MECHANISTIC-EMPIRICAL MODELING AND DESIGN MODEL DEVELOPMENT OF GEOSYNTHETIC REINFORCED FLEXIBLE PAVEMENTS:

APPENDIX C - DARWin OUTPUT

FHWA/MT-01-002/99160-1B

Final Report

prepared for
THE STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION

in cooperation with
THE U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
and the
Idaho, Kansas, Minnesota, New York, Texas, Wisconsin
and Wyoming Departments of Transportation and the
Western Transportation Institute at Montana State University

November 2001

prepared by
Dr. Steven W. Perkins
Montana State University

RESEARCH PROGRAM

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Prepared for the
STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION
RESEARCH, DEVELOPMENT AND TECHNOLOGY TRANSFER PROGRAM
in cooperation with the
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
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and the
Western Transportation Institute at Montana State University

October 1, 2001

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APPENDIX C: DARWin OUTPUT

Summary of Files Printout:

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Life Cycle Cost Analysis: Example 1, Option 1
Life Cycle Cost Analysis: Example 1, Option 2
Life Cycle Cost Analysis: Example 1, Option 3
Life Cycle Cost Analysis: Example 1, Option 4
Life Cycle Cost Analysis: Example 1, Option 5
Life Cycle Cost Analysis: Example 1, Option 6
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Life Cycle Cost Analysis: Example 1, Option 9

Flexible Structural Design: Example 2, Option 1
Flexible Structural Design: Example 2, Option 2

Life Cycle Cost Analysis: Example 2, Option 1
Life Cycle Cost Analysis: Example 2, Option 2
Life Cycle Cost Analysis: Example 2, Option 3
Life Cycle Cost Analysis: Example 2, Option 4

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Flexible Structural Design Module

Example 1

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	35,000
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	15,500 kPa
Stage Construction	1
Calculated Design Structural Number	80 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt Concrete - New	0.4	1	85	4	34
2	Base Course Aggregate	0.14	1	325	5	46
Total	-	-	-	410	-	80

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Life Cycle Cost Module

Example 1, Option 1: Unreinforced

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 204,954
Rehabilitation Cost	$ 64,255
Salvage Value	$ 0
Total Cost	$ 269,210

Initial Construction

New Construction

Construction Year	2000
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,022,313.10	$ 204,462.62
Maintenance	DARWin Calculated	$ 2,459.13	$ 491.83
Total	-	$ 1,024,772.23	$ 204,954.45

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2010
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 28,706.67
Maintenance	DARWin Calculated	$ 2,459.13	$ 348.66
Total	-	$ 204,927.13	$ 29,055.34

Rehabilitation #2

Second Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 2,459.13	$ 247.17
Total	-	$ 204,927.13	$ 20,597.88

Rehabilitation #3

Third Rehabilitation - Milling and AC replacement

Rehabilitation Year	2030
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 14,427.00
Maintenance	DARWin Calculated	$ 2,459.13	$ 175.23
Total	-	$ 204,927.13	$ 14,602.22

Salvage Values

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	33,296	$ 732,517.50

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,022,313.10
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,022,313.10

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	325

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Life Cycle Cost Module

Example 1, Option 2: Reinforced Geogrid A, TBR=4, BCR=0

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 221,641
Rehabilitation Cost	$ 0
Salvage Value	$ 0
Total Cost	$ 221,641

Initial Construction

New Construction

Construction Year	2000
Performance Period	40 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,097,313.10	$ 219,462.62
Maintenance	DARWin Calculated	$ 10,893.39	$ 2,178.68
Total	-	$ 1,108,206.49	$ 221,641.30

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 10,893.39

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	33,296	$ 732,517.50
Geogrid A	T.L.	2	sq m	$ 1.50	50,000	$ 75,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,097,313.10
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,097,313.10

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	325

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

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Life Cycle Cost Module

Example 1, Option 3: Reinforced Geogrid A, TBR=2, BCR=15.5%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 198,178
Rehabilitation Cost	$ 20,981
Salvage Value	$ 0
Total Cost	$ 219,159

Initial Construction

New Construction

Construction Year	2000
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 984,618.10	$ 196,923.62
Maintenance	DARWin Calculated	$ 6,272.97	$ 1,254.59
Total	-	$ 990,891.07	$ 198,178.21

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 6,272.97	$ 630.52
Total	-	$ 208,740.97	$ 20,981.22

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	28,174	$ 619,822.50
Geogrid A	T.L.	2	sq m	$ 1.50	50,000	$ 75,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 984,618.10
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 984,618.10

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	275

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50
Milling Thickness		0 mm	

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Life Cycle Cost Module

Example 1, Option 4: Reinforced Geogrid A, TBR=1, BCR=29.7%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 176,229
Rehabilitation Cost	$ 64,255
Salvage Value	$ 0
Total Cost	$ 240,484

Initial Construction

New Construction

Construction Year	2000
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 878,684.80	$ 175,736.96
Maintenance	DARWin Calculated	$ 2,459.13	$ 491.83
Total	-	$ 881,143.93	$ 176,228.79

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2010
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 28,706.67
Maintenance	DARWin Calculated	$ 2,459.13	$ 348.66
Total	-	$ 204,927.13	$ 29,055.34

Rehabilitation #2

Second Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 2,459.13	$ 247.17
Total	-	$ 204,927.13	$ 20,597.88

Rehabilitation #3

Third Rehabilitation - Milling and AC replacement

Rehabilitation Year	2030
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 14,427.00
Maintenance	DARWin Calculated	$ 2,459.13	$ 175.23
Total	-	$ 204,927.13	$ 14,602.22

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	23,359	$ 513,889.20
Geogrid A	T.L.	2	sq m	$ 1.50	50,000	$ 75,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 878,684.80
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 878,684.80

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	228

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Life Cycle Cost Module

Example 1, Option 5: Reinforced Geogrid B, TBR=4, BCR=5.7%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 228,076
Rehabilitation Cost	$ 0
Salvage Value	$ 0
Total Cost	$ 228,076

Initial Construction

New Construction

Construction Year	2000
Performance Period	40 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,129,489.00	$ 225,897.80
Maintenance	DARWin Calculated	$ 10,893.39	$ 2,178.68
Total	-	$ 1,140,382.39	$ 228,076.48

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 10,893.39

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	31,350	$ 689,693.40
Geogrid B	T.L.	2	sq m	$ 3.00	50,000	$ 150,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,129,489.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,129,489.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	306

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

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Life Cycle Cost Module

Example 1, Option 6: Reinforced Geogrid B, TBR=2, BCR=20.3%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 205,966
Rehabilitation Cost	$ 20,981
Salvage Value	$ 0
Total Cost	$ 226,947

Initial Construction

New Construction

Construction Year	2000
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,023,555.70	$ 204,711.14
Maintenance	DARWin Calculated	$ 6,272.97	$ 1,254.59
Total	-	$ 1,029,828.67	$ 205,965.73

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 6,272.97	$ 630.52
Total	-	$ 208,740.97	$ 20,981.22

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	26,535	$ 583,760.10
Geogrid B	T.L.	2	sq m	$ 3.00	50,000	$ 150,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,023,555.70
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,023,555.70

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	259

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

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Life Cycle Cost Module

Example 1, Option 7: Reinforced Geogrid B, TBR=1, BCR=33.7%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 185,369
Rehabilitation Cost	$ 64,255
Salvage Value	$ 0
Total Cost	$ 249,624

Initial Construction

New Construction

Construction Year	2000
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 924,384.10	$ 184,876.82
Maintenance	DARWin Calculated	$ 2,459.13	$ 491.83
Total	-	$ 926,843.23	$ 185,368.65

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2010
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 28,706.67
Maintenance	DARWin Calculated	$ 2,459.13	$ 348.66
Total	-	$ 204,927.13	$ 29,055.34

Rehabilitation #2

Second Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 2,459.13	$ 247.17
Total	-	$ 204,927.13	$ 20,597.88

Rehabilitation #3

Third Rehabilitation - Milling and AC replacement

Rehabilitation Year	2030
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 14,427.00
Maintenance	DARWin Calculated	$ 2,459.13	$ 175.23
Total	-	$ 204,927.13	$ 14,602.22

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	22,027	$ 484,588.50
Geogrid B	T.L.	2	sq m	$ 3.00	50,000	$ 150,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 924,384.10
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 924,384.10

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	215

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Life Cycle Cost Module

Example 1, Option 8: Reinforced Geotextile, TBR=2, BCR=0

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 213,217
Rehabilitation Cost	$ 20,981
Salvage Value	$ 0
Total Cost	$ 234,198

Initial Construction

New Construction

Construction Year	2000
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,059,813.10	$ 211,962.62
Maintenance	DARWin Calculated	$ 6,272.97	$ 1,254.59
Total	-	$ 1,066,086.07	$ 213,217.21

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	20 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 6,272.97	$ 630.52
Total	-	$ 208,740.97	$ 20,981.22

Salvage Values

Salvage Year	2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 6,272.97

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	33,296	$ 732,517.50
Geotextile	T.L.	2	sq m	$ 0.75	50,000	$ 37,500.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,059,813.10
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,059,813.10

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	325

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

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Life Cycle Cost Module

Example 1, Option 9: Reinforced Geotextile, TBR=1, BCR=16.6%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	10 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 188,112
Rehabilitation Cost	$ 64,255
Salvage Value	$ 0
Total Cost	$ 252,368

Initial Construction

New Construction

Construction Year	2000
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 938,102.50	$ 187,620.50
Maintenance	DARWin Calculated	$ 2,459.13	$ 491.83
Total	-	$ 940,561.63	$ 188,112.33

Rehabilitation #1

First Rehabilitation - Milling and AC replacement

Rehabilitation Year	2010
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 28,706.67
Maintenance	DARWin Calculated	$ 2,459.13	$ 348.66
Total	-	$ 204,927.13	$ 29,055.34

Rehabilitation #2

Second Rehabilitation - Milling and AC replacement

Rehabilitation Year	2020
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 20,350.70
Maintenance	DARWin Calculated	$ 2,459.13	$ 247.17
Total	-	$ 204,927.13	$ 20,597.88

Rehabilitation #3

Third Rehabilitation - Milling and AC replacement

Rehabilitation Year	2030
Performance Period	10 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 202,468.00	$ 14,427.00
Maintenance	DARWin Calculated	$ 2,459.13	$ 175.23
Total	-	$ 204,927.13	$ 14,602.22

Salvage Values

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 62.50 per lane km
Annual Increase in Maintenance Costs	0 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 2,459.13

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	7,626	$ 289,795.60
Base Course Aggregate	T.L.	2	metric ton	$ 22.00	27,764	$ 610,806.90
Geotextile	T.L.	2	sq m	$ 0.75	50,000	$ 37,500.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 938,102.50
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 938,102.50

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 38.00	4,486	$ 170,468.00
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	40,000	$ 32,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 202,468.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 202,468.00

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	4	85
2	Base Course Aggregate	5	271

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4	50

Milling Thickness 0 mm

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Flexible Structural Design Module

Example 2, Option 1: Unreinforced Crushed Base

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	165,549
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.35
Roadbed Soil Resilient Modulus	31,005 kPa
Stage Construction	1
Calculated Design Structural Number	76 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt Concrete - CB Option	0.33	1	90	5.095	30
2	Base Course Aggregate	0.095	1	486	7.768	46
Total	-	-	-	576	-	76

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

Example 2, Option 2: Unreinforced Cement Treated Base

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	165,549
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.35
Roadbed Soil Resilient Modulus	31,005 kPa
Stage Construction	1
Calculated Design Structural Number	76 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	Asphalt Concrete - CTB Option	0.33	1	90	-	30
2	Cement Treated Base	0.18	1	257	-	46
Total	-	-	-	347	-	76

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Life Cycle Cost Module

Example 2, Option 1: Unreinforced Crushed Base

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	17.5 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 249,579
Rehabilitation Cost	$ 196,571
Salvage Value	$ 0
Total Cost	$ 446,151

Initial Construction

Initial Construction

Construction Year	2000
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 2,183,819.92	$ 249,579.42
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 2,183,819.92	$ 249,579.42

Rehabilitation #1

First Rehabilitation - Crack and Chip Sealing

Rehabilitation Year	2005
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 141,972.25	$ 13,661.35
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 141,972.25	$ 13,661.35

Rehabilitation #2

Second Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2010
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 667,265.28	$ 54,061.36
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 667,265.28	$ 54,061.36

Rehabilitation #3

Third Rehabilitation - Crack and chip sealing

Rehabilitation Year	2015
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 141,972.25	$ 9,684.79
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 141,972.25	$ 9,684.79

Rehabilitation #4

Fourth Rehabilitation - Asphalt concrete removal, reconstruction and chip seal

Rehabilitation Year	2020
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,505,373.50	$ 86,462.78
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 1,505,373.50	$ 86,462.78

Rehabilitation #5

Fifth Rehabilitation - Crack and chip sealing

Rehabilitation Year	2025
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 5,974.84
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 5,974.84

Rehabilitation #6

Sixth Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2030
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 22,490.41
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 22,490.41

Rehabilitation #7

Seventh Rehabilitation - Crack and chip sealing

Rehabilitation Year	2035
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 4,235.67
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 4,235.67

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #4	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #5	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #6	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #7	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2000
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2010
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #4 Maintenance Costs

Year Maintenance Costs Begin	2020
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #5 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #6 Maintenance Costs

Year Maintenance Costs Begin	2030
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #7 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	97,248	$ 106,972.25
Asphalt Concrete - New	T.L.	2	metric ton	$ 28.00	21,380	$ 598,641.45
Base Course Aggregate	T.L.	3	metric ton	$ 9.20	160,675	$ 1,478,206.22

Non Discounted Costs (One Direction)

Traffic Lane	$ 2,183,819.92
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00

Total Non Discounted Cost (One Direction) $ 2,183,819.92

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	97,248	$ 106,972.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 141,972.25
Inner Shoulder	$ 0.00

Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 141,972.25

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	97,248	$ 77,798.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	17,232	$ 482,495.03
Chip Seal	T.L.	1	sq m	$ 1.10	97,248	$ 106,972.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 667,265.28
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 667,265.28

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	97,248	$ 106,972.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 141,972.25
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 141,972.25

Rehabilitation #4 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 28.00	38,723	$ 1,084,243.00
Chip Seal	T.L.	1	sq m	$ 1.10	97,536	$ 107,289.88
Asphalt Concrete Removal	T.L.	1	sq m	$ 2.50	97,536	$ 243,840.63
Traffic Control	T.L.	NA	lump sum	$ 70,000.00	1	$ 70,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,505,373.50
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,505,373.50

Rehabilitation #5 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #6 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #7 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Salvage Value Pay Items for Initial Construction

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #1

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #2

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #3

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #4

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #5

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #6

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #7

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Upper Deck	5.557	0
2	Asphalt Concrete - New	6.052	90
3	Base Course Aggregate	9.22	486

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.557	0

Milling Thickness - mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	5.557	79

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.557	0

Milling Thickness - mm

Rehabilitation #3 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	5.5735	177

Milling Thickness 0 mm

Rehabilitation #4 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #5 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #5 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #5 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79
Milling Thickness		0 mm	

Rehabilitation #6 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0
Milling Thickness		- mm	

Rehabilitation #7 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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Life Cycle Cost Module

Example 2, Option 2: Unreinforced Cement Treated Base

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	17.5 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 205,607
Rehabilitation Cost	$ 178,526
Salvage Value	$ 0
Total Cost	$ 384,133

Initial Construction

Initial Construction

Construction Year	2000
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,799,064.31	$ 205,607.35
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 1,799,064.31	$ 205,607.35

Rehabilitation #1

First Rehabilitation - Crack and Chip Sealing

Rehabilitation Year	2005
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 135,196.25	$ 13,009.33
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 135,196.25	$ 13,009.33

Rehabilitation #2

Second Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2010
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 624,998.34	$ 50,636.92
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 624,998.34	$ 50,636.92

Rehabilitation #3

Third Rehabilitation - Crack and chip sealing

Rehabilitation Year	2015
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 135,196.25	$ 9,222.56
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 135,196.25	$ 9,222.56

Rehabilitation #4

Fourth Rehabilitation - Asphalt concrete removal, reconstruction and chip seal

Rehabilitation Year	2020
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,270,215.90	$ 72,956.25
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 1,270,215.90	$ 72,956.25

Rehabilitation #5

Fifth Rehabilitation - Crack and chip sealing

Rehabilitation Year	2025
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 5,974.84
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 5,974.84

Rehabilitation #6

Sixth Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2030
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 22,490.41
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 22,490.41

Rehabilitation #7

Seventh Rehabilitation - Crack and chip sealing

Rehabilitation Year	2035
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 4,235.67
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 4,235.67

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #4	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #5	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #6	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #7	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2000
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2010
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #4 Maintenance Costs

Year Maintenance Costs Begin	2020
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #5 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #6 Maintenance Costs

Year Maintenance Costs Begin	2030
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #7 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	91,088	$ 100,196.25
Asphalt Concrete - New	T.L.	2	metric ton	$ 28.00	20,137	$ 563,822.91
Cement Treated Base	T.L.	3	metric ton	$ 16.20	70,065	$ 1,135,045.15

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,799,064.31
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,799,064.31

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	91,088	$ 100,196.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 135,196.25
Inner Shoulder	$ 0.00

Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 135,196.25

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	91,088	$ 72,870.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	16,140	$ 451,932.09
Chip Seal	T.L.	1	sq m	$ 1.10	91,088	$ 100,196.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 624,998.34
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 624,998.34

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	91,088	$ 100,196.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 135,196.25
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 135,196.25

Rehabilitation #4 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 28.00	30,720	$ 860,173.40
Chip Seal	T.L.	1	sq m	$ 1.10	94,456	$ 103,901.88
Asphalt Concrete Removal	T.L.	1	sq m	$ 2.50	94,456	$ 236,140.63
Traffic Control	T.L.	NA	lump sum	$ 70,000.00	1	$ 70,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,270,215.90
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,270,215.90

Rehabilitation #5 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #6 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #7 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Salvage Value Pay Items for Initial Construction

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #1

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #2

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #3

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #4

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #5

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #6

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #7

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Upper Deck	5.205	0
2	Asphalt Concrete - New	5.7	90
3	Cement Treated Base	7.603	257

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.205	0

Milling Thickness - mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	5.205	79

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.205	0

Milling Thickness - mm

Rehabilitation #3 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	5.3975	145

Milling Thickness 0 mm

Rehabilitation #4 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #5 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #5 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #5 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79
Milling Thickness		0 mm	

Rehabilitation #6 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0
Milling Thickness		- mm	

Rehabilitation #7 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Montana State University - Department of Civil Engineering
205 Cobleigh Hall
Bozeman, MT
USA

Life Cycle Cost Module

Example 2, Option 3: Reinforced Crushed Base, TBR=2, BCR=2.3%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	17.5 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 240,030
Rehabilitation Cost	$ 129,494
Salvage Value	$ 0
Total Cost	$ 369,524

Initial Construction

Initial Construction

Construction Year	2000
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 2,100,262.54	$ 240,030.00
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 2,100,262.54	$ 240,030.00

Rehabilitation #1

First Rehabilitation - Crack and Chip Sealing

Rehabilitation Year	2005
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 11,888.66
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 11,888.66

Rehabilitation #2

Second Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2010
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 44,751.17
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 44,751.17

Rehabilitation #3

Third Rehabilitation - Crack and chip sealing

Rehabilitation Year	2015
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 8,428.10
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 8,428.10

Rehabilitation #4

Fourth Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2020
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 31,724.95
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 31,724.95

Rehabilitation #5

Fifth Rehabilitation - Crack and chip sealing

Rehabilitation Year	2025
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 5,974.84
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 5,974.84

Rehabilitation #6

Sixth Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2030
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 22,490.41
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 22,490.41

Rehabilitation #7

Seventh Rehabilitation - Crack and chip sealing

Rehabilitation Year	2035
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 4,235.67
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 4,235.67

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #4	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #5	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #6	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #7	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2000
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2010
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #4 Maintenance Costs

Year Maintenance Costs Begin	2020
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #5 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #6 Maintenance Costs

Year Maintenance Costs Begin	2030
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #7 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00
Asphalt Concrete - New	T.L.	2	metric ton	$ 28.00	17,999	$ 503,978.55
Base Course Aggregate	T.L.	3	metric ton	$ 9.20	139,655	$ 1,284,827.75
Geogrid A	T.L.	2	sq m	$ 2.50	89,163	$ 222,906.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 2,100,262.54
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 2,100,262.54

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00

Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #4 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #5 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #6 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #7 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Salvage Value Pay Items for Initial Construction

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #1

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #2

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #3

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #4

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #5

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #6

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #7

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Upper Deck	4.6	0
2	Asphalt Concrete - New	5.095	90
3	Base Course Aggregate	8.2025	474.822

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #3 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79

Milling Thickness 0 mm

Rehabilitation #4 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #5 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #5 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #5 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79
Milling Thickness		0 mm	

Rehabilitation #6 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0
Milling Thickness		- mm	

Rehabilitation #7 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Montana State University - Department of Civil Engineering
205 Cobleigh Hall
Bozeman, MT
USA

Life Cycle Cost Module

Example 2, Option 4: Reinforced Crushed Base, TBR=1, BCR=18.5%

Life Cycle Cost Data

Summary

Analysis Period	40 years
Project Length	17.5 km
Discount Rate	3.5 %
Number of Lanes in One Direction	1
Type of Roadway	Undivided

Total Costs -- Using NPV on a basis of cost/kilometer for both directions

Initial Construction Cost	$ 227,406
Rehabilitation Cost	$ 174,126
Salvage Value	$ 0
Total Cost	$ 401,531

Initial Construction

Initial Construction

Construction Year	2000
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Construction (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,989,798.78	$ 227,405.57
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 1,989,798.78	$ 227,405.57

Rehabilitation #1

First Rehabilitation - Crack and Chip Sealing

Rehabilitation Year 2005
Performance Period 5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 133,502.25	$ 12,846.32
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 133,502.25	$ 12,846.32

Rehabilitation #2

Second Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year 2010
Performance Period 5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 614,431.60	$ 49,780.81
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 614,431.60	$ 49,780.81

Rehabilitation #3

Third Rehabilitation - Crack and chip sealing

Rehabilitation Year 2015
Performance Period 5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 133,502.25	$ 9,107.00
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 133,502.25	$ 9,107.00

Rehabilitation #4

Fourth Rehabilitation - Asphalt concrete removal, reconstruction and chip seal

Rehabilitation Year 2020
Performance Period 5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 1,213,360.86	$ 69,690.72
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 1,213,360.86	$ 69,690.72

Rehabilitation #5

Fifth Rehabilitation - Crack and chip sealing

Rehabilitation Year	2025
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 5,974.84
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 5,974.84

Rehabilitation #6

Sixth Rehabilitation - Asphalt concrete milling, overlay and chip seal

Rehabilitation Year	2030
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 552,352.04	$ 22,490.41
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 552,352.04	$ 22,490.41

Rehabilitation #7

Seventh Rehabilitation - Crack and chip sealing

Rehabilitation Year	2035
Performance Period	5 years

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Information Type	Source	Costs at Year of Rehabilitation (One Direction)	Net Costs
Construction	DARWin Calculated	$ 123,550.00	$ 4,235.67
Maintenance	DARWin Calculated	$ 0.00	$ 0.00
Total	-	$ 123,550.00	$ 4,235.67

Salvage Year 2040

Cost Information -- Using NPV on a basis of cost/kilometer for both directions

Phase	Description	Source	Salvage Value	Net Value
Initial Construction	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #1	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #2	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #3	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #4	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #5	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #6	-	User Entered	$ 0.00	$ 0.00
Rehabilitation #7	-	User Entered	$ 0.00	$ 0.00

Initial Construction Maintenance Costs

Year Maintenance Costs Begin	2000
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #1 Maintenance Costs

Year Maintenance Costs Begin	2005
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #2 Maintenance Costs

Year Maintenance Costs Begin	2010
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #3 Maintenance Costs

Year Maintenance Costs Begin	2015
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %
Calculated Non Discounted Maintenance Costs (One Direction)	$ 0.00

Rehabilitation #4 Maintenance Costs

Year Maintenance Costs Begin	2020
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #5 Maintenance Costs

Year Maintenance Costs Begin	2025
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #6 Maintenance Costs

Year Maintenance Costs Begin	2030
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Rehabilitation #7 Maintenance Costs

Year Maintenance Costs Begin	2035
Annual Maintenance Costs	$ 0.00 per lane km
Annual Increase in Maintenance Costs	3 %

Calculated Non Discounted Maintenance Costs (One Direction) $ 0.00

Initial Construction Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Chip Seal	T.L.	1	sq m	$ 1.10	89,548	$ 98,502.25
Asphalt Concrete - New	T.L.	2	metric ton	$ 28.00	19,826	$ 555,118.28
Base Course Aggregate	T.L.	3	metric ton	$ 9.20	118,549	$ 1,090,653.25
Geogrid A	T.L.	2	sq m	$ 2.50	98,210	$ 245,525.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,989,798.78
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00

Total Non Discounted Cost (One Direction) $ 1,989,798.78

Rehabilitation #1 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	89,548	$ 98,502.25

Non Discounted Costs (One Direction)

Traffic Lane $ 133,502.25

Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 133,502.25

Rehabilitation #2 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	89,548	$ 71,638.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	15,868	$ 444,291.35
Chip Seal	T.L.	1	sq m	$ 1.10	89,548	$ 98,502.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 614,431.60
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 614,431.60

Rehabilitation #3 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	89,548	$ 98,502.25

Non Discounted Costs (One Direction)

Traffic Lane	$ 133,502.25
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 133,502.25

Rehabilitation #4 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete - New	T.L.	1	metric ton	$ 28.00	28,789	$ 806,090.36
Chip Seal	T.L.	1	sq m	$ 1.10	93,686	$ 103,054.88
Asphalt Concrete Removal	T.L.	1	sq m	$ 2.50	93,686	$ 234,215.63
Traffic Control	T.L.	NA	lump sum	$ 70,000.00	1	$ 70,000.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 1,213,360.86
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 1,213,360.86

Rehabilitation #5 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Rehabilitation #6 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Asphalt Concrete Milling	T.L.	1	sq m	$ 0.80	80,500	$ 64,400.00
Asphalt Concrete Overlay	T.L.	1	metric ton	$ 28.00	14,264	$ 399,402.04
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 552,352.04
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 552,352.04

Rehabilitation #7 Pay Items

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Crack Sealing	T.L.	1	linear m	$ 2.00	17,500	$ 35,000.00
Chip Seal	T.L.	1	sq m	$ 1.10	80,500	$ 88,550.00

Non Discounted Costs (One Direction)

Traffic Lane	$ 123,550.00
Inner Shoulder	$ 0.00
Outer Shoulder	$ 0.00
Miscellaneous	$ 0.00
Total Non Discounted Cost (One Direction)	$ 123,550.00

Salvage Value Pay Items for Initial Construction

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #1

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #2

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #3

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-
Total Non Discounted Cost (One Direction)						-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #4

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost
Non Discounted Costs (One Direction)*						
Traffic Lane						-
Inner Shoulder						-
Outer Shoulder						-
Miscellaneous						-

Total Non Discounted Cost (One Direction) -

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #5

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #6

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Salvage Value Pay Items for Rehabilitation #7

Name	Lane	Layer	Unit	Unit Cost	Quantity	Total Cost

Non Discounted Costs (One Direction)*

Traffic Lane	-
Inner Shoulder	-
Outer Shoulder	-
Miscellaneous	-
Total Non Discounted Cost (One Direction)	-

*Note: These values are not represented by the inputs or an error occurred in calculation.

Initial Construction -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Upper Deck	5.117	0
2	Asphalt Concrete - New	5.612	90
3	Base Course Aggregate	8.296	398.52

Initial Construction -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Initial Construction -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Rehabilitation #1 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.117	0

Milling Thickness - mm

Rehabilitation #1 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #1 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	5.117	79

Milling Thickness 0 mm

Rehabilitation #2 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #2 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	5.117	0

Milling Thickness - mm

Rehabilitation #3 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #3 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete - New	5.3535	137

Milling Thickness 0 mm

Rehabilitation #4 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #4 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)

Milling Thickness - mm

Rehabilitation #5 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0

Milling Thickness - mm

Rehabilitation #5 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #5 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	Asphalt Concrete Overlay	4.6	79
Milling Thickness		0 mm	

Rehabilitation #6 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #6 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Traffic Lane Dimensions

Layer	Material Description	Width (m)	Thickness (mm)
1	AC Upper Deck	4.6	0
Milling Thickness		- mm	

Rehabilitation #7 -- Inner Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

Rehabilitation #7 -- Outer Shoulder Dimensions

Layer	Material Description	Width (m)	Inner Thickness (mm)	Outer Thickness (mm)
Milling Thickness		- mm		

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