



# Calculator Resource Guide

Provided by PPRA

# Contents

1. **Strength & Cost** - Compare cross sections
2. **Life Cycle Cost** - How much does a road cost over time?
3. **Remaining Service Life** - Are you adding or losing life?
4. **Cost-Benefit Value** - Which projects have the best bang for buck?

# Strength & Cost Calculator

Compare two cross sections to understand cost and structural value.

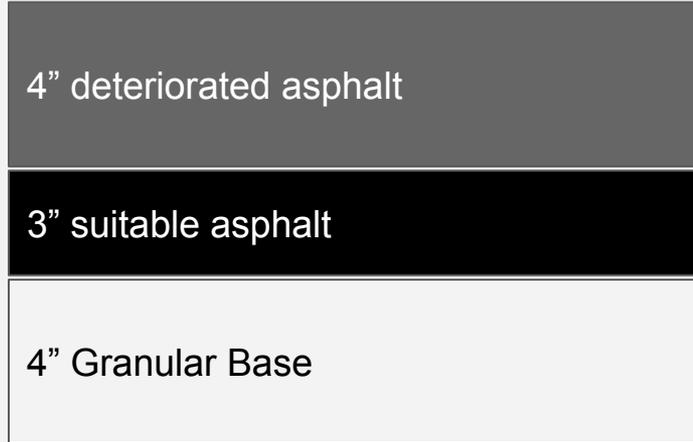
## Scenario

Due to the original construction, a township in Michigan was dealing with excessive cracking in one neighborhood.

The community found themselves in a position where 4-inch mill and fill was required every 10 years to keep the roads drivable.

After a while, they began to wonder: could there be a better way to maintain these roads, makes better use of resources AND delivers more structural strength?

## Existing Pavement Cross Section



Proposed solution: 4" Mill & Fill

# Conventional Solution

## 4" Mill & Fill


 yd Export

Layer Type	Depth (in)	Coefficient ?	Unit Cost ?		SN ?
Remove Existing /	4	0.00	0.65	/SY/in	0.00
Hot Mix Asphalt	4	0.44	4.65	/SY/in	1.76
Existing HMA	3	0.20	0.00	/SY/in	0.60
Existing Granular	4	0.10	0.00	/SY/in	0.40

ADD ROW

Overall Structural Number: ? **2.76**

161,000 SY x **\$21.20** /SY = **\$3,413,200** total

# Alternate Solution #1

4" CIR with 2" HMA

Layer Type	Depth (in)	Coefficient	Unit Cost		SN
Hot Mix Asphalt	2	0.44	4.65	/SY/in	0.88
Cold In-Place Rec	4	0.36	1.90	/SY/in	1.44
Existing HMA	3	0.20	0.00	/SY/in	0.60
Existing Granular	4	0.10	0.00	/SY/in	0.40

ADD ROW

Overall Structural Number: **3.32**

161,000 SY x **\$16.90** /SY = **\$2,720,900** total

# Alternate Solution #2

8" FDR with 2" HMA

Layer Type	Depth (in)	Coefficient	Unit Cost		SN
Hot Mix Asphalt	2	0.44	4.65	/SY/in	0.88
Bituminous FDR	8	0.30	1.23	/SY/in	2.40
Existing Granular	3	0.10	0.00	/SY/in	0.30
Select...	0.00	0.00	0.00	/SY/in	0.00

ADD ROW

Overall Structural Number: **3.58**

161,000 SY x **\$19.14** /SY = **\$3,081,540** total

# Compare Results

## 4" Mill & Fill

Layer Type	Depth (in)	Coefficient	Unit Cost	SN
Remove Existing /	4	0.00	0.65 /SY/in	0.00
Hot Mix Asphalt	4	0.44	4.65 /SY/in	1.76
Existing HMA	3	0.20	0.00 /SY/in	0.60
Existing Granular	4	0.10	0.00 /SY/in	0.40

ADD ROW

Overall Structural Number: **2.76**  
 161,000 SY x **\$21.20** /SY = **\$3,413,200** total

## 4" CIR with 2" HMA

Layer Type	Depth (in)	Coefficient	Unit Cost	SN
Hot Mix Asphalt	2	0.44	4.65 /SY/in	0.88
Cold In-Place Rec	4	0.36	1.90 /SY/in	1.44
Existing HMA	3	0.20	0.00 /SY/in	0.60
Existing Granular	4	0.10	0.00 /SY/in	0.40

ADD ROW

Overall Structural Number: **3.32**  
 161,000 SY x **\$16.90** /SY = **\$2,720,900** total

## 8" FDR with 2" HMA

Layer Type	Depth (in)	Coefficient	Unit Cost	SN
Hot Mix Asphalt	2	0.44	4.65 /SY/in	0.88
Bituminous FDR	8	0.30	1.23 /SY/in	2.40
Existing Granular	3	0.10	0.00 /SY/in	0.30
Select...	0.00	0.00	0.00 /SY/in	0.00

ADD ROW

Overall Structural Number: **3.58**  
 161,000 SY x **\$19.14** /SY = **\$3,081,540** total

# Life Cycle Cost Calculator

What combination of treatments, overtime, will maximize a road's service life and stretch my budgets furthest?

## Scenario

My agency has been managing roads reactively for many years. It's gotten to the point where our roads are deteriorating faster than our budgets can keep up.

I'm curious: Is there a better way to maintain a road over time?

I'll start by comparing the past management strategy to alternative approaches.

# Past Management Strategy

## “How to maintain a road over 40 years”

Inflation/CPI

%

Interest Rate

%

Total Paved Area

SY


 yd Export

### CONVENTIONAL PLAN

Year ?	Treatment Type	Cost in Constant Dollars ?	Future Cost ?	Present Value ?
0	▼ Major Mill & Fill	16.64	16.64	16.64
10	▼ Major Mill & Fill	16.64	27.10	21.17
20	▼ Major Mill & Fill	16.64	44.15	26.94
30	▼ Major Mill & Fill	16.64	71.92	34.29
40	▼ Major Mill & Fill	16.64	117.15	43.63
<b>ADD ROW</b>		<b>\$83.20</b>	<b>\$276.96</b>	<b>\$142.67</b>

Net Present Value: **\$142.67 / SY**  
 Total Life Cycle Cost: **\$1,854,710**

## Trial & Error

Ouch! What if I compared alternate strategies, while prioritizing the following?

- ◇ Maximizing the time-value of money by spending cash earlier in time
- ◇ Managing pavement preventively, to avoid greater costs in the future
- ◇ Recycling and reusing existing materials to save more and leverage resources across my network

# New Management Strategy

## “How to maintain a road over 40 years”

Year ?	Treatment Type	Cost in Constant Dollars ?	Future Cost ?	Present Value ?
0	Full Depth Reclamation + 4"	28.54	28.54	28.54
3	Rejuvenating Fog Seal	0.67	0.78	0.72
8	Crack Seal	0.48	0.71	0.58
12	Micro Surfacing- Double Lift	3.92	7.04	5.23
17	Crack Seal	0.48	1.10	0.72
17	Fog Seal	0.57	1.31	0.86
22	Cape Seal	5.20	15.21	8.84
27	Crack Seal	0.48	1.79	0.92
30	Cold Recycling + 1.5" HMA	13.98	60.42	28.81
32	Rejuvenating Fog Seal	0.67	3.19	1.45
37	Crack Seal	0.48	2.92	1.17
40	Micro Surfacing- Double Lift	3.92	27.60	10.28
ADD ROW		\$59.39	\$150.61	\$88.12

Net Present Value: **\$88.12 / SY**  
 Total Life Cycle Cost: **\$1,145,560**

## Side-by-Side Comparison

### Past Strategy

Net Present Value: **\$142.67 / SY**

Total Life Cycle Cost: **\$1,854,710**

### New Strategy

Net Present Value: **\$80.66 / SY**

Total Life Cycle Cost: **\$1,048,580**

By choosing an optimized treatment strategy...

OPTIMIZED STRATEGY  
TOTAL SAVINGS

**\$806,130**

Note: Logistics & prices vary greatly by region and project. Contact a contractor/supplier near you for a precise estimate.

# Remaining Service Life Calculator

Is your treatment plan adding or losing life for your network?

## Scenario

I'm the road manager of a small 200 mile community. Our budgets are limited each year, and this year, we have \$950,000 to spend on roadway maintenance and repair.

I'm curious: If we approach this year with the same planning strategies as years prior, will it positively impact our network?

To test this theory, I'll input the "proposed" approach and see where it takes me.

# The “Proposed Approach”

Total Network Lane-Miles Average Lane Width (ft) Total Budget Remaining Budget

200 12 \$ 950000 \$1,430

Treatment Type	Category	Life Extension	Lane-Miles* Treated	Lane-Mile-Years	Unit Cost	Total Cost
Full Depth Remove & Replace	Reconstruction	25.0	2	50	39.01	\$549,261
Major Mill & Fill	Rehabilitation	15.0	2	30	16.64	\$234,291
Minor Mill & Fill	Rehabilitation	11.0	2	22	9.80	\$137,984
Crack Seal	Preservation	3.0	8	24	0.48	\$27,034
Select...				0		\$0
Select...				0		\$0
Select...				0		\$0
Select...				0		\$0

ADD ROW

Total Lane-Miles Treated: **14**

Total Lane-Mile-Years: **126**

Total Cost: **\$948,570**

# The Proposed Approach: Outcome

## Total Network Impact

Preservation  
**\$27,034**

8 Lane-Miles  
24 Lane-Mile-Years

Rehabilitation  
**\$372,275**

4 Lane-Miles  
52 Lane-Mile-Years

Reconstruction  
**\$549,261**

2 Lane-Miles  
50 Lane-Mile-Years

Ouch!

YOU ONLY ADDED  
126 LANE-MILE-YEARS OF LIFE

74  
LANE-MILE-YEAR  
NET LOSS

7%  
OF ROADS ADDRESSED

## But, what if we used the same budget, on the same network differently?

Understanding the principles of pavement management, I'm going to test a few theories. What happens if I:

- ◇ Reuse and recycle existing materials where appropriate
- ◇ Preserve pavement where possible to avoid greater costs in the future
- ◇ Attempt to address more of my network with each annual plan

# The “New” Approach

Total Network Lane-Miles

200

Average Lane Width (ft)

12

Total Budget

\$ 950000

Remaining Budget

\$1,430


 yd [Export](#)

Treatment Type	Category	Life Extension 	Lane-Miles* Treated 	Lane-Mile-Years 	Unit Cost 	Total Cost
Full Depth Reclamation + 4" HMA	Reconstruction	25.0	2	50	28.54	\$401,843
Cold Recycling + Double Chip Seal	Rehabilitation	13.0	2	26	10.36	\$145,869
Cape Seal	Preservation	10.0	2	20	5.20	\$73,216
Crack Seal	Preservation	3.0	33	99	0.48	\$111,514
Chip Seal	Preservation	6.0	15	90	2.06	\$217,536
Select...				0		\$0
Select...				0		\$0
Select...				0		\$0

[ADD ROW](#)

Total Lane-Miles Treated  
**54**

Total Lane-Mile-Years  
**285**

Total Cost  
**\$949,978**

# The New Approach: Outcome

## Total Network Impact



## Congratulations



# How Does it Pay Off Over Time?

## A Tale of Two New England Municipalities



### Network Size:

- 288 total miles

### Network Gains / Deficit:

2013:	27 mile deficit
2014:	37 mile deficit
2015:	44 mile deficit
2016:	30 mile surplus

# Cost Benefit Value Calculator

Which projects will give you the “best bang for the buck?”

## Scenario

I'm a road manager with A LOT on my "to-do list."

With so many road projects that *could* get attention and resources next year, I'm interested in knowing which *should* get addressed with limited budgets.

Cost Benefit Value evaluates:

- ◇ What is the treatment cost?
- ◇ How much life will be added to my road?
- ◇ How many people will benefit from this fix?
- ◇ How much will the road condition be improved?

... as compared with the other projects on my list.

... and within my budget for the year.

# Input: All Projects on Your To Do List

All lanes 12ft wide, 2 lane roads

<b>network size</b>	100 miles		<b>Budget</b> 229,000	
Street name	PCI	AADT	LENGTH (1km)	TREATMENT
1	72	6500	3281	micro- double lift
2	43	7000	3281	FDR + 4"HMA
3	64	7500	3281	minor m & f
4	62	3000	3281	minor m & f
5	86	8500	3281	crack seal
6	47	1500	3281	Full depth remove
7	84	5500	3281	crack seal
8	68	3500	3281	chip seal

# Input: All Projects on Your To Do List

Total Network Lane-Miles ?

100

AADT Constraint ?

7

Total Budget

\$ 229000



Road Segment	PCI	Length (ft)	Treatment	Life Extension <span>?</span>	Unit Cost <span>?</span>	Segment Cost	Cumulative Cost	CBV
1	72	3281	Micro Surfacing- Double Lift	8.0	3.92	\$17,149	\$17,149	26.32
2	43	3281	Full Depth Reclamation + 4" HMA	25.0	28.54	\$124,853	\$142,002	20.37
3	64	3281	Minor Mill & Fill	11.0	9.80	\$42,872	\$184,873	18.79
4	62	3281	Minor Mill & Fill	11.0	9.80	\$42,872	\$227,745	7.76
5	86	3281	Crack Seal	3.0	0.48	\$2,100	\$229,845	88.25
6	47	3281	Full Depth Remove & Replace	25.0	39.01	\$170,656	\$400,501	2.92
7	84	3281	Crack Seal	3.0	0.48	\$2,100	\$402,601	58.46
8	68	3281	Cold Recycling + Double Chip Seal	13.0	10.36	\$45,322	\$447,922	9.23
<input type="button" value="ENTER ROAD SEGMENT"/>		<input type="text"/>	Select...	<input type="text"/>	<input type="text"/>	\$0	\$447,922	0.00

Network Lane Miles Addressed: 4%

Budget Line

# If Addressed Worst-First

Total Network Lane-Miles ?

100

AADT Constraint ?

7

Total Budget

\$ 200000


yd Export

Road Segment	PCI	Length (ft)	Treatment	Life Extension <span>?</span>	Unit Cost <span>?</span>	Segment Cost	Cumulative Cost	CBV
2	43	3281	Full Depth Reclamation + 4" HMA	25.0	28.54	\$124,853	\$124,853	20.37
6	47	3281	Full Depth Remove & Replace	25.0	39.01	\$170,656	\$295,509	2.92
4	62	3281	Minor Mill & Fill	11.0	9.80	\$42,872	\$338,380	7.76 *
3	64	3281	Minor Mill & Fill	11.0	9.80	\$42,872	\$381,252	18.79 *
8	70	3281	Chip Seal	6.0	2.06	\$9,012	\$390,264	20.80 *
1	72	3281	Micro Surfacing- Double Lift	8.0	3.92	\$17,149	\$407,413	26.32 *
7	84	3281	Crack Seal	3.0	0.48	\$2,100	\$409,513	58.46 *
5	86	3281	Crack Seal	3.0	0.48	\$2,100	\$411,612	88.25 *
<input type="text" value="ENTER ROAD SEGMENT"/>			Select...			\$0	\$411,612	0.00

Network Lane Miles Addressed: 1%

# If Addressed Based on CBV Score

Total Network Lane-Miles ?

100

AADT Constraint ?

7

Total Budget

\$ 200000

 yd <span>Export</span>		Road Segment	PCI	Length (ft)	Treatment	Life Extension <span>?</span>	Unit Cost <span>?</span>	Segment Cost	Cumulative Cost	CBV
5	86	3281	▼	Crack Seal	3.0	0.48	\$2,100	\$2,100	88.25	
7	84	3281	▼	Crack Seal	3.0	0.48	\$2,100	\$4,200	58.46	
1	72	3281	▼	Micro Surfacing- Double Lift	8.0	3.92	\$17,149	\$21,348	26.32	
8	68	3281	▼	Chip Seal	6.0	2.06	\$9,012	\$30,360	21.42	
2	43	3281	▼	Full Depth Reclamation + 4" HMA	25.0	28.54	\$124,853	\$155,213	20.37	
3	63	3281	▼	Minor Mill & Fill	11.0	9.80	\$42,872	\$198,085	19.09	
4	62	3281	▼	Minor Mill & Fill	11.0	9.80	\$42,872	\$240,957	7.76	
6	47	3281	▼	Full Depth Reclamation + 4" HMA	25.0	28.54	\$124,853	\$365,810	3.99	
<input type="text" value="ENTER ROAD SEGMENT"/>			▼	Select...			\$0	\$365,810	0.00	
<input type="button" value="ADD ROW"/>		Network Lane Miles Addressed: 7%								

Budget Line

# Questions?

Attend the next Roadvocate Training for an in-depth breakdown of the calculator tools and concepts found on [roadresource.org](http://roadresource.org)

[Learn More / Register](#)