



Montana Department of Transportation Value Analysis Program

2019 Save International Conference
Darin Reynolds, PE



Darin Reynolds, PE

MDT:

Value Analysis Engineer -Section Supervisor	2018-2019
Pavement Design Engineer	2013-2018
District Materials Supervisor	2011-2013

<u>Private Sector (Vertical Construction)</u>	2000-2011
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Structural Engineer
Construction Project Manager

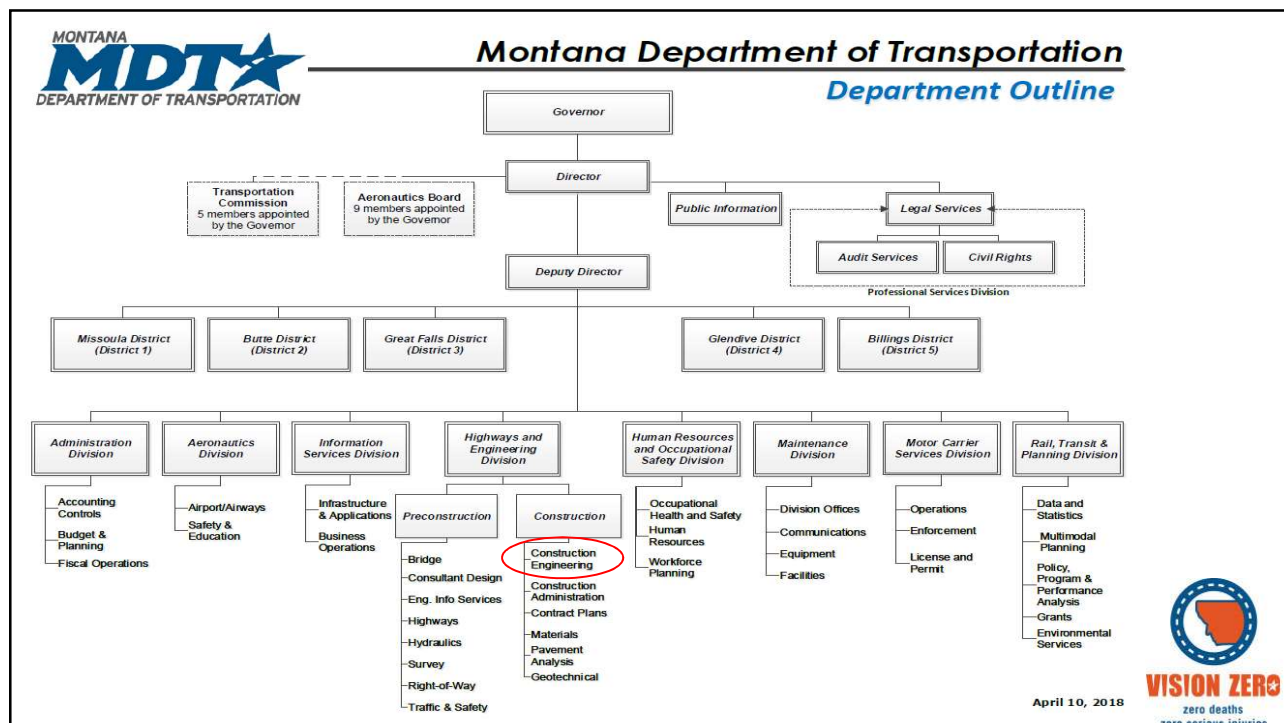
B.S./M.S. Montana State University - Go Bobcats!





Outline

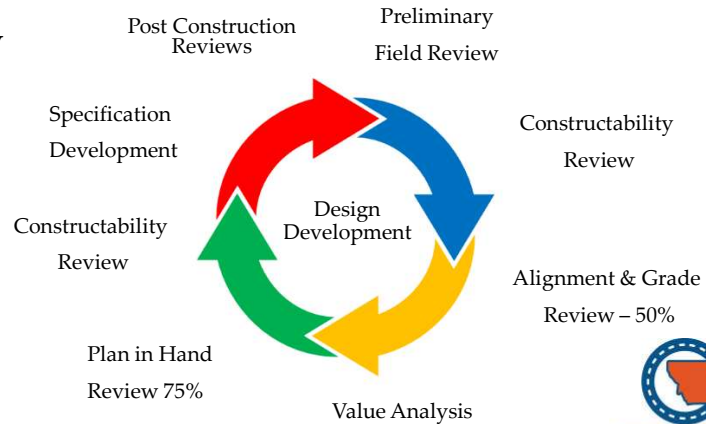
- MDT Value Analysis Program overview
- Recent Studies
- Alternative Pavement Sections





2018 Construction Bureau Reorganization

- Value Analysis Program
- Constructability Review
- Specifications Unit



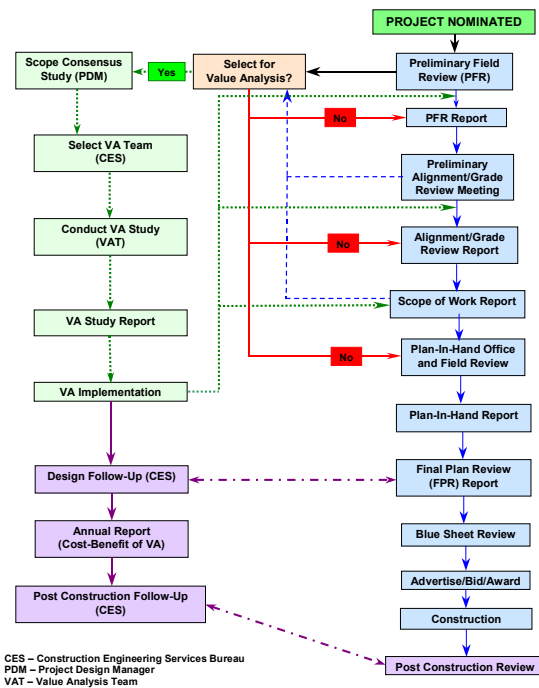
VA/VE Delivery

- Value Engineering – Contractor proposals
 - 2-3 per year
- Value Analysis – Design Development
 - ~4 per year
- New Applications
 - Design Build
 - GCCM – 4 pilot projects approved by legislature





VA Process Flow Chart



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VA Program Notes

- Project Selection
 - Meet FHWA REQUIREMENTS (23 CFR)
 - > \$50 million (environmental/design/row/construction)
 - > \$40 million – bridges
 - EIS/EA Corridor Studies (comprise several nominated projects)
- Tracking
- Reporting

www.fhwa.dot.gov/ve/



MDT COMPLETED VA STUDIES						
DESCRIPTION	UPN / Study Cost ¹	COST ESTIMATE	DATE COMPLETED	COST SAVINGS	# of STUDY RECOMM.	ACTUAL COST SAVINGS ²
FY 2016 (October 2015 to September 2016)						
59. WATERLOO N&S (Consultant Led)	5801001	\$9,640,000	Apr-16	-\$120,000	10	(\$1,920,000)
60. GREAT FALLS - NORTH	7625000	\$10,820,000	Jun-16	\$2,580,000	6	\$415,000
61. LAMBERT - WEST (Consultant Led)	8715000	\$10,771,419	Aug-16	\$2,715,802	1	\$2,099,200
62. LAMBERT - SOUTH	8149000	\$16,380,000	Aug-16	\$3,740,000	4	\$1,010,000
Totals for FY 2016	\$110,000	\$47,531,419		\$8,915,802	21	\$1,604,200
FY 2017 (October 2016 to September 2017)						
63. DIVIDE - WEST (Consultant Led - CRAVE)	8538000	\$10,410,000	Dec-16	\$2,310,000	8	\$2,387,000
64. WOLF CREEK N&S	7617000	\$19,080,000	Feb-17	\$2,626,000	4	\$359,000
65. N OF ROCKER INT - NORTH	7896000	\$2,100,000	Feb-17	\$536,862	4	\$252,000
66. WESTBY - WEST	7953000	\$19,700,000	Feb-17	\$2,600,130	3	\$0
67. SF 139 - RACETRACK BRIDGE REMOVAL	8613000	\$7,420,000	Feb-17	\$1,809,741	7	\$399,125
68. BILLINGS BYPASS (Consultant Led - CRAVE)	4199000	\$129,350,000	May-17	\$13,310,000	12	\$10,830,000
Totals for FY 2017	\$233,134	\$168,390,000		\$23,192,732	38	\$14,227,125
FY 2018 (October 2017 to September 2018)						
69. L80 YELLOWSTONE RIVER BRIDGES	7972000	\$76,200,200	Mar-18	\$17,800,000	7	\$12,989,000
Totals for FY 2018		\$76,200,200		\$17,800,000	7	\$12,989,000
FY 2019 (October 2018 to September 2019)						
70. Taft West	9487000	\$38,000,000	Feb-19	\$7,960,000	6	TBD
71. Luther E & W	8541000	\$19,700,000	Mar-19	\$2,148,000	7	TBD
72. Livingston South	8790000	\$7,200,000	Mar-19	\$370,000	5	TBD
73. Lincoln Road West of Green Meadow	8939000	\$11,580,000	Mar-19	\$873,843	6	TBD
Totals for FY 2019		\$76,480,000		\$11,351,843	24	\$0
TOTALS SINCE PROGRAM IMPLEMENTATION (2/15/05)		\$1,434,269,339		\$248,266,245	338	\$131,555,032
						53.0%



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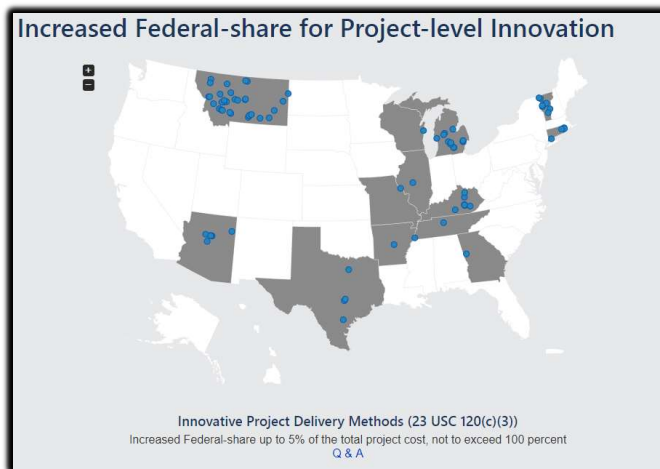
VA Program Notes

- Post Construction Reviews on VA's ➡ Lessons Learned
- Training (Team members = MDT employees)
 - NHI Value Engineering Workshop 2017, 2019 (~25 people)
 - VMF I/II Training (2 staff currently)
- Team Leader
 - Continue to Utilize Consultants
 - Term Contract RFQ ~2020
- Innovations



5% Increased Federal Share - Innovation

- Federal Funds vs. State
- ~87% Fed. / 13% State



https://www.fhwa.dot.gov/innovation/resources/increased_federal_share.cfm



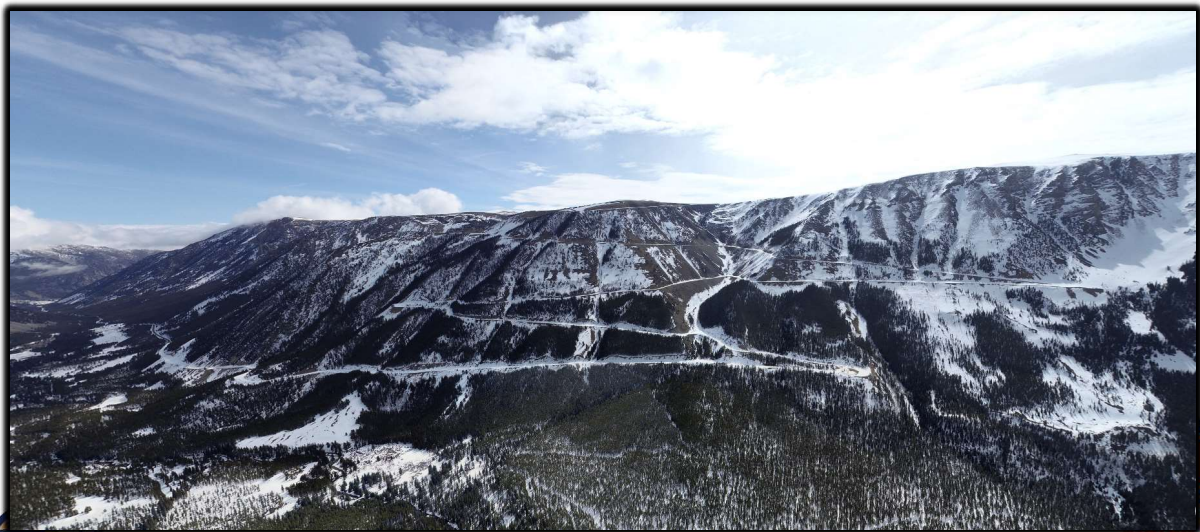


Unmanned Aerial Vehicle (UAV) Program

- Used since 2016
- UAV General test for commercial use
- Phantom 4 (\$1,000) and Inspire 2 (\$5,400)
- Uses
 - Measure stockpiles
 - Take photos/video for documentation, potential claims
 - Videos for the VA program
 - Survey, Lidar can be mounted on them
 - Beartooth Pass: [Beartooth Pass Panoramic](#)



<https://roundme.com/tour/397456/view/1377469/>



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...and that 4 letter word RISK

- MDT implemented 2016 Project Risk Management Policy (Preconstruction)
- Currently being revised
- Looking into utilizing consultants for High Risk Projects
- http://mdtinfo.mdt.mt.gov/other/webdata/external/cadd/report_templates_guidance/RiskManagementPolicyMemo.pdf

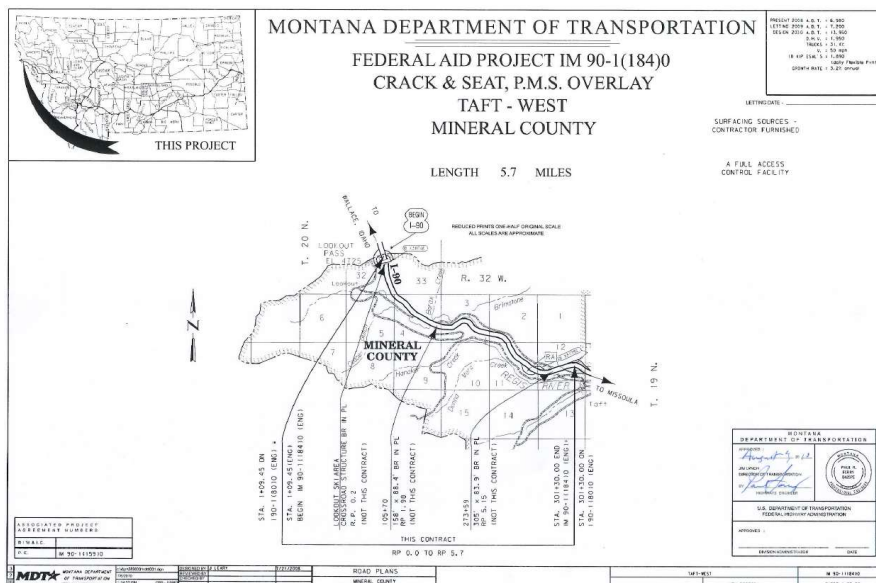
Project Level of Risk See table in Appendix A	Minimum Process Project managers may use a higher level process as needed
Low Risk Pavement Preservation or minor projects	Risk identification using the Project Risk Documentation worksheet and document in milestone reports
Medium Risk Rehab or Reconstruct	Qualitative risk analysis using the RMP worksheet
High Risk Complex projects	Risk analysis workshop using the RMP worksheet



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Taft West VA Study



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Taft West VA Study

- PFR stage (5% Design)
- Pavement Resurfacing Project
- Idaho DOT Peer Exchange
 - Review Idaho's Lookout Pass Projects
- TEAM
 - FHWA (Local office/Resource Center/Western Federal Lands)
 - MDT Staff (Design/Construction/Maintenance/Materials)
 - American Concrete Paving Association (ACPA)
 - Consulted Idaho DOT Staff – Risk Analysis



Taft West VA Study

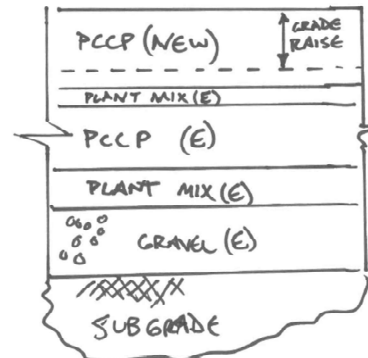
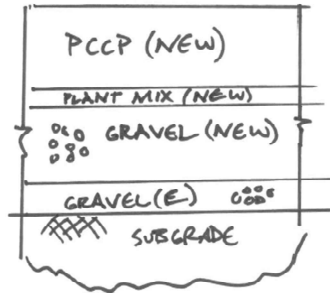
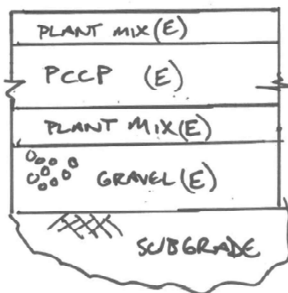
- 1970's: 8" PCCP over 6" HMA
- 2011: Crack and sealed – 5" HMA overlay
- Bituminous pavement not performing well – joint failures/raveling
- Chip seal ~ 3 year intervals since
- Resurfacing (Mill/Fill) ~ 6 year intervals
- Nominated for a full PCCP Reconstruct
 - \$33 million
 - similar scope to Idaho side of Lookout Pass





Taft West Pavement Sections

- Flexible Pavement (status quo)
- PCCP Reconstruct (like Idaho)
- PCCP Unbonded Overlay



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Taft West - Challenges

- Climate (moisture/freeze-thaw)
- Maintenance Practices (Deicers – Salt)
- CBR failures
- Materials – Limited gravel resources
- Logistics/Site Constraints



<https://drive.google.com/open?id=1rnkjq0wktIy-tTMZHduaTKIvEzUgGII>



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Project Visit?

February 2019 – Avalanche During Study!



Taft West Drone Flight

- October 2018 – Winter was well on its way
- Coordination – MDT Construction & Maintenance
- Pre-programmed flight plan (~45 mph, powerlines)
- Crash attenuator truck
- Video Processing
- 10 min. <https://drive.google.com/open?id=1q53K-ZNlaFCgvEWfaDrEljqjKkrcA62e>
- 2 min. https://drive.google.com/open?id=1bVuhhX_J_P6HX4wlfi_YozRnp02nS420
- 1 min. <https://drive.google.com/open?id=1KvMHA1nQdy0QPX61Ws-ea0nZ0GBpxdId>





Life Cycle Cost Analysis (LCCA)

- 60 Year Analysis Period
- Compares alternatives w/ different design lives
- Net Present Value (NPV)
 - Initial Construction Cost
 - Maintenance/Rehabilitation Cost & Interval
 - Salvage Value
- Discount Rate = 1.5% (adjusted for inflation)
- $FV = PV \cdot (1+i)^n$ (Time Value of Money)



21

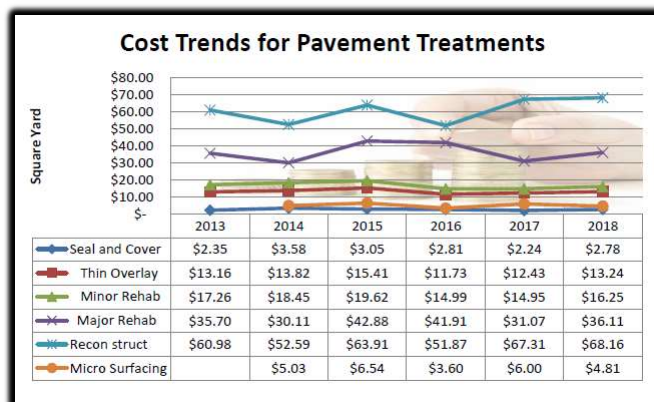


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LCCA Inputs

- Pavement Costs (MDT Annual Report)
- Maintenance Cost and Interval (Actual Construction History)



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60-YEAR LCCA	
Alternate	Net Present Worth
PCCP OVERLAY	\$26,412,350
PCCP PULVERIZED BASE	\$28,850,804
PCCP RECONSTRUCT (BASELINE)	\$33,070,779
PMS	\$61,770,883

~\$6.7 million estimated cost savings

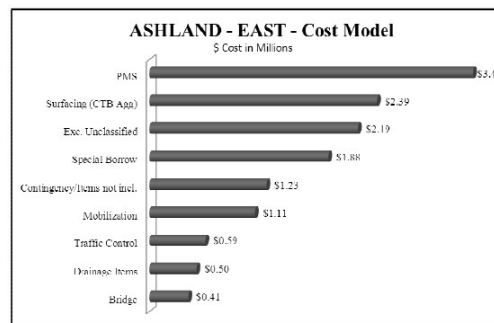
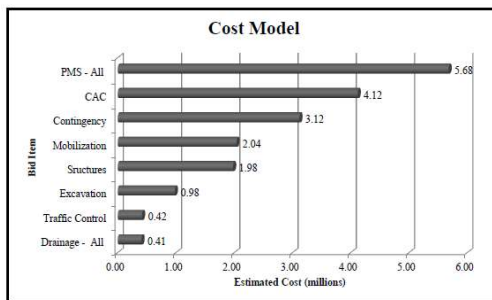


60-YEAR LCCA					
Discount Rate = 1.5 https://www.whitehouse.gov/wp-content/uploads/2018/12/M-18-05.pdf					
Discount Rate from the 2016 White House Office of Budget and Management (OMB) Circular No. A-94					
	Cost (\$)	Type of Maintenance	Year of Maint.	(14)/n	Present Worth
PCCP OVERLAY					
Initial Construction	\$22,710,254		0	1	\$22,710,254
Maintenance #1	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	20	1.35	\$3,458,251
Maintenance #2	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	40	1.81	\$2,567,649
Salvage Value	-\$5,677,563	25% of Reconstruct	60	2.44	-\$2,323,804
Total Cost					Total NPV \$26,412,350
PCCP PULVERIZED BASE					
Initial Construction	\$25,426,661		0	1	\$25,426,661
Maintenance #1	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	20	1.35	\$3,458,251
Maintenance #2	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	40	1.81	\$2,567,649
Salvage Value	-\$6,356,665	25% of Reconstruct	60	2.44	-\$2,601,757
Total Cost					Total NPV \$28,850,804
PCCP RECONSTRUCT (BASELINE)					
Initial Construction	\$30,127,662	#REF!	0	1	\$30,127,662
Maintenance #1	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	20	1.35	\$3,458,251
Maintenance #2	\$4,657,763	Diamond Grid/Joint Seal/Slab Replacement	40	1.81	\$2,567,649
Salvage Value	-\$7,531,915	25% of Reconstruct	60	2.44	-\$3,082,783
Total Cost					Total NPV \$33,070,779
PMS					
Initial Construction	\$5,774,675	0.20" MILL/FILL	0	1	\$5,774,675
Maintenance #1	\$977,896	Chip Seal	3	1.05	\$935,179
Maintenance #2	\$977,896	Chip Seal	6	1.09	\$894,327
Maintenance #3	\$11,549,350	0.40" MILL/FILL	9	1.14	\$10,100,972
Maintenance #4	\$977,896	Chip Seal	12	1.20	\$817,300
Maintenance #5	\$977,896	Chip Seal	15	1.25	\$782,173
Maintenance #6	\$20,618,368	RECONSTRUCT	18	1.31	\$15,771,229
Maintenance #7	\$977,896	Chip Seal	21	1.37	\$715,329
Maintenance #8	\$977,896	Chip Seal	24	1.43	\$684,081
Maintenance #9	\$5,774,675	0.20" MILL/FILL	27	1.49	\$3,863,175
Maintenance #10	\$977,896	Chip Seal	30	1.56	\$625,621
Maintenance #11	\$977,896	Chip Seal	33	1.63	\$539,232
Maintenance #12	\$11,549,350	0.40" MILL/FILL	36	1.71	\$6,751,409
Maintenance #13	\$977,896	Chip Seal	39	1.79	\$547,163
Maintenance #14	\$977,896	Chip Seal	42	1.87	\$523,262
Maintenance #15	\$20,618,368	RECONSTRUCT	45	1.95	\$10,550,727
Maintenance #16	\$977,896	Chip Seal	48	2.04	\$478,545
Maintenance #17	\$977,896	Chip Seal	51	2.14	\$457,641
Maintenance #18	\$5,774,675	0.20" MILL/FILL	54	2.23	\$2,584,409
Maintenance #19	\$977,896	Chip Seal	57	2.34	\$418,532
Salvage Value	-\$5,154,532	25% of Reconstruct	60	2.44	-\$2,109,754
Total Cost					Total NPV \$61,770,883



Reconstruction - Where is the Money at??

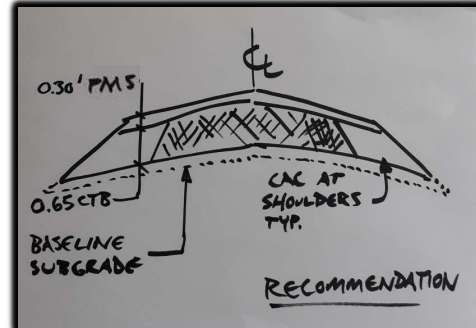
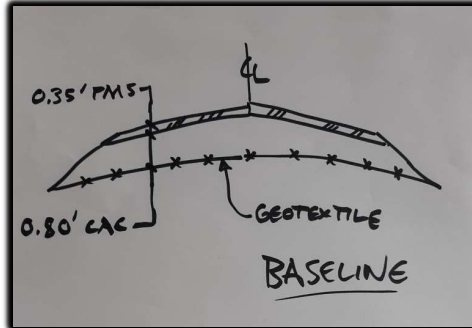
- Surfacing (Hot mix, Gravel ~ 1/2 total project cost)
- Excavation
- Structures



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Lincoln Road W. Green Meadow



- Low Volume, rural, secondary road (500,000 CY of waste excavation)
- Reduce PMS Thickness to 0.30' FT (from 0.35')
- Use CTB instead of CAC
 - Eliminates the need to geotextile
 - Thinner Typical Reduces Excavation, reduces subgrade width (ROW, Pipe length, etc)
 - CTB provides a robust base for thinner Plant mix section



Lincoln Road W. Green Meadow

Lincoln Road West of Green Meadow Surfacing Alternatives		Option 1 0.35' PMS over CAC	Option 2 0.30' PMS over CAC	Option 3 CCPR	Option 4 CCPR CTB	Option 5 CTB
PMS Thickness	FT	0.35	0.30	0.20	0.20	0.30
CCPR Thickness	FT	-	-	0.20	0.20	-
CAC Thickness	FT	0.80	1.00	0.80	-	-
CTB Thickness	FT	-	-	-	0.56	0.65
Total Surfacing Thickness	FT	1.15	1.30	1.20	0.96	0.95

Item	Unit	Source	Unit \$	Note
PMS Unit \$	\$/TON	Estimate	66.13	
CCPR Unit \$	\$/CY		68.61	
CCPR Unit \$	\$/TON	1/2 of PMS	35.60	ave prices
CAC Unit \$	\$/CY	Estimate	19.03	27.41
CTB Unit \$	\$/CY	158% of CAC	30.00	40.09
Stabilization Geotextile Unit \$	\$/SY	Ave. Prices	0.98	
MILLING UNIT \$	\$/SY	0	1.74	
UNCLASSIFIED EX. UNIT \$	\$/CY	Estimate	4.25	
ROW Unit Cost	\$/ACRE		2000	





Lincoln Road W. Green Meadow

Lincoln Road West of Green Meadow Surfacing Alternatives		Option 1 0.35' PMS over CAC	Option 2 0.30' PMS over CAC	Option 3 CCPR	Option 4 CCPR CTB	Option 5 CTB
PMS Cost	\$	2,078,800	1,767,798	1,159,825	1,159,825	1,767,798
CCPR Cost	\$	-	-	664,639	664,639	-
CAC Cost	\$	837,904	1,061,345	849,076	229,399	254,921
CTB Cost	\$	-	-	-	545,745	635,601
Stabilization Geotextile Cost	\$	179,073	185,545	181,230	-	-
Milling Cost	\$	-	-	153,227	153,227	-
Unclassified Ex. Cost	\$	-	39,531	28,148	(89,227)	(50,525)
ROW Savings	\$	-	2,729	910	(3,457)	(3,639)
"Option Total"	\$	3,095,776	3,056,949	3,037,055	2,660,152	2,604,156
Cost Savings	\$	-	38,828	58,722	435,624	491,620
% More than least Expensive Option	%	0%	1%	2%	14%	16%

Project Baseline Cost ~\$10,000,000
Potential Cost Savings: ~\$492,000



Alternate Pavement Sections

- Competition can drive cost down (~5%)
- Reconstruction
 - Rigid (Concrete) vs. Flexible Pavement (Hot Mix)
 - Plant Mix Base vs. Cold Central Plant Recycling
- Pavement Preservation Surfacing treatments
 - Mill / Fill vs. Hot in-place vs. Cold In-Place Recycling
 - Chip Seal vs. Microsurfacing
 - Hot In-Place Recycling vs. Cold In-Place Recycling vs. High Rap Plant Mix





Alternate Pavement Sections

WOLF CREEK N+5 **PAVEMENT COST**



ALTERNATE 1

0.50' PMS @ \$60/TON.....\$5.9 MILLION
1.50' CAC @ \$18/CY.....\$ 3.2 MILLION
2.00' TOTAL.....\$9.1 MILLION

ALTERNATE 2

0.30' PMS @ \$60/TON...\$3.5 MILLION
0.30' CCPR @ \$30/TON....\$1.8 MILLION
1.40' CAC @ \$18/CY.....\$3.0 MILLION
2.00' TOTAL.....\$8.3 MILLION

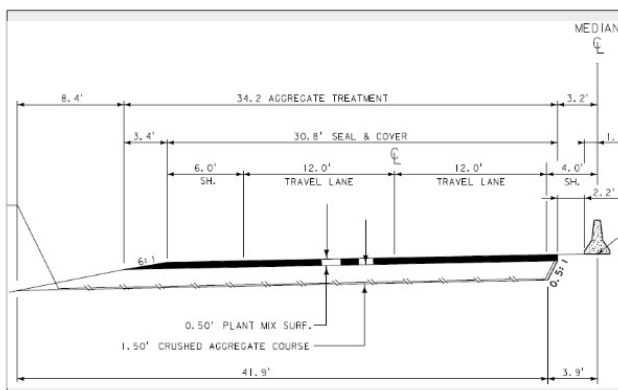
SAVINGS = \$800,000 (EQUIVALENT TO A 24' X 3.8 MILE OVERLAY @ \$15/SY)



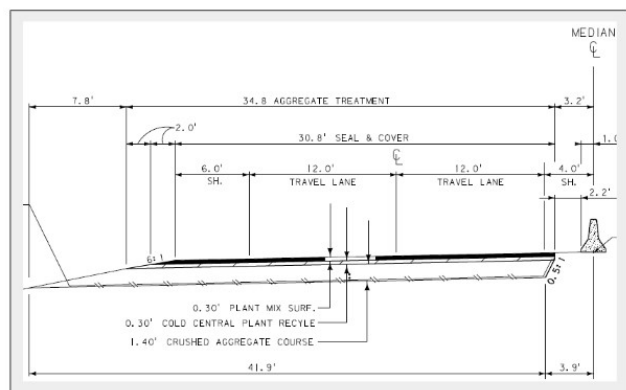
Alternate Pavement Sections

- Equal Surfacing depths = 1 Design, 1 Mass Diagram,
- Bid alternate surfacing sections

PMS - CAC



PMS - CCPR - CAC





Questions???



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