RECEIVED

SEP 18 2013

BUREAU OF
DESIGN & ENVIRONMENT

FAP Route 301 (US 20)
Section 24R
Jo Daviess County
Job No. D-92-103-05
Contract No. 64B40

From Logemann Road to approximately 0.5 miles West of Canyon Park Road will be reconstructed with a horizontal realignment to the north approximately 65 feet and vertical realignments.

From 0.5 miles West of Canyon Park Road to approximately 0.16 miles West of Golf/Mapes Road will be resurfaced with the addition of 8 feet shoulders and grading and shaping of the ditches.

From approximately 0.16 miles West of Golf/Mapes Road to 0.2 miles West of S. Park Road/Rush Street will be reconstructed with a horizontal and vertical realignment with a frontage road for the entrances at the crest.

Attached is the pavement selection analysis for the subject section. This section consists of approximately 35,067 square yards of rural roadway.

A comparison was performed between the following Mechanistic Pavement Designs:

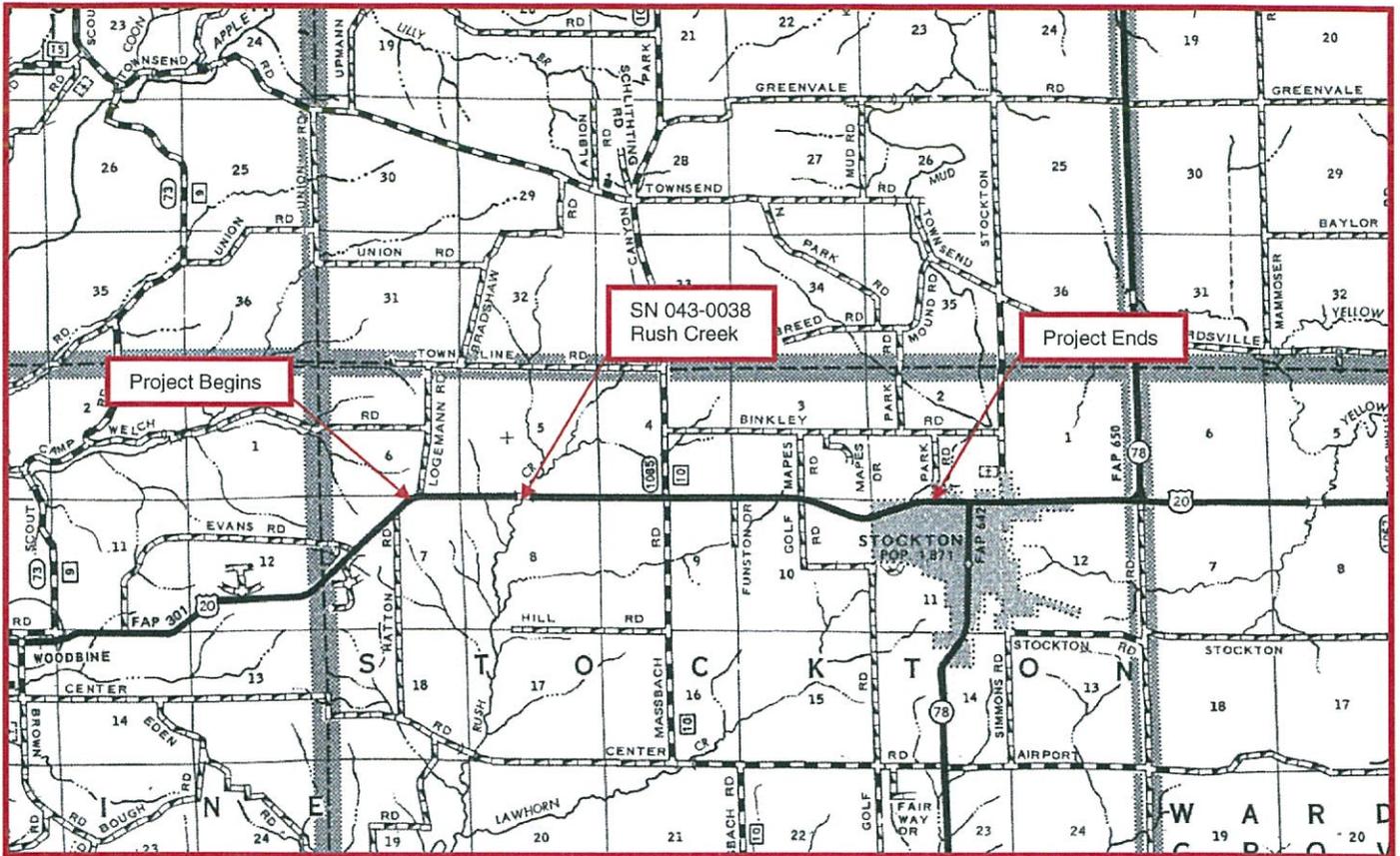
1. Flexible pavement design
2. Rigid pavement design that included 4" stabilized sub-base with PCC Shoulders
3. Rigid pavement design that does not include 4" stabilized sub-base with PCC Shoulders
4. Rigid pavement design that included 4" stabilized sub-base with HMA Shoulders
5. Rigid pavement design that does not include 4" stabilized sub-base with HMA Shoulders
6. Composite Design with 9" Rigid Pavement with 2.25" Overlay with HMA Shoulders

Option 1 indicates that the flexible pavement presents the lowest life cycle costs, providing a 17.8% annual cost savings versus Option 2, a rigid pavement design.

The District would like to recommend the flexible pavement design consisting of 9.5" of Hot-Mix Asphalt Pavement for US 20. The District's recommendation is based on a rural area, lowest life cycle cost, and constructability.

If you have any questions or need additional information, please contact Traci Duden at 815/284-5932.

Attachments
S&P/td-0301/ss



FAP 301 (US 20)

Sec 24R

JoDavies Co

P-92-103-05

Contract No 64B40

Stockton Township, Range T. 27 N.-R.4 E., Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

3.41 miles along US 20 from Logemann Road to the West Edge of Stockton

Horizontal and Vertical Realignment from Logemann Road to Canyon Park Road, Resurfacing from Canyon Park Road to Mapes/Golf Road, and Horizontal and Vertical Realignment from Mapes/Golf Road to Park Road.

PROJECT AND TRAFFIC INPUTS		(Enter Data in Gray Shaded Cells)	
Route: FAP 301 (US 20)	Comments:		
Section: 24R	Design Date:	<-- BY	
County: JoDaviess	Modify Date:	<-- BY	ADT Year
Location: Logemann Road to Stockton		Current:	- -
Facility Type: Other Marked State Route		Future:	- -
# of Lanes = 2 or 3		Structural Design Traffic	
Part of future 4 lanes or more? No		Minimum ADT	Actual ADT Actual % of Total ADT % of ADT in Design Lane
One Way Street? No			
Road Class: II		PV = 0	5,280 88.0% P = 50%
Subgrade Support Rating (SSR): Poor		SU = 250	345 5.8% S = 50%
Construction Year: 2013		MU = 750	375 6.3% M = 50%
Design Period (DP) = 20 years		Struct. Design ADT = 6,000	(2023)

TRAFFIC FACTOR CALCULATION			
FLEXIBLE PAVEMENT		RIGID PAVEMENT	
Cpv = 0.15		Cpv = 0.15	
Csu = 112.06		Csu = 135.78	
Cmu = 385.44		Cmu = 567.21	
TF flexible (Actual) = 1.84	(Actual ADT)	TF rigid (Actual) = 2.60	(Actual ADT)
TF flexible (Min) = 3.17	(Min ADT Fig. 54-2.C)	TF rigid (Min) = 4.59	(Min ADT Fig. 54-2.C)

NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS			
Full-Depth HMA Pavement		JPC Pavement	
Use TF flexible = 3.17		Use TF rigid = 4.59	
PG Grade Lower Binder Lifts = PG 64-22 (Fig. 53-4.R)		Edge Support = Untied Shoulder or C.&G.	
HMA Mixture Temp. = 73.0 deg. F (Fig. 54-5.C)		Rigid Pavt Thick. = 9.25 in. (Fig. 54-4.E)	
Design HMA Mixture Modulus (E _{HMA}) = 760 ksi (Fig. 54-5.D)			
Design HMA Strain (ε _{HMA}) = 86 (Fig. 54-5.E)		CRC Pavement	
Full Depth HMA Design Thickness = 9.50 in. (Fig. 54-5.F)		Use TF rigid = 4.59	
Limiting Strain Criterion Thickness = 14.17 in. (Fig. 54-5.I)		IBR value = 3	
Use Full-Depth HMA Thickness = 9.50 inches		CRCP Thickness = 7.75 in. (Fig. 54-4.N)	

TF MUST BE > 60 FOR CRCP

RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS			
HMA Overlay of Rubblized PCC		Unbonded Concrete Overlay	
Use TF flexible = 3.17		Review 54-4.03 for limitations and special considerations.	
District = 1,2		JPCP Thickness = NA inches	
HMA Overlay Design Thickness = 7.50 in. (Fig. 54-5.U)			

CONTACT BMPR FOR ASSISTANCE

DESIGN TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN						
Class I Roads 4 lanes or more Part of a future 4 lanes or more One-way Streets with ADT > 3500	Class II Roads 2 lanes with ADT > 2000 One way Street with ADT <= 3500	Class III Roads 2 Lanes (ADT 750 -2000)	Class IV Roads 2 Lanes (ADT < 750)			
Min. Str. Design Traffic (Fig 54-2.C)				Class Table for One-Way Streets		
Facility Type	PV	SU	MU	ADT	Class	
Interstate or Supplemental Freeway	0	500	1500	0 - 3500	II	
Other Marked State Route	0	250	750	>3501	I	
Unmarked State Route	No Min	No Min	No Min			
Traffic Factor ESAL Coefficients				Class Table for 2 or 3 lanes (not future 4 lane & not one-way street)		
Class	Rigid (Fig. 54-4.C)		Flexible (Fig. 54-5.B)		ADT	Class
	Csu	Cmu	Csu	Cmu		
I	143.81	696.42	132.50	482.53	0 - 749	IV
II	135.78	567.21	112.06	385.44	750 - 2000	III
III	129.58	562.47	109.14	384.35	>2000	II
IV	129.58	562.47	109.14	384.35		
Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-2.B)						
Number of Lanes	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

FULL-DEPTH HMA PAVEMENT

Standard Design

ROUTE **FAP 301 (US 20)**
 SECTION **24R**
 COUNTY **JoDavie**
 LOCATION **Logemann Road to Stockton**

FACILITY TYPE **NON-INTERSTATE**

PROJECT LENGTH **13150 FT ==> 2.49 Miles**
 # OF CENTERLINES **2 CL**
 # OF LANES **2 LANES**
 # OF EDGES **2 EP**
 LANE WIDTH - AVERAGE **12 FT**
 SHOULDER WIDTH HMA Inside **8 FT**
 HMA Outside **8 FT**

PAVEMENT THICKNESS (FLEXIBLE) **9.50 IN** **14.17 IN MAX**
 SHOULDER THICKNESS **8.00 IN** **HMA 3" Standard Design**
 POLICY OVERLAY THICKNESS **2.25 IN**

FLEX PAVEMENT	TRAFFIC FACTORS	MINIMUM	ACTUAL	USE
		3.17	1.84	3.17

Read Me!

HMA	COST PER TON	UNIT PRICE
HMA SURFACE		\$79.35 / TON
HMA TOP BINDER		\$81.60 / TON
HMA LOWER BINDER		\$66.40 / TON
HMA BINDER (LEVELING)		\$0.00 / TON
HMA SHOULDER		\$68.30 / TON

INITIAL COSTS

ITEM	THICKNESS	100% QUANTITY	UNIT	UNIT PRICE	COST
HMA PAVEMENT (FULL-DEPTH)	(9.50")	35,067	SQ YD	\$40.00 / SQ YD	\$1,402,667 ~
HMA SURFACE COURSE	(2.00")	3,955	TONS	\$79.35 / TON	\$0
HMA TOP BINDER COURSE	(2.25")	4,514	TONS	\$81.60 / TON	\$0
HMA LOWER BINDER COURSE	(5.25")	10,802	TONS	\$66.40 / TON	\$0
HMA SHOULDER	(8.00")	23,378	SQ YD	\$30.60 / SQ YD	\$715,323 ~
CURB & GUTTER		0	LIN FT	\$30.00 / LIN FT	\$0
SUBBASE GRAN MATL TY C (TONS)		0	TONS	\$25.00 / TON	\$0
IMPROVED SUBGRADE:	Aggregate	62,219	SQ YD	\$8.95 / SQ YD	\$556,860
Reserved For User Supplied Item		0	UNITS	\$0.00 / UNITS	\$0
Reserved For User Supplied Item		0	UNITS	\$0.00 / UNITS	\$0
PAVEMENT REMOVAL		35,067	SQ YD	\$8.50 / SQ YD	\$298,070
SHOULDER REMOVAL		23,378	SQ YD	\$7.00 / SQ YD	\$163,646

Note: * Denotes User Supplied Quantity
 FLEXIBLE CONSTRUCTION INITIAL COST \$2,674,850
 FLEXIBLE CONSTRUCTION ANNUAL COST PER MILE \$43,804

MAINTENANCE COSTS:

ITEM	THICKNESS	MATERIAL	UNIT COST
ROUTINE MAINTENANCE ACTIVITY			\$0.00 LANE-MILE / YEAR
HMA OVERLAY PVMT SURF	(2.00")	Surface Mix	\$79.35 / TON
HMA OVERLAY PVMT	(2.25")	Surface Mix	\$79.35 / TON
HMA SURFACE MIX	(1.50")	Surface Mix	\$0.00 / TON
HMA BINDER MIX	(0.75")	Leveling Binder Mix	\$0.00 / TON
HMA OVERLAY SHLD (Year 30)	(2.25")	Shoulder Mix	\$71.20 / TON
HMA OVERLAY SHLD	(2.00")	Shoulder Mix	\$71.20 / TON
MILLING (2.00 IN)			\$2.30 / SQ YD
PARTIAL DEPTH PVMT PATCH (Mill & Fill Surf)		Surface Mix	\$53.00 / SQ YD
PARTIAL DEPTH SHLD PATCH (Mill & Fill Surf)		Shoulder Mix	\$0.00 / SQ YD
PARTIAL DEPTH PVMT PATCH (Mill & Fill +2.00")		Leveling Binder Mix	\$35.50 / SQ YD
PARTIAL DEPTH SHLD PATCH (Mill & Fill +2.00")		Shoulder Mix	\$44.50 / SQ YD
LONGITUDINAL SHOULDER JOINT ROUT & SEAL			\$0.65 / LIN FT
CENTERLINE JOINT ROUT & SEAL			\$0.65 / LIN FT
RANDOM / THERMAL CRACK ROUT & SEAL (100% Rehab = 110.00' / Station / Lane)			\$0.65 / LIN FT

FLEXIBLE TOTAL LIFE-CYCLE COST \$3,553,418
 FLEXIBLE TOTAL ANNUAL COST PER MILE \$58,191

FULL-DEPTH HMA PAVEMENT
HMA OVERLAY OF RUBBLIZED PCC PAVEMENT
Figure 54-7.C
STANDARD DESIGN

MAINTENANCE COSTS:	ITEM	%	QUANTITY	UNIT	UNIT COST	COST	PRESENT WORTH
YEAR 5							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.10%	35	SQ YD	\$53.00	\$1,855	
	PWF _n =	0.8626		PW =	0.8626 X	\$45,447	\$39,203
YEAR 10							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.50%	175	SQ YD	\$53.00	\$9,275	
	PWF _n =	0.7441		PW =	0.7441 X	\$52,867	\$39,338
YEAR 15							
	MILL PVMT & SHLD 2.00"	100.00%	58,444	SQ YD	\$2.30	\$134,421	
	PD PVMT PATCH M&F ADD'L 2.00"	1.00%	351	SQ YD	\$35.50	\$12,461	
	HMA OVERLAY PVMT 2.00"	100.00%	3,955	TON	\$79.35	\$313,809	
	HMA OVERLAY SHLD 2.00 "	100.00%	2,618	TON	\$71.20	\$186,424	
	PWF _n =	0.6419		PW =	0.6419 X	\$647,115	\$415,358
YEAR 20							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.10%	35	SQ YD	\$53.00	\$1,855	
	PWF _n =	0.5537		PW =	0.5537 X	\$45,447	\$25,163
YEAR 25							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.50%	175	SQ YD	\$53.00	\$9,275	
	PWF _n =	0.4776		PW =	0.4776 X	\$52,867	\$25,250
HMA_SD							
YEAR 30 NON-INTERSTATE							
	MILL PVMT & SHLD 2.00"	100.00%	58,444	SQ YD	\$2.30	\$134,421	
	PD PVMT PATCH M&F ADD'L 2.00"	2.00%	701	SQ YD	\$35.50	\$24,886	
	PD SHLD PATCH M&F ADD'L 2.00"	1.00%	234	SQ YD	\$44.50	\$10,413	
	HMA OVERLAY PVMT 2.25 "	100.00%	4,453	TON	\$79.35	\$353,339	
	HMA OVERLAY SHLD 2.25 "	100.00%	2,946	TON	\$71.20	\$209,727	
	PWF _n =	0.4120		PW =	0.4120 X	\$732,786	\$301,898
YEAR 35							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.10%	35	SQ YD	\$53.00	\$1,855	
	PWF _n =	0.3554		PW =	0.3554 X	\$45,447	\$16,151
YEAR 40							
	LONG SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CNTR LINE JOINT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RNDM / THRM CRACK R&S	50.00%	14,465	LIN FT	\$0.65	\$9,402	
	PD PVMT PATCH M&F SURF	0.50%	175	SQ YD	\$53.00	\$9,275	
	PWF _n =	0.3066		PW =	0.3066 X	\$52,867	\$16,207
							\$878,568
ROUTINE MAINTENANCE ACTIVITY			4.98 Lane Miles		0.00	\$0	\$0
			MAINTENANCE LIFE-CYCLE COST				\$878,568
45	YEAR LIFE CYCLE	CRF _n = 0.0407852	MAINTENANCE ANNUAL COST PER MILE				\$14,388

JOINTED PLAIN CONCRETE PAVEMENT
UNBONDED JOINTED PLAIN CONCRETE OVERLAY
Figure 54-7.A

MAINTENANCE COSTS:	ITEM	%	QUANTITY	UNIT	UNIT COST	COST	PRESENT WORTH
YEAR 10							
	PAVEMENT PATCH CLASS B	0.10%	35	SQ YD	\$100.00	\$3,500	
		PWF _n = 0.7441			PW = 0.7441 X	\$3,500	\$2,604
YEAR 15							
	PAVEMENT PATCH CLASS B	0.20%	70	SQ YD	\$100.00	\$7,000	
		PWF _n = 0.6419			PW = 0.6419 X	\$7,000	\$4,493
YEAR 20							
	PAVEMENT PATCH CLASS B	2.00%	701	SQ YD	\$100.00	\$70,100	
	SHOULDER PATCH CLASS C	0.50%	117	SQ YD	\$95.00	\$11,115	
	LONGITUDINAL SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CENTERLINE JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
		PWF _n = 0.5537			PW = 0.5537 X	\$115,405	\$63,897
YEAR 25							
	PAVEMENT PATCH CLASS B	3.00%	1,052	SQ YD	\$100.00	\$105,200	
	SHOULDER PATCH CLASS C	1.00%	234	SQ YD	\$95.00	\$22,230	
		PWF _n = 0.4776			PW = 0.4776 X	\$127,430	\$60,861
YEAR 30 NON-INTERSTATE							
	PAVEMENT PATCH CLASS B	4.00%	1,403	SQ YD	\$100.00	\$140,300	
	SHOULDER PATCH CLASS C	1.50%	351	SQ YD	\$95.00	\$33,345	
	HMA POLICY OVERLAY 2.5" (PVMT)	100.00%	4,952	TON	\$71.55	\$354,312	
	HMA POLICY OVERLAY 2.5" (SHLD)	100.00%	3,273	TON	\$71.20	\$233,030	
		PWF _n = 0.4120			PW = 0.4120 X	\$760,987	\$313,517
YEAR 35 NON-INTERSTATE							
	LONGITUDINAL SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CENTERLINE JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	RANDOM CRACK R&S	50.00%	13,150	LIN FT	\$0.65	\$8,548	
	REFLECTIVE TRANSVERSE CRACK R&S	40.00%	8,419	LIN FT	\$0.65	\$5,472	
	PD PVMT PATCH M&F HMA 2.50"	0.10%	35	SQ YD	\$64.00	\$2,240	
		PWF _n = 0.3554			PW = 0.3554 X	\$50,450	\$17,929
YEAR 40 NON-INTERSTATE							
	PAVEMENT PATCH CLASS B	0.50%	175	SQ YD	\$100.00	\$17,500	
	LONGITUDINAL SHLD JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	CENTERLINE JT R&S	100.00%	26,300	LIN FT	\$0.65	\$17,095	
	REFLECTIVE TRANSVERSE CRACK R&S	60.00%	12,629	LIN FT	\$0.65	\$8,209	
	RANDOM CRACK R&S	50.00%	13,150	LIN FT	\$0.65	\$8,548	
	PD PVMT PATCH M&F HMA 2.50"	0.50%	175	SQ YD	\$64.00	\$11,200	
		PWF _n = 0.3066			PW = 0.3066 X	\$79,647	\$24,416
							\$487,717
	ROUTINE MAINTENANCE ACTIVITY		4.98 Lane Miles		\$0.00	\$0	\$0
							MAINTENANCE LIFE-CYCLE COST \$487,717
45	YEAR LIFE CYCLE	CRF _n = 0.0407852					MAINTENANCE ANNUAL COST PER MILE \$7,987

LIFE-CYCLE COST ANALYSIS: NEW DESIGN

Calculated / Revised : 9/5/13 11:54 AM

			JPCP	HMA
CONSTRUCTION	INITIAL COST	PRESENT WORTH	\$3,697,386	\$2,674,850
		ANNUAL COST PER MILE	\$60,549	\$43,804
MAINTENANCE	LIFE-CYCLE COST	PRESENT WORTH	\$487,717	\$878,568
		ANNUAL COST PER MILE	\$7,987	\$14,388
TOTAL	LIFE-CYCLE COST	PRESENT WORTH	\$4,185,103	\$3,553,418
		ANNUAL COST PER MILE	\$68,536	\$58,191

LIFE-CYCLE COST ANALYSIS: FINAL SUMMARY

LOWEST COST OPTION	=====>	HMA	\$58,191	
OTHER OPTIONS (LOWEST TO HIGHEST):	TYPE / PERCENTAGE	JPCP	\$68,536	17.8%

P:\Pavement Design Stuff\D-2\US 20 from from Logemann Road to west of South Park Road - Rush Street[Option 1 & 2.xlsm]LifeCycleCost