

APPENDIX J

Economic Crash Analysis Tool Results



APPENDIX J

Economic Crash Analysis Tool Results - Northbound Left Turn Lane at US 42
and Township Line Road



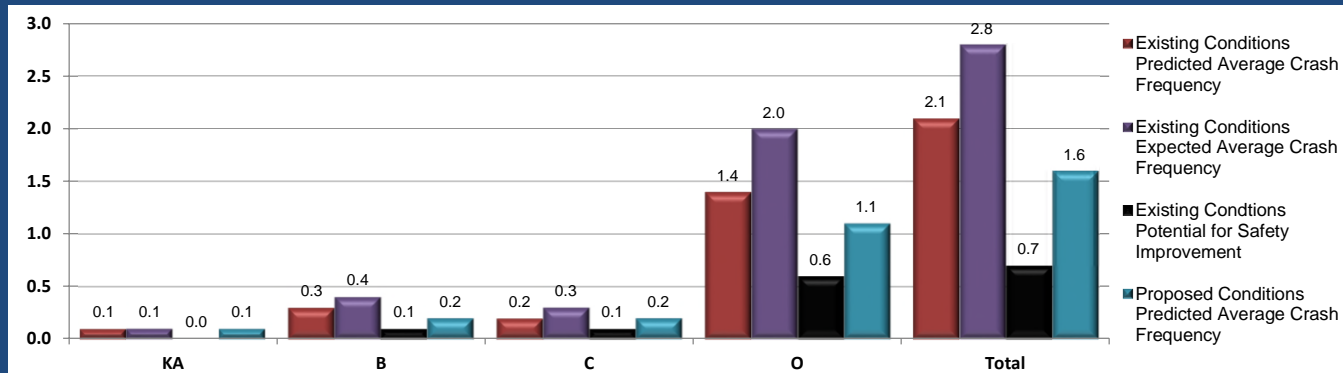


Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.1143	0.3311	0.2407	1.4301	2.1162
N_{expected} - Existing Conditions	0.1395	0.4045	0.2944	2.0053	2.8437
N_{potential for improvement} - Existing Conditions	0.0252	0.0734	0.0537	0.5752	0.7275
N_{expected} - Proposed Conditions	0.0851	0.2463	0.1795	1.0650	1.5759



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1143	0.3311	0.2407	1.4301	2.1162



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1395	0.4045	0.2944	2.0053	2.8437



Project Safety Performance Report

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Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0252	0.0734	0.0537	0.5752	0.7275



Project Safety Performance Report

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Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0851	0.2463	0.1795	1.065	1.5759




Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0083	0.0117	0.0034	0.0065
Head On	0.0228	0.0293	0.0065	0.0169
Rear End	0.6369	0.8562	0.2193	0.4742
Backing	0.0702	0.0976	0.0274	0.0522
Sideswipe - Meeting	0.1003	0.1330	0.0327	0.0746
Sideswipe - Passing	0.0916	0.1247	0.0331	0.0682
Angle	0.2930	0.3937	0.1007	0.2181
Parked Vehicle	0.0782	0.1079	0.0297	0.0582
Pedestrian	0.0130	0.0162	0.0032	0.0097
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0004	0.0001	0.0003
Pedalcycles	0.0117	0.0147	0.0030	0.0087
Other Non-Vehicle	0.0004	0.0005	0.0001	0.0003
Fixed Object	0.6349	0.8527	0.2178	0.4728
Other Object	0.0230	0.0316	0.0086	0.0172
Overturning	0.0417	0.0535	0.0118	0.0311
Other Non-Collision	0.0378	0.0519	0.0141	0.0281
Left Turn	0.0521	0.0681	0.0160	0.0388
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		\$0.00			\$0.00	\$0.00	-0.540	\$341,321
Site Characteristic Improvements (i.e. Lighting)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		\$0.00			\$0.00	\$0.00		
Added Left Turn Lane	20	\$221,499.02			\$221,499.02	\$221,499.02	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$221,499.02	\$0.00	\$0.00	\$221,499.02	\$221,499.02	-0.540	\$341,321



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Benefit - Cost Calculator

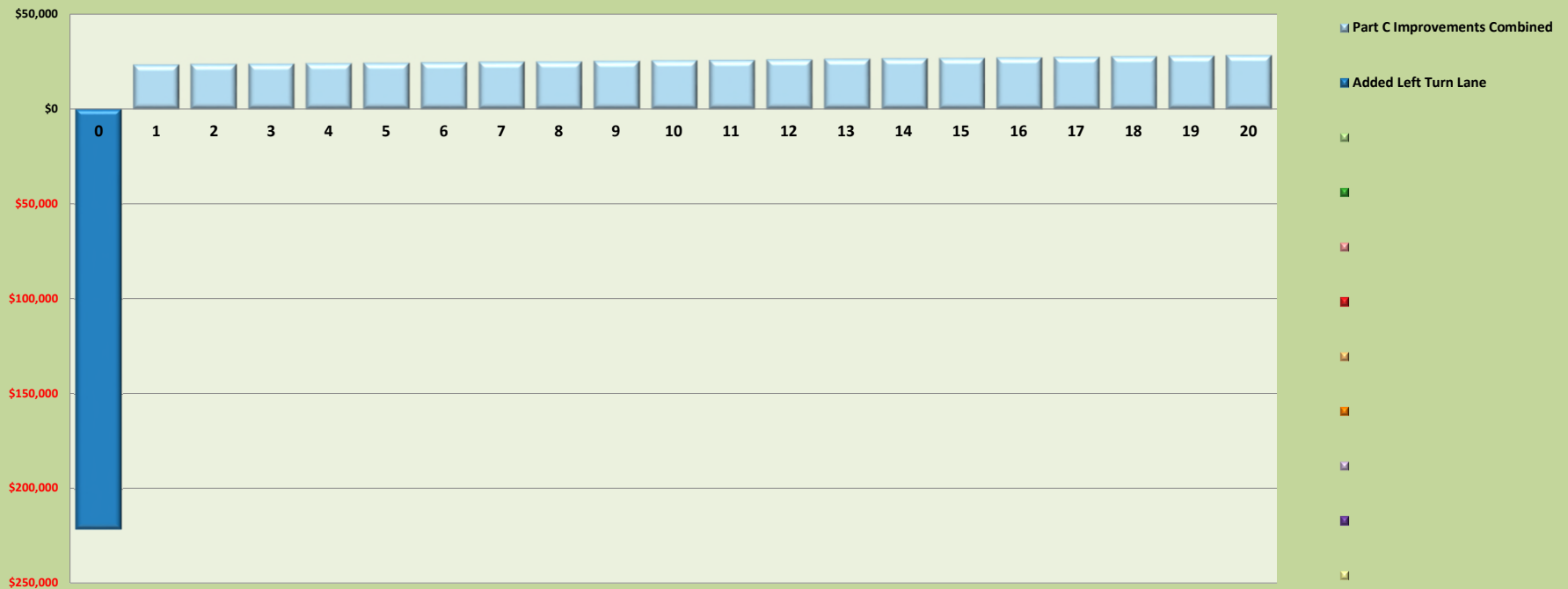
Net Present Value of Project	\$221,499.02
Net Present Value of Safety Benefits	\$341,320.84
Net Benefit	\$119,821.82
Benefit / Cost Ratio	1.54

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.029
Number of Injury Crashes	-0.175
Number of Total Crashes	-0.540

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year





Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX J

Economic Crash Analysis Tool Results - Roundabout at US 42 and Middletown Road



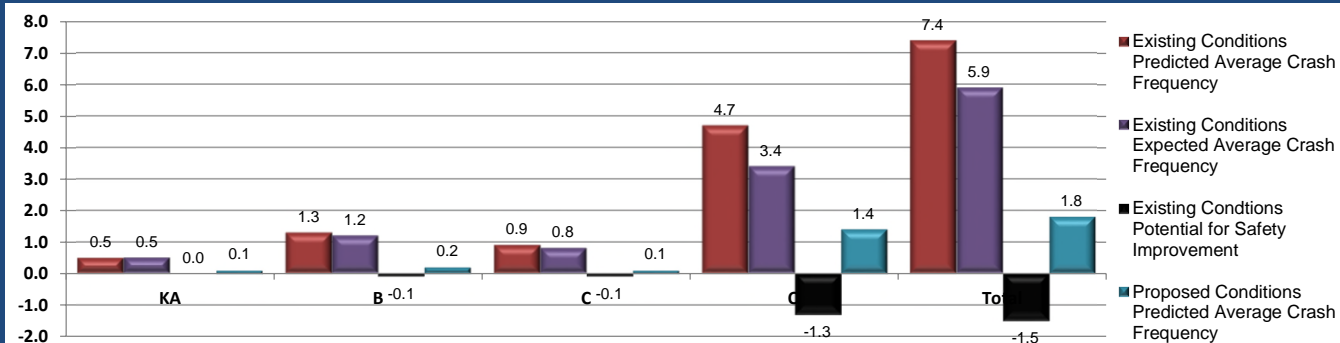


Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.5419	1.3135	0.8752	4.7016	7.4322
N_{expected} - Existing Conditions	0.5043	1.2222	0.8139	3.4019	5.9423
N_{potential for improvement} - Existing Conditions	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899
N_{expected} - Proposed Conditions	0.0727	0.1763	0.1175	1.4075	1.7740



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5419	1.3135	0.8752	4.7016	7.4322



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5043	1.2222	0.8139	3.4019	5.9423



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	US 42 at Middletown Road	0.0727	0.1763	0.1175	1.4075	1.774




Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0296	0.0229	-0.0067	0.0075
Head On	0.0639	0.0550	-0.0089	0.0122
Rear End	1.5884	1.2514	-0.3370	0.3939
Backing	0.2990	0.2194	-0.0796	0.0870
Sideswipe - Meeting	0.2159	0.1743	-0.0416	0.0503
Sideswipe - Passing	0.3360	0.2590	-0.0770	0.0879
Angle	2.8360	2.3364	-0.4996	0.6218
Parked Vehicle	0.2644	0.1973	-0.0671	0.0745
Pedestrian	0.0362	0.0325	-0.0037	0.0058
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0013	0.0011	-0.0002	0.0002
Pedalcycles	0.0273	0.0238	-0.0035	0.0048
Other Non-Vehicle	0.0005	0.0005	0.0000	0.0001
Fixed Object	1.2465	0.9758	-0.2707	0.3143
Other Object	0.0435	0.0325	-0.0110	0.0122
Overtuning	0.0751	0.0641	-0.0110	0.0147
Other Non-Collision	0.0985	0.0747	-0.0238	0.0269
Left Turn	0.2701	0.2216	-0.0485	0.0599
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		\$0.00			\$0.00	\$0.00	0.240	(\$189,363)
Site Characteristic Improvements (i.e. Lighting)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		\$0.00			\$0.00	\$0.00		
CMF 1 - Convert intersection with minor-road stop control to modern roundabout (Rural)	20	\$1,545,538.54			\$1,545,538.54	\$1,545,538.54	-5.898	\$5,283,616
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$1,545,538.54	\$0.00	\$0.00	\$1,545,538.54	\$1,545,538.54	-5.658	\$5,094,253



Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Benefit - Cost Calculator

Net Present Value of Project **\$1,545,538.54**

Net Present Value of Safety Benefits **\$5,094,253.16**

Net Benefit **\$3,548,714.62**

Benefit / Cost Ratio **3.30**

Expected Annual Crash Adjustment

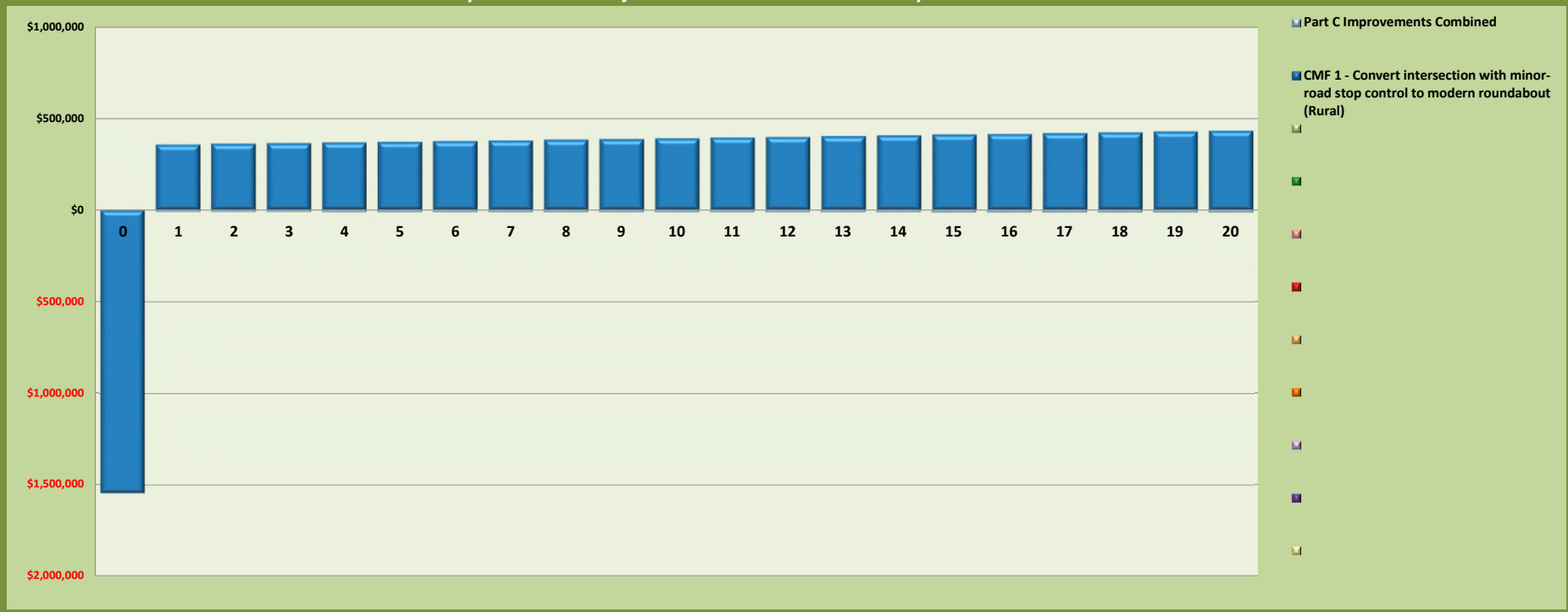
Number of Fatal & Incapacitating Injury Crashes **-0.469**

Number of Injury Crashes **-2.364**

Number of Total Crashes **-5.658**

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



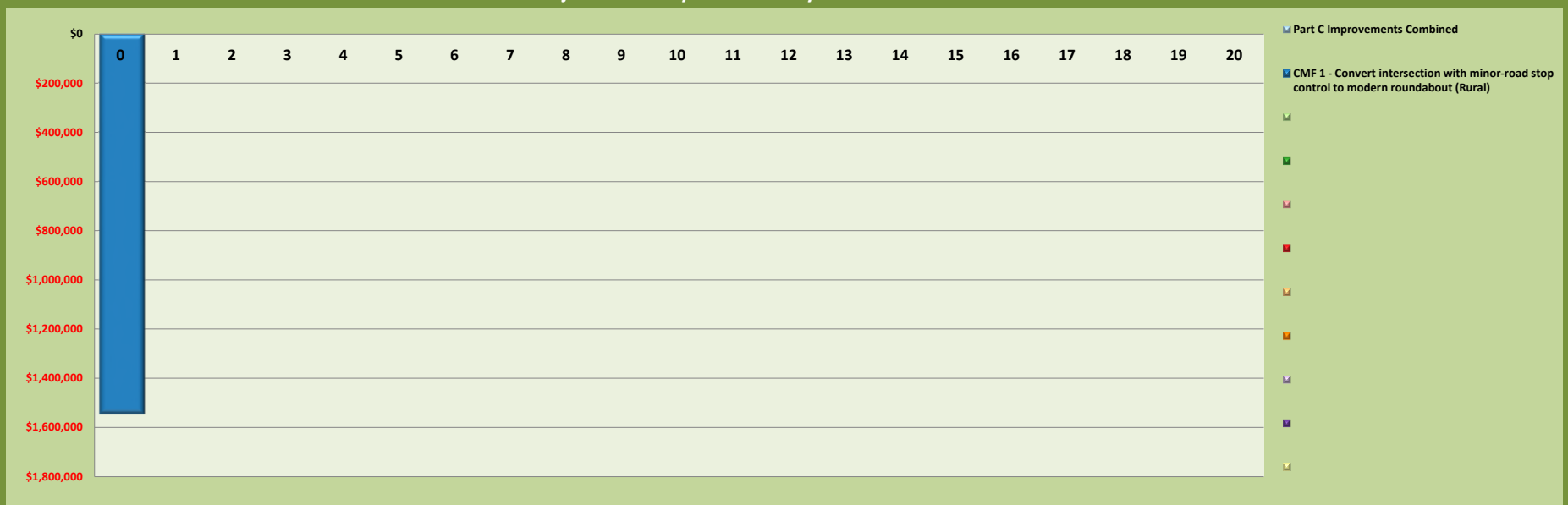


Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX J

Economic Crash Analysis Tool Results - Right-Out Only at US 42 and
Township Line Road



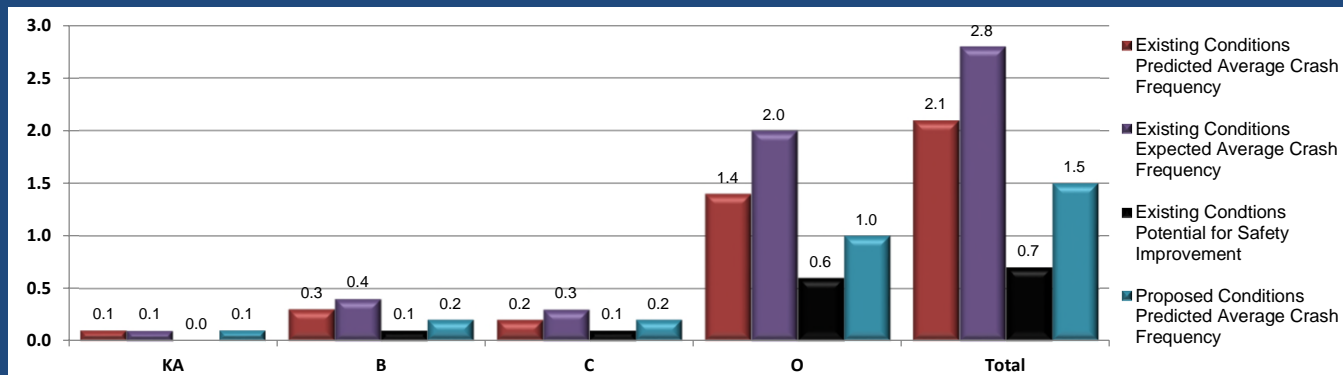


Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.1143	0.3311	0.2407	1.4301	2.1162
N_{expected} - Existing Conditions	0.1395	0.4045	0.2944	2.0053	2.8437
N_{potential for improvement} - Existing Conditions	0.0252	0.0734	0.0537	0.5752	0.7275
N_{expected} - Proposed Conditions	0.0836	0.2423	0.1758	1.0460	1.5477



Project Safety Performance Report

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Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1143	0.3311	0.2407	1.4301	2.1162



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Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1395	0.4045	0.2944	2.0053	2.8437



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Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0252	0.0734	0.0537	0.5752	0.7275



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Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0836	0.2423	0.1758	1.046	1.5477




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Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0083	0.0117	0.0034	0.0058
Head On	0.0228	0.0293	0.0065	0.0167
Rear End	0.6369	0.8562	0.2193	0.4659
Backing	0.0702	0.0976	0.0274	0.0514
Sideswipe - Meeting	0.1003	0.1330	0.0327	0.0734
Sideswipe - Passing	0.0916	0.1247	0.0331	0.0670
Angle	0.2930	0.3937	0.1007	0.2143
Parked Vehicle	0.0782	0.1079	0.0297	0.0572
Pedestrian	0.0130	0.0162	0.0032	0.0095
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0004	0.0001	0.0002
Pedalcycles	0.0117	0.0147	0.0030	0.0086
Other Non-Vehicle	0.0004	0.0005	0.0001	0.0003
Fixed Object	0.6349	0.8527	0.2178	0.4643
Other Object	0.0230	0.0316	0.0086	0.0168
Overturning	0.0417	0.0535	0.0118	0.0305
Other Non-Collision	0.0378	0.0519	0.0141	0.0276
Left Turn	0.0521	0.0681	0.0160	0.0382
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		\$0.00			\$0.00	\$0.00	0.698	(\$440,683)
Site Characteristic Improvements (i.e. Lighting)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		\$0.00			\$0.00	\$0.00		
CMF 1 - Install right-in-right-out (RIRO) operations at stop-controlled intersections	20	\$107,636.70			\$107,636.70	\$107,636.70	-1.266	\$799,559
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$107,636.70	\$0.00	\$0.00	\$107,636.70	\$107,636.70	-0.569	\$358,876



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Benefit - Cost Calculator

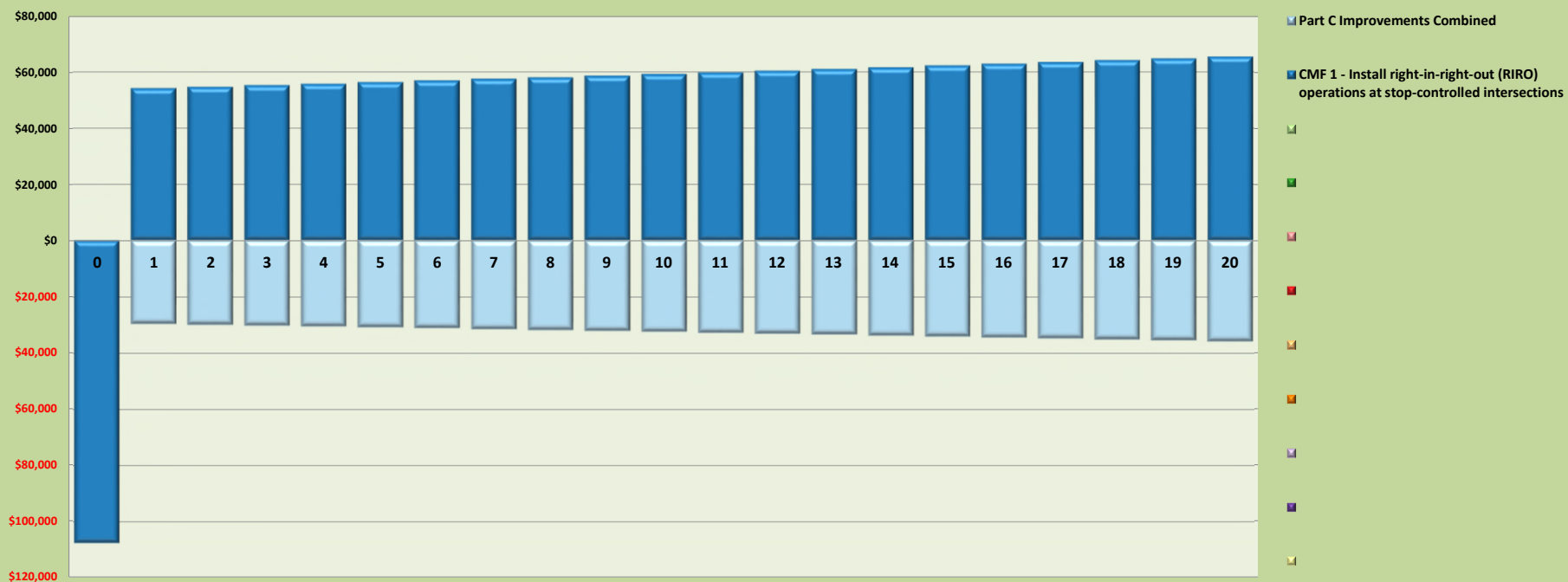
Net Present Value of Project	\$107,636.70
Net Present Value of Safety Benefits	\$358,875.91
Net Benefit	\$251,239.21
Benefit / Cost Ratio	3.33

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.031
Number of Injury Crashes	-0.184
Number of Total Crashes	-0.569

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



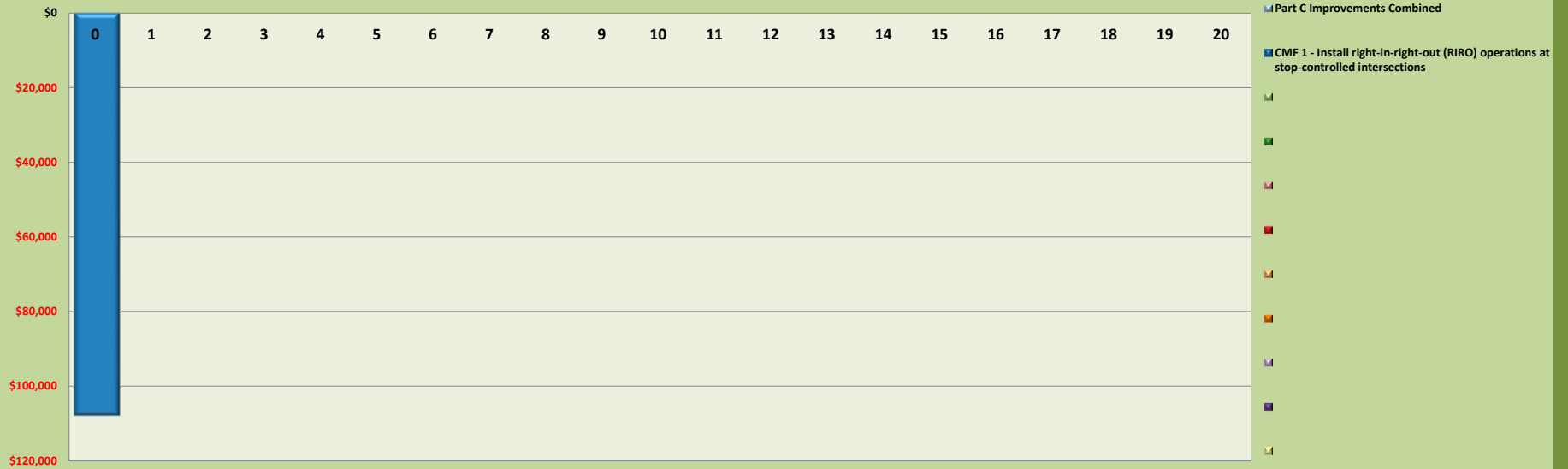


Safety Benefit - Cost Analysis

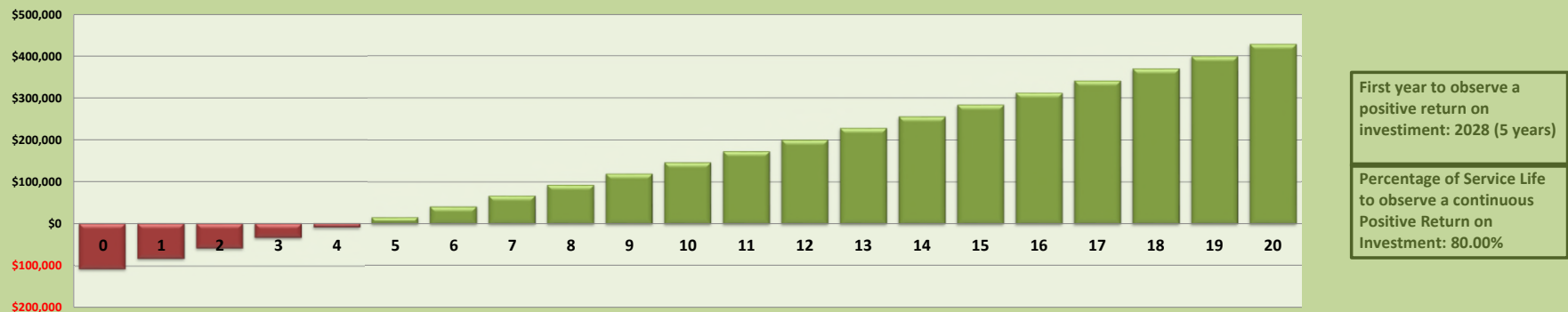
General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2023
Agency/Company	Arcadis		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX J

Economic Crash Analysis Tool Results - Close West Leg of US 42 and
Middletown Road



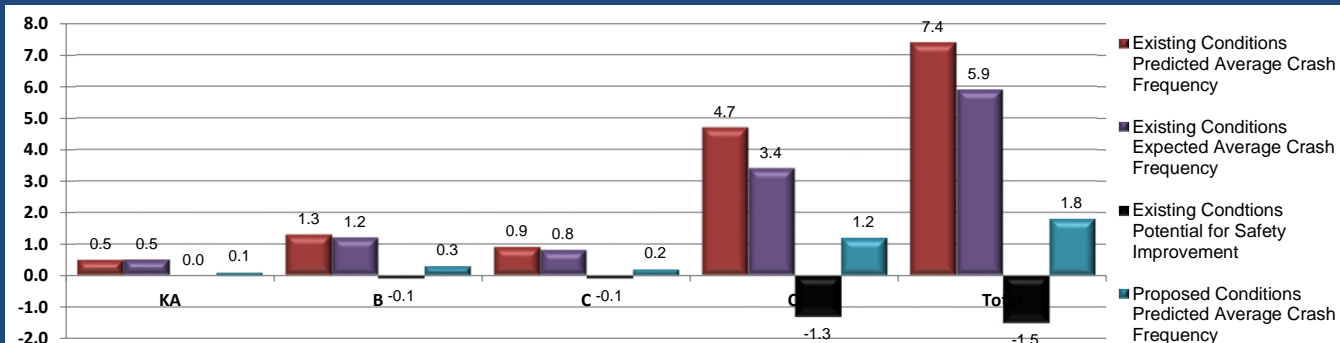


Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.5419	1.3135	0.8752	4.7016	7.4322
N_{expected} - Existing Conditions	0.5043	1.2222	0.8139	3.4019	5.9423
N_{potential for improvement} - Existing Conditions	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899
N_{expected} - Proposed Conditions	0.0976	0.2834	0.2063	1.2243	1.8116



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5419	1.3135	0.8752	4.7016	7.4322



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5043	1.2222	0.8139	3.4019	5.9423



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	US 42 at Middletown Road	0.0976	0.2834	0.2063	1.2243	1.8116




Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0296	0.0229	-0.0067	0.0074
Head On	0.0639	0.0550	-0.0089	0.0196
Rear End	1.5884	1.2514	-0.3370	0.5453
Backing	0.2990	0.2194	-0.0796	0.0600
Sideswipe - Meeting	0.2159	0.1743	-0.0416	0.0858
Sideswipe - Passing	0.3360	0.2590	-0.0770	0.0784
Angle	2.8360	2.3364	-0.4996	0.2508
Parked Vehicle	0.2644	0.1973	-0.0671	0.0670
Pedestrian	0.0362	0.0325	-0.0037	0.0111
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0013	0.0011	-0.0002	0.0003
Pedalcycles	0.0273	0.0238	-0.0035	0.0100
Other Non-Vehicle	0.0005	0.0005	0.0000	0.0003
Fixed Object	1.2465	0.9758	-0.2707	0.5435
Other Object	0.0435	0.0325	-0.0110	0.0196
Overturning	0.0751	0.0641	-0.0110	0.0356
Other Non-Collision	0.0985	0.0747	-0.0238	0.0323
Left Turn	0.2701	0.2216	-0.0485	0.0446
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		\$0.00			\$0.00	\$0.00	-5.621	\$4,741,721
Site Characteristic Improvements (i.e. Lighting)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		\$0.00			\$0.00	\$0.00		
Close West Leg	20	\$169,789.91			\$169,789.91	\$169,789.91	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$169,789.91	\$0.00	\$0.00	\$169,789.91	\$169,789.91	-5.621	\$4,741,721



Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Benefit - Cost Calculator

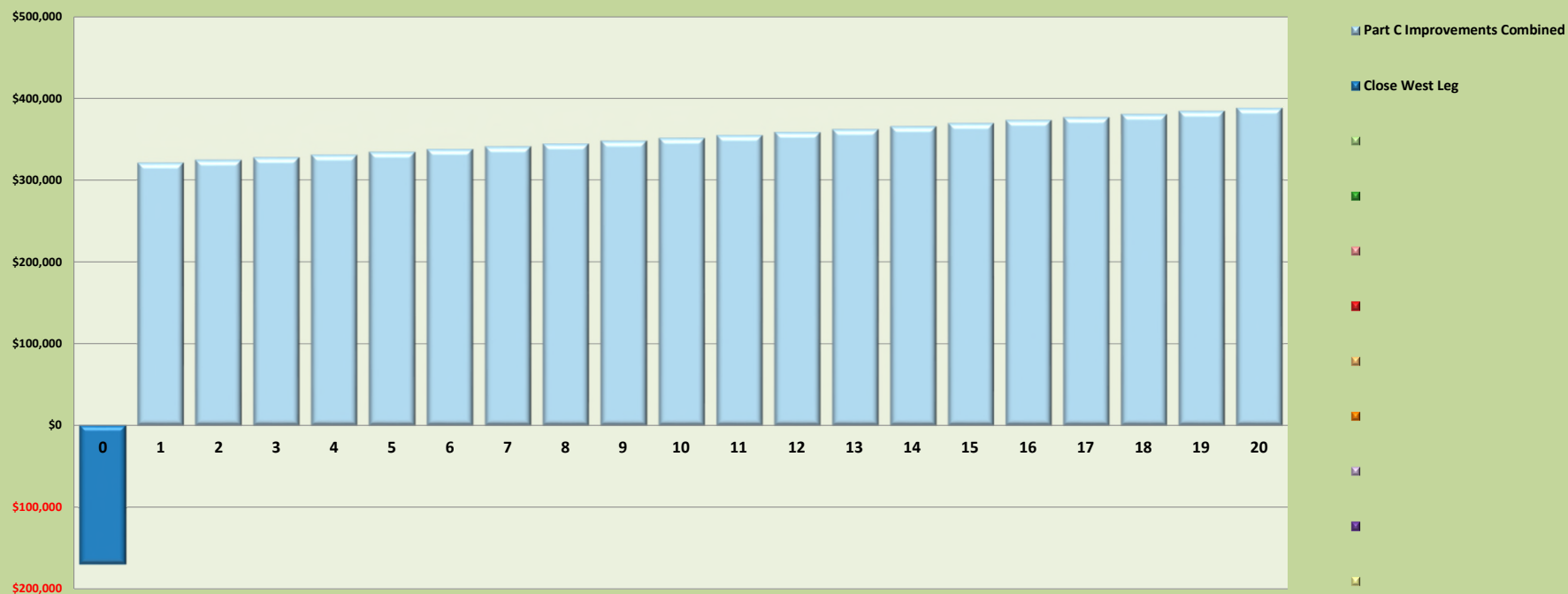
Net Present Value of Project	\$169,789.91
Net Present Value of Safety Benefits	\$4,741,721.02
Net Benefit	\$4,571,931.11
Benefit / Cost Ratio	27.93

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.444
Number of Injury Crashes	-2.143
Number of Total Crashes	-5.621

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



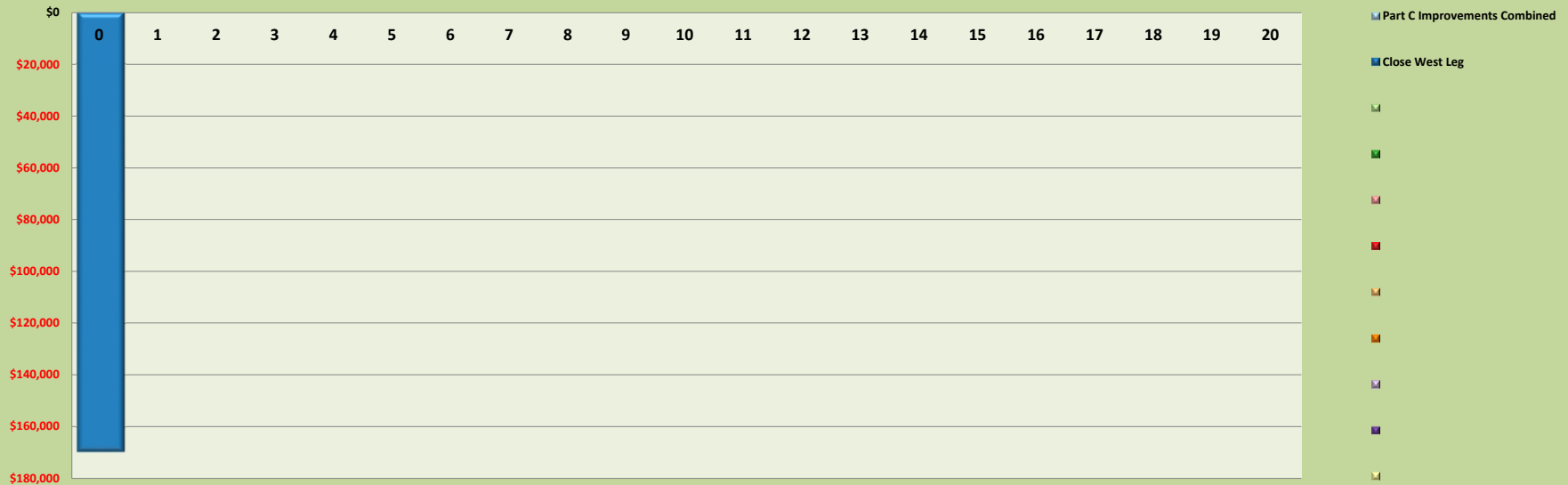


Safety Benefit - Cost Analysis

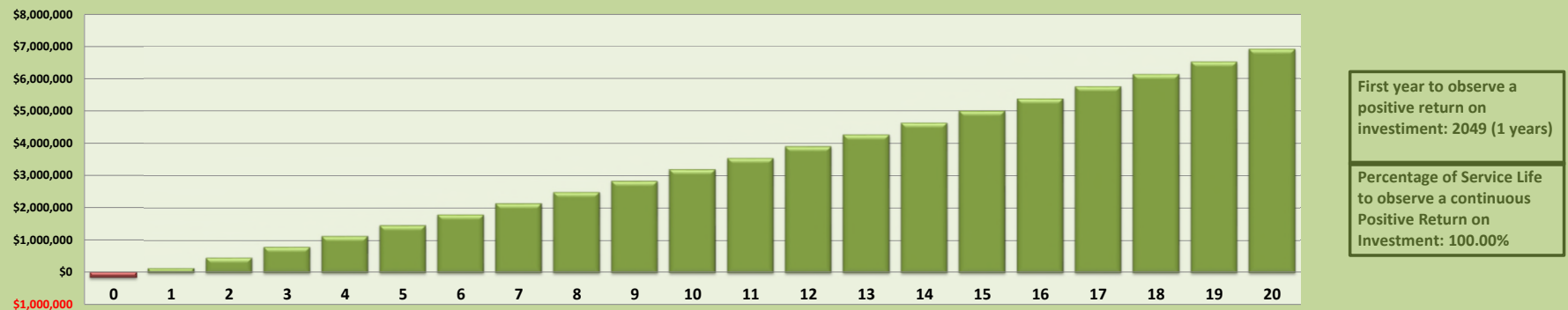
General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX J

Economic Crash Analysis Tool Results - Roundabout at US 42 and Township
Line Road



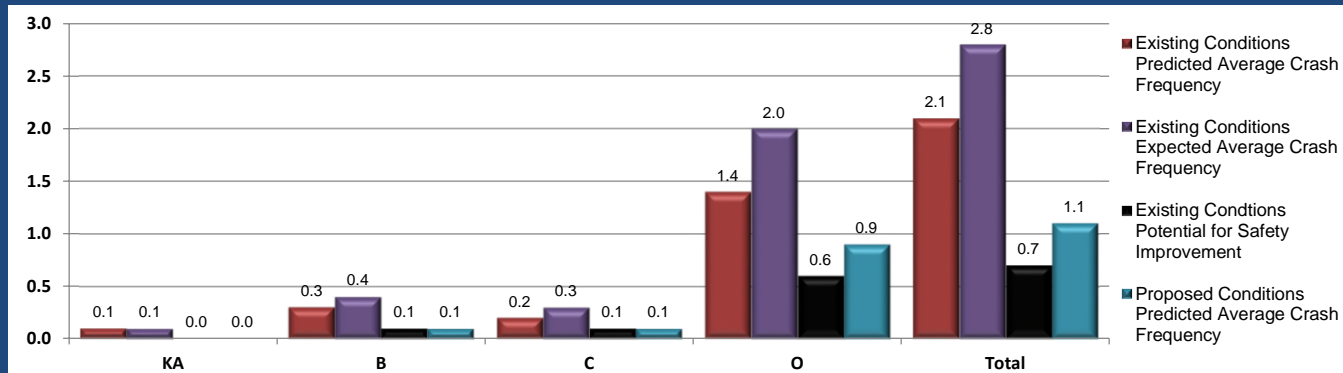


Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.1143	0.3311	0.2407	1.4301	2.1162
N_{expected} - Existing Conditions	0.1395	0.4045	0.2944	2.0053	2.8437
N_{potential for improvement} - Existing Conditions	0.0252	0.0734	0.0537	0.5752	0.7275
N_{expected} - Proposed Conditions	0.0328	0.0950	0.0691	0.9150	1.1119



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1143	0.3311	0.2407	1.4301	2.1162



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.1395	0.4045	0.2944	2.0053	2.8437



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0252	0.0734	0.0537	0.5752	0.7275



Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 15.65	Township Line Rd	0.0328	0.095	0.0691	0.915	1.1119




Project Safety Performance Report

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0083	0.0117	0.0034	0.0047
Head On	0.0228	0.0293	0.0065	0.0094
Rear End	0.6369	0.8562	0.2193	0.3352
Backing	0.0702	0.0976	0.0274	0.0435
Sideswipe - Meeting	0.1003	0.1330	0.0327	0.0493
Sideswipe - Passing	0.0916	0.1247	0.0331	0.0513
Angle	0.2930	0.3937	0.1007	0.1540
Parked Vehicle	0.0782	0.1079	0.0297	0.0465
Pedestrian	0.0130	0.0162	0.0032	0.0046
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0004	0.0001	0.0001
Pedalcycles	0.0117	0.0147	0.0030	0.0041
Other Non-Vehicle	0.0004	0.0005	0.0001	0.0002
Fixed Object	0.6349	0.8527	0.2178	0.3326
Other Object	0.0230	0.0316	0.0086	0.0134
Overturning	0.0417	0.0535	0.0118	0.0170
Other Non-Collision	0.0378	0.0519	0.0141	0.0223
Left Turn	0.0521	0.0681	0.0160	0.0237
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (i.e. Lane widening)		\$0.00			\$0.00	\$0.00	2.553	(\$1,611,019)
Site Characteristic Improvements (i.e. Lighting)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		\$0.00			\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		\$0.00			\$0.00	\$0.00		
CMF 1 - Convert intersection with minor-road stop control to modern roundabout (Rural)	20	\$1,896,153.15			\$1,896,153.15	\$1,896,153.15	-3.557	\$2,563,623
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$1,896,153.15	\$0.00	\$0.00	\$1,896,153.15	\$1,896,153.15	-1.004	\$952,605



Safety Benefit - Cost Analysis

General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Benefit - Cost Calculator

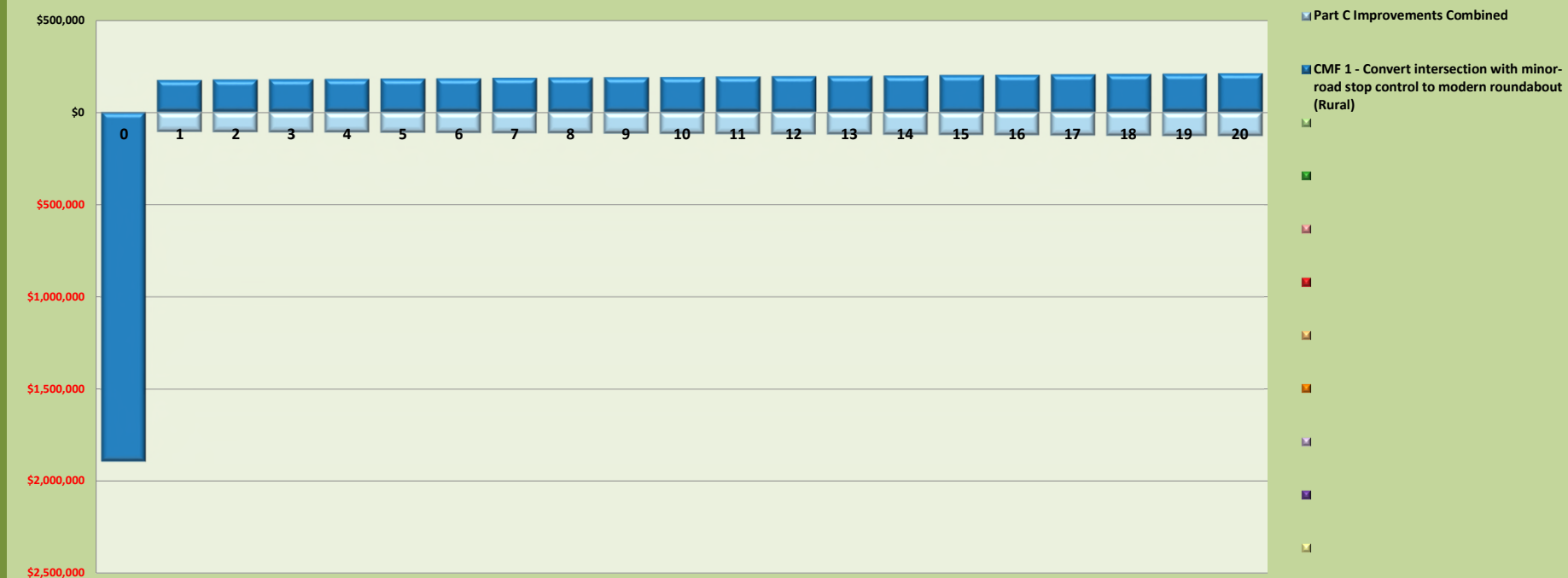
Net Present Value of Project	\$1,896,153.15
Net Present Value of Safety Benefits	\$952,604.64
Net Benefit	(\$943,548.51)
Benefit / Cost Ratio	0.50

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.082
Number of Injury Crashes	-0.489
Number of Total Crashes	-1.004

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



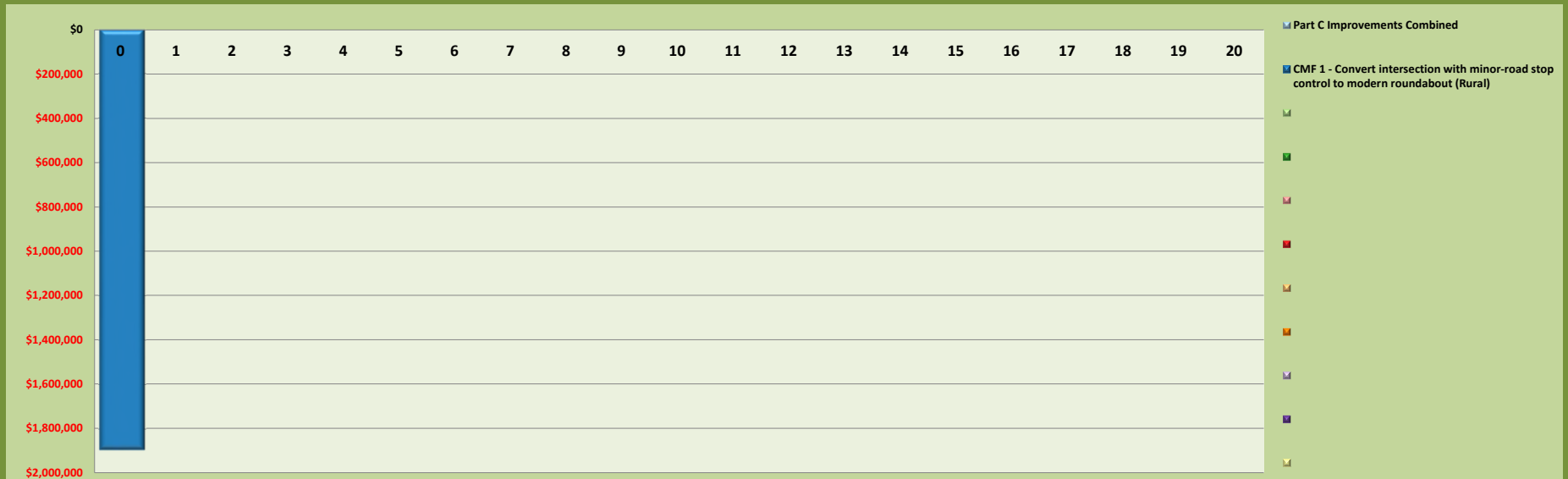


Safety Benefit - Cost Analysis

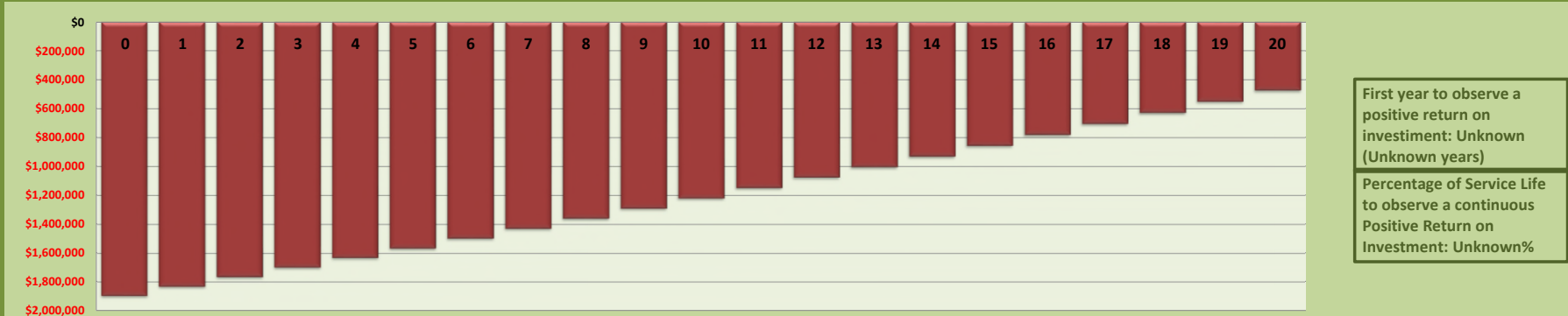
General Information

Project Name	US 42 at Middletown Road	Contact Email	Justin.Maderia@arcadis.com
Project Description	Safety Studies 2023	Contact Phone	(216) 298 5239
Reference Number		Date Performed	6/20/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX J

Economic Crash Analysis Tool Results - Traffic Signal at US 42 and Middletown Road



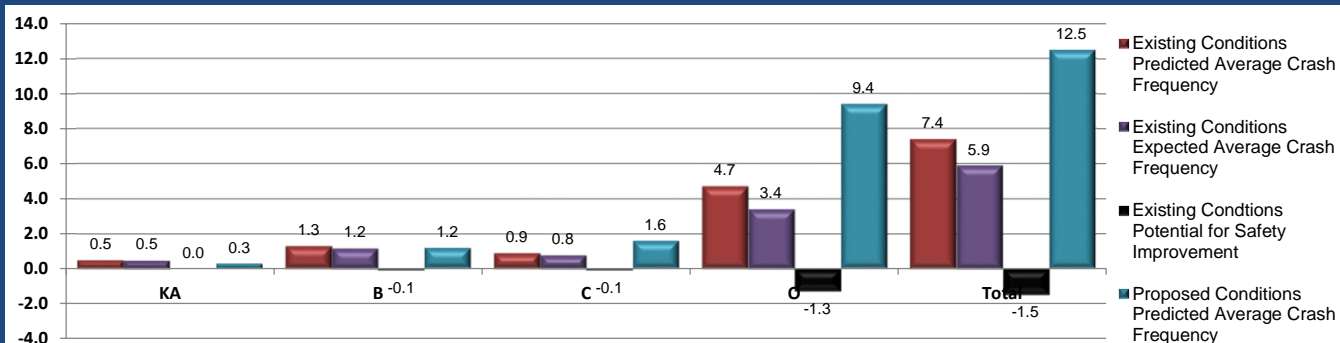


Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
N_{predicted} - Existing Conditions	0.5419	1.3135	0.8752	4.7016	7.4322
N_{expected} - Existing Conditions	0.5043	1.2222	0.8139	3.4019	5.9423
N_{potential for improvement} - Existing Conditions	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899
N_{expected} - Proposed Conditions	0.2913	1.2386	1.5655	9.3558	12.4512



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5419	1.3135	0.8752	4.7016	7.4322



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	0.5043	1.2222	0.8139	3.4019	5.9423



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	Middletow Road	-0.0376	-0.0913	-0.0613	-1.2997	-1.4899



Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
US42: 16.57	US 42 at Middletown Road	0.2913	1.2386	1.5655	9.3558	12.4512




Project Safety Performance Report

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0296	0.0229	-0.0067	0.0145
Head On	0.0639	0.0550	-0.0089	0.0911
Rear End	1.5884	1.2514	-0.3370	5.4848
Backing	0.2990	0.2194	-0.0796	0.5930
Sideswipe - Meeting	0.2159	0.1743	-0.0416	0.2518
Sideswipe - Passing	0.3360	0.2590	-0.0770	0.8579
Angle	2.8360	2.3364	-0.4996	2.5188
Parked Vehicle	0.2644	0.1973	-0.0671	0.4644
Pedestrian	0.0362	0.0325	-0.0037	0.1156
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0013	0.0011	-0.0002	0.0000
Pedalcycles	0.0273	0.0238	-0.0035	0.0766
Other Non-Vehicle	0.0005	0.0005	0.0000	0.0000
Fixed Object	1.2465	0.9758	-0.2707	0.7918
Other Object	0.0435	0.0325	-0.0110	0.0253
Overturning	0.0751	0.0641	-0.0110	0.0497
Other Non-Collision	0.0985	0.0747	-0.0238	0.0710
Left Turn	0.2701	0.2216	-0.0485	1.0449
Right Turn	0.0000	0.0000	0.0000	0.0000



Safety Benefit - Cost Analysis

General Information

Project Name	Safety Studies 2023	Contact Email	
Project Description	Task 9 US 42 at Middletown Road	Contact Phone	
Reference Number		Date Performed	6/12/2023
Analyst	Qai	Analysis Year	2048
Agency/Company	Arcadis		


Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Site Characteristic Improvements (Please add description about improvements i.e. Lane widening)					\$0.00	\$0.00	5.019	\$0
Site Characteristic Improvements (Please add description about improvements i.e. Lighting)					\$0.00	\$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Signal Phasing)					\$0.00	\$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Added Right Turn Lane)					\$0.00	\$0.00		
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
					\$0.00	\$0.00	0.000	\$0
Totals		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	5.019	\$0



Safety Benefit - Cost Analysis

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Benefit - Cost Calculator


Net Present Value of Project	\$0.00
Net Present Value of Safety Benefits	\$0.00
Net Benefit	\$0.00
Benefit / Cost Ratio	Unable to Calculate

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.251
Number of Injury Crashes	0.365
Number of Total Crashes	5.019


Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



Part C Improvements Combined

-
-
-
-
-
-
-
-
-
-

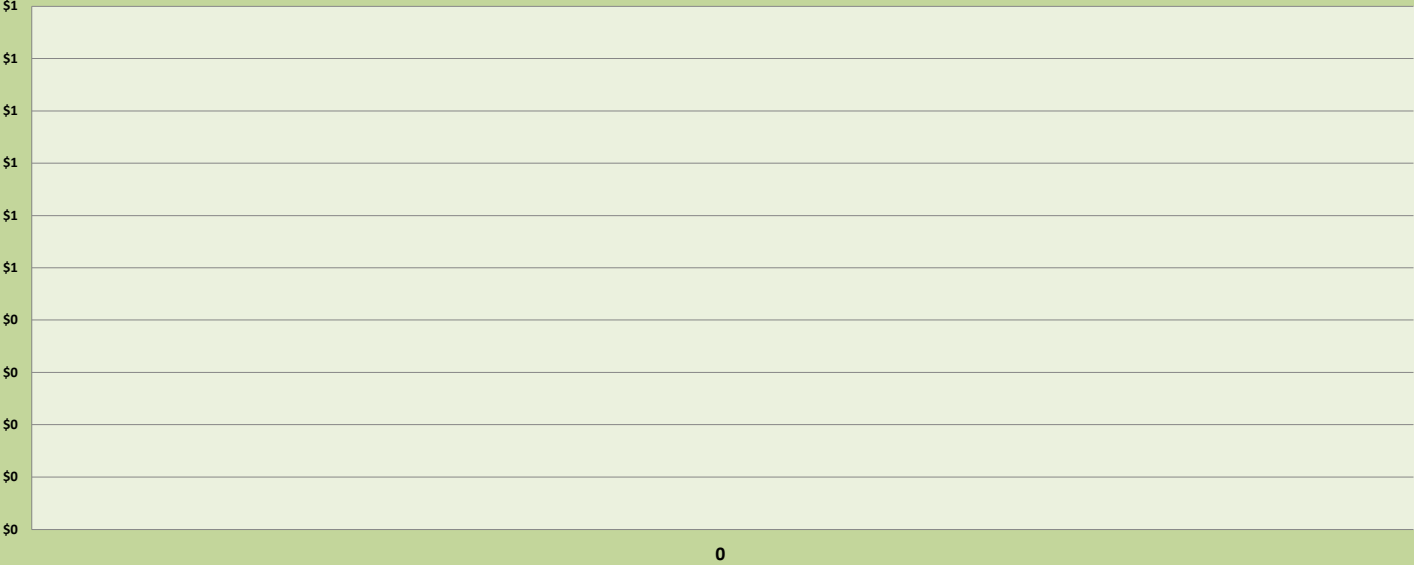


Safety Benefit - Cost Analysis

General Information

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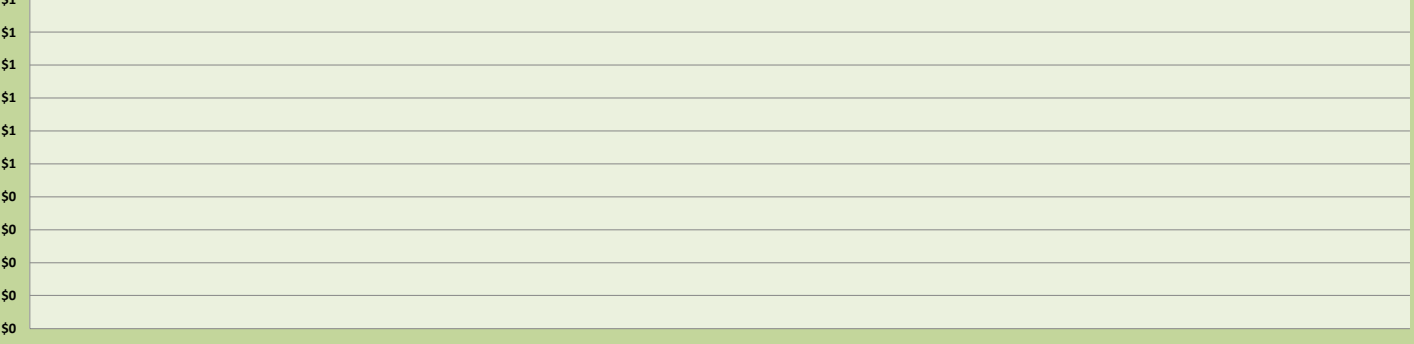
Project Costs Only Cash Flows By Countermeasure Per Year



Part C Improvements Combined

-
-
-
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-
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-
-
-

Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%