Southeast Region I-94 N/S Corridor ITS Benefit/Cost Analysis

prepared for

Wisconsin Department of Transportation

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1.0 Introduction and Background

1.1 Project Objectives

The objective of this project was to complete a moderately-detailed, planning-level analysis of the benefits of deploying selected Intelligent Transportation's System (ITS) elements along freeway segments in the Wisconsin Department of Transportation (WisDOT) Southeast Region. The ITS elements currently being discussed for possible implementation in this region include:

- Ramp metering
- Ramp closure gates
- Closed-circuit television (CCTV)
- System detector stations (SDS)
- Dynamic message signs (DMS)
- Crash investigation sites (CIS)
- Freeway service patrols (FSP)

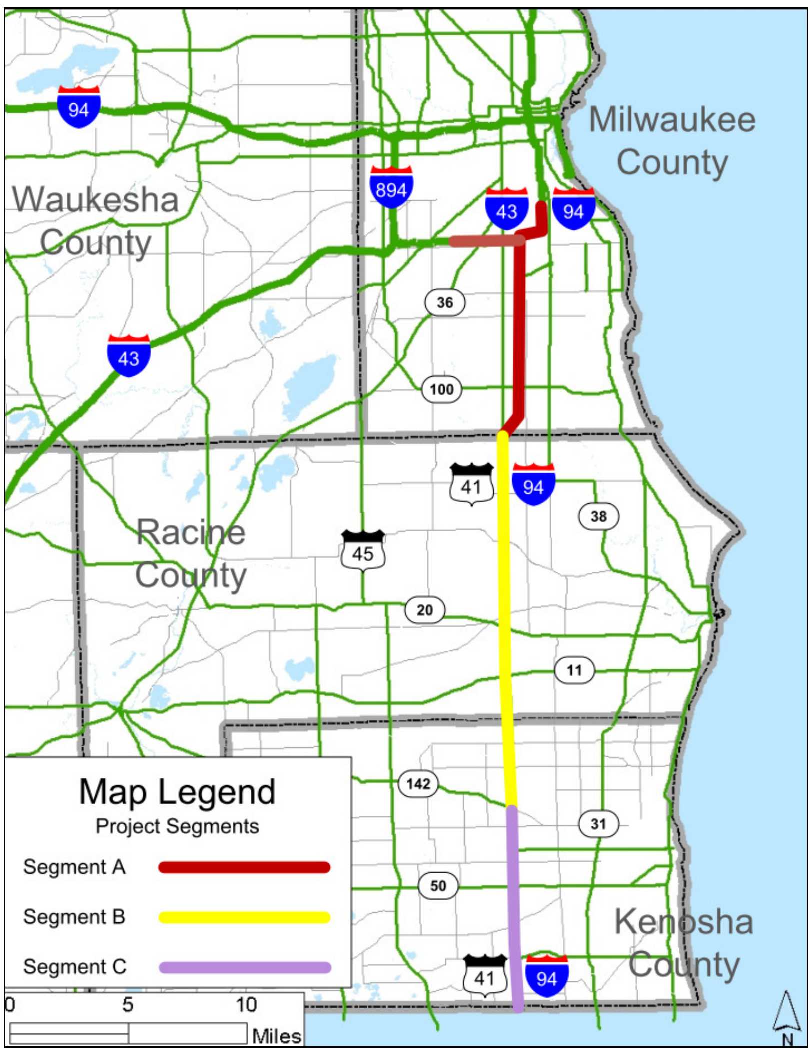
The analysis used the ITS Deployment Analysis System (IDAS) to determine benefit/cost (B/C) ratios at various levels of ITS deployment density for both present and future conditions. ITS elements were proposed based on the WisDOT Traffic Operations Infrastructure Plan (TOIP) while considering the existing quantity of ITS deployments. To compare the existing conditions to future conditions the Statewide Planning Model was used. Using information from IDAS, the WisDOT TOIP and the Statewide Planning Model, B/C ratios can be computed and used to determine which ITS elements should be considered for deployment.

1.2 Project Corridors

The analysis was performed for three individual freeway segments of the I-94 North/South Corridor. The I-94 N/S Corridor is the primary route within the WisDOT TOIP Hiawatha Corridor. The following segments within this TOIP corridor were evaluated:

- **Segment A –** I-43/94 from Oklahoma Avenue in Milwaukee to STH 241 at the Milwaukee/Racine County Line. This segment also includes I-43/894 from 60th Street to the I-43/I-94 Interchange.
- **Segment B –** USH 41/I-94 from STH 241 at the Milwaukee/Racine County Line to STH 142.
- **Segment C –** USH 41/I-94 from STH 142 to the I-94/USH 41 Interchange in Lake County, Illinois.

Figure 1.1 I-94 N/S Segment Map



1.3 CORRIDOR CHARACTERISTICS

As mentioned, Segments A, B and C all fall within the Hiawatha Corridor. WisDOT TOIP corridor descriptions:

- The Hiawatha Corridor includes the Milwaukee-Waukesha Region area as well as I-94 from downtown Milwaukee (I-43) to the Illinois border, I-894 from I-43 to I-94 and parallel routes WIS 45, WIS 31 and WIS 32. The corridor experiences significant regional traffic, high peaking on weekends (Friday afternoon and evening and Sunday afternoon), recurring congestion westbound into the Milwaukee metro area during daily peak periods and weather disturbances during the winter months.

The I-94 N/S Corridor falls within Milwaukee, Racine and Kenosha Counties in southeastern Wisconsin. Collectively, the population of these three counties is expected to remain relatively constant from 2005-2035 according to projections by the Wisconsin Department of Administration. However, projections indicate highly variable growth rates along the I-94 N/S Corridor. At the north end of the corridor, heavily urbanized Milwaukee County is projected to lose 8% of its population. Conversely, Racine and Kenosha Counties are expected to grow by 11.4% and 34.4% respectively. A population projection summary for Milwaukee, Racine and Kenosha Counties, along with statewide data, is presented in Table 1.1.

Table 1.1 Population Projections for Milwaukee, Racine and Kenosha Counties

	Population				Growth
County	**2005**	**2015**	**2025**	**2035**	**2005 to 2035**
Milwaukee	938,497	928,077	912,020	863,208	-8.0%
Racine	193,573	202,677	210,772	215,697	11.4%
Kenosha	158,570	176,837	196,549	213,077	34.4%
Study Area Total	**1,290,640**	**1,307,591**	**1,319,341**	**1,291,982**	**0.1%**
Wisconsin	5,589,920	5,988,420	6,390,900	6,653,970	19.0%
Study Area as % of State	23.1%	21.8%	20.6%	19.4%	

Source: State of Wisconsin – Department of Administration

Projected traffic growth in the corridor was also documented by the WisDOT Data and Analysis Unit. Appendix E shows these projected volumes.

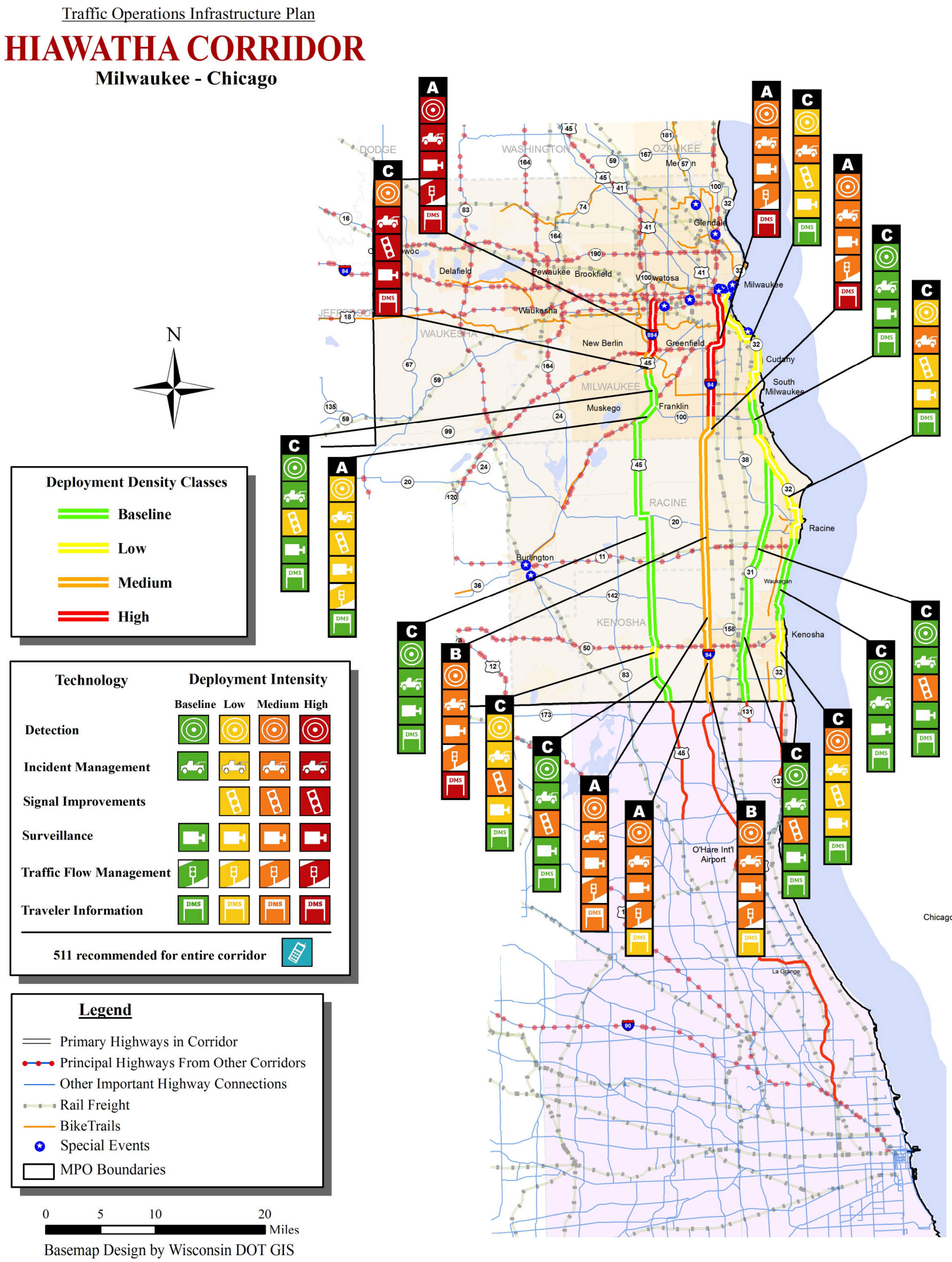
1.4 TOIP RECOMMENDATIONS

The TOIP recommends various deployment density classes for the level of ITS deployment that should be considered for a given segment of roadway. The deployment density classes ranging from baseline to high were identified based on a variety of operational performance measures including traffic volumes and patterns, safety and the impacts of weather and special events. These deployment density classes range from low to high and are based on a spectrum of ITS deployments that were developed for the TOIP. The TOIP spectrum of deployment density provides planners and designers with a range of ITS options for each deployment density. The Spectrum of Deployment Density for roadway type A - urban interstate/expressway as presented in the WisDOT TOIP is shown in Appendix A.

For example, an urban interstate/expressway may be classified as recommending a low deployment density which would only consist of cameras at site specific locations, minimal incident management and ramp closure gates where applicable. On the other hand, a medium deployment density would include a level of operations technology deployment between high and low density. An urban interstate/expressway may be classified as recommending a high deployment density which could include full camera coverage, detection with no more than 1/2 mile coverage, dedicated weekly service patrols and ramp metering.

The Hiawatha Corridor ranges from low to high deployment densities. In Segment A, which includes Milwaukee, a medium to high deployment density is recommended by the TOIP as shown in Figure 1.2. This would include cameras and detection at site specific locations and dynamic message signs at major interchanges as well as every 5-10 miles along the freeway. For the southern portion of I-94 (Segments B and C), the TOIP recommends medium deployment density. This would include cameras and detection at site specific locations. However, fewer dynamic message signs would be displayed. Overall, these recommendations are intended to achieve long-term goals for traffic operations infrastructure.

Figure 1.2 Hiawatha Corridor TOIP Recommendations



2.0 Description of Alternatives

In order to determine benefit/cost ratios for the deployment of varying levels of ITS intensity, alternatives were created. Different scenarios were developed to determine and recommend an appropriate level of deployment needed to meet long term infrastructure goals. Currently, ITS is deployed in various intensities throughout the I-94 corridor between Milwaukee and the Wisconsin/Illinois state border. In order to enable a more accurate IDAS analysis, I-94 was broken down into segments consisting of similar deployment densities.

The first scenario analyzed was the existing scenario. This scenario was developed based on the ITS elements that are currently deployed. Figure 2.1 shows the existing deployments in Segment A of the I-94 corridor.

To determine the benefits and costs of increasing the intensity of ITS deployments an alternative scenario was also created. This increased deployment scenario was created using recommendations from the Southeast Region. Figure 2.2 shows the elements from the existing scenario as well as the additionally proposed deployments for Segment A. Segment B and C follow the same approach. The first scenario analyzed was the existing deployments while the alternative scenario analyzed was the existing deployments as well as proposed deployments. The table in Appendix B lists a detailed breakdown of elements and field approaches analyzed per ITS deployment. Deployment maps of each segment are shown in Appendix C. Appendix D includes detailed tables describing each scenario.

Figure 2.1 Segment A Existing Devices – I 43/94

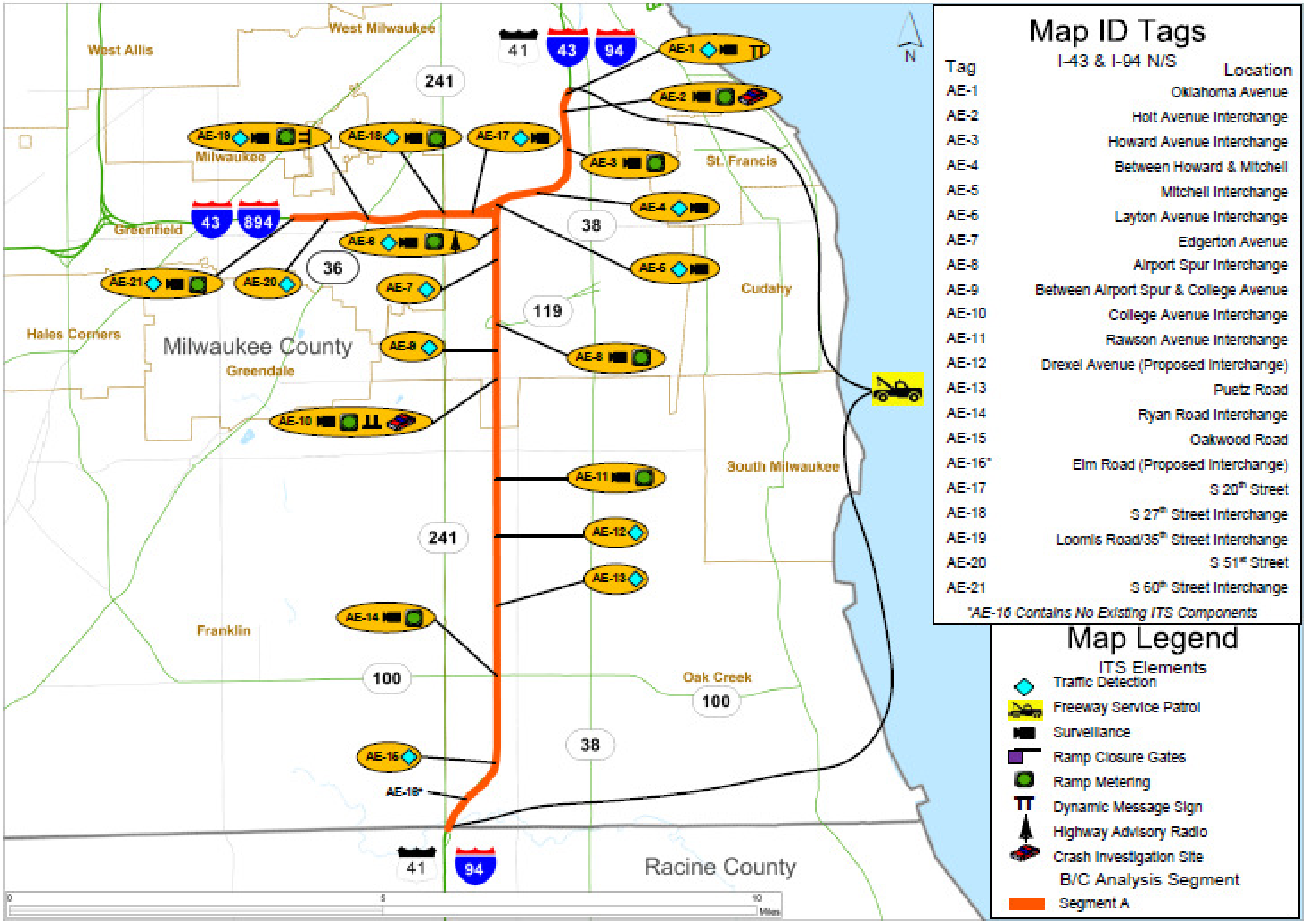
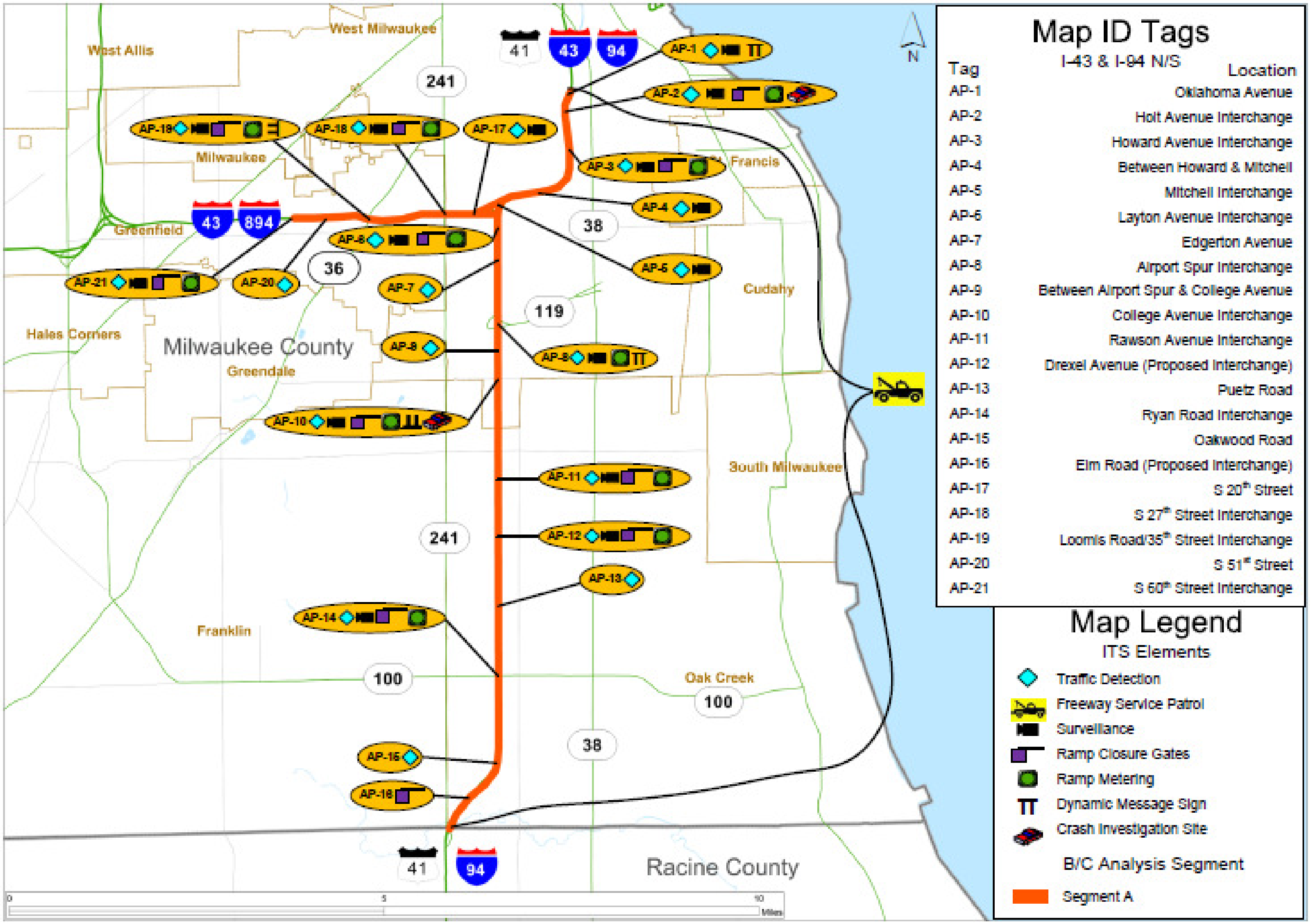


Figure 2.2 Segment A Existing & Proposed Devices – I-43/94



2.1 COST ASSUMPTIONS

Initial capital cost, annual operations and maintenance (O&M) costs and useful lives were assigned to each ITS device based on information from the IDAS Database, the WisDOT TOIP, the Research and Innovative Technology Administration of the USDOT, as well as project experience. A summary of this information is presented in Table 2.1. Basic capital cost assumptions and quantities for each segment and alternative can be found in Table 2.2.

Table 2.1 ITS Device Cost Assumptions

Device	Capital Cost (2007 Dollars)	Annual Operations & Maintenance Cost (2007 Dollars)	Estimated Life (Years)	Cost Assumption Source
Ramp Metering	$50,000	$5,000	5	Research and Innovative Technology Administration – USDOT, Derived*
Ramp Metering with HOV Lane	$65,000	$6,500	5	Research and Innovative Technology Administration – USDOT, Derived*
Ramp Closure Gate (Vertical Drop)	$19,000	$1,900	10	WisDOT
Ramp Closure Gate (Type III Barricade)	$1,300	$130	10	3 barricades plus storage - Derived*
CCTV	$40,000	$2,300	10	TOIP Appendix A – Traffic Management and Surveillance Operations Infrastructure Plan and Cost Estimates, Derived*
System Detector Station (mainline)	$25,000	$800	10	2 radar sensors - Derived*
Dynamic Message Sign	$197,000	$19,700	10	Derived*
HAR System	$35,000	$2,000	20	Research and Innovative Technology Administration – USDOT, SRF ITS
HAR Sign & Flashers	$5,000	$250	10	Research and Innovative Technology Administration – USDOT
Crash Investigation Site	$0	$0	20	N/A
Freeway Service Patrol	$65,000	$101,400	5	IDAS

*Derived: Determined from ITS and Transportation Project Experience

Table 2.2 ITS Device Quantities

Device	Units	Quantities by Segment and Scenario					
		A Existing	A Proposed	B Existing	B Proposed	C Existing	C Proposed
Ramp Metering	on ramp	13	14	0	0	0	0
Ramp Metering with HOV Lane	on ramp	7	8	0	0	0	0
Ramp Closure Gate (Vertical Drop)	gate	0	42	21	21	11	11
Ramp Closure Gate (Type III Barricade)	gate	0	0	0	0	2	2
CCTV	camera	14	16	6	10	2	5
System Detector Station (mainline)	2 radar sensors	14	20	8	11	5	5
Dynamic Message Sign	sign	3	4	1	2	1	2
Highway Advisory Radio (HAR)	each	1	0	0	0	1	0
HAR Sign & Flashers	sign & flasher	1	0	0	0	2	0
Crash Investigation Site	each	2	2	2	2	1	1
Freeway Service Patrol	each	1	1	1	1	1	1

2.2 Benefit Assumptions

In calculating benefits, there are several key inputs to the IDAS modeling. IDAS utilizes regional travel demand models as the basis of the benefit/cost analysis. A description of IDAS can be found in the Appendix F. In this study, the WisDOT Statewide Planning Model was used. The model was run for a future (2035) scenario which is the long-term planning horizon year. Due to the size and resource requirements of the statewide model, the IDAS analysis was conducted using a spreadsheet technique, rather than running the network model. It should be noted that this technique does not incorporate analysis of air quality benefits. While these benefits are generally a very small proportion of the total, the benefits may be slightly underestimated.

Both costs and benefits were calculated for a base year of 2005 and a future year of 2035. An annual adjustment rate of 5 percent was used and the costs and benefits are presented in 2007 dollars. IDAS requires benefit parameters to estimate the impacts of various deployments. While IDAS includes default impact parameters based on national studies it also can accommodate information from other sources. Several sources were used in a similar benefit/cost analysis completed for WisDOT's Northeast Region. Similar benefit parameters to those used in the Northeast Region were also used for the Southeast Region analysis. For these parameters, see Table 2.3.

Table 2.3 Comparison of Impact Parameters Used for IDAS Analysis

Deployment	Benefit	Parameter
Freeway Management System (DMS, CCTV, Detection)[a]	% of drivers who divert.	25%
	% of time useful information is provided.	5%
	Estimated time saved.	5 minutes
Additional Benefits from Detection and Surveillance Deployment	Incident duration reduction.	1%
	Fuel consumption reduction.	1%
	Fatality reduction.	1%
	Emissions reduction.	1%
Freeway Service Patrols[b]	Reduction in incident duration.	5%
	Reduction in fuel consumption.	1%
	Reduction in fatality rate.	1%
Ramp Closure Gates[c]	Crash reduction – Fatality.	80%
	Crash reduction – Injury.	80%
	Crash reduction – PDO.	80%
	Reduced operating costs through reduction in police presence.	$50/hour
	PCT of time gate closed (28 hours/year).	0.30%
Ramp Metering	Increase in capacity on metered links	5%
	Increase in capacity on other metered freeway links	13.5%
	Reduction in capacity on metered ramps	27%
	Reduction in crashes on metered links	13.5%
Highway Advisory Radio	% of time conditions exist for diversion (urban)	1%
	% of drivers who will divert and save time (urban)	20%
	Minutes saved (urban)	4
	% of time conditions exist for diversion (rural)	10%
	% of drivers who will divert and save time (rural)	15%
	Minutes saved (rural)	4
Crash Investigation Sites[d]	Reduction in incident duration.	5%
	Reduction in fuel consumption.	1%
	Reduction in fatality rate.	1%

[a] Based on Ohio and Michigan customer survey data.
[b] IDAS defaults modified based on initial runs.
[c] *Desktop Reference for crash Reduction Factors* Report No. FHWA-SA-07-015, Federal Highway Administration, U.S. DOT, September, 2007, p.89.
[d] Used same parameters as Freeway Service Patrols – no research found.

Once benefit parameters were calculated, they were monetized in order to permit direct comparison of the various benefit categories. Although IDAS contains default economic parameters, WisDOT provided a set of economic parameters in a recently issued draft of the WisDOT *Traffic Guidelines Manual, 16-20-70, Financial Assumptions for Engineering Economic Analysis,* January 2008. WisDOT also provided a second resource: *Transportation Engineering Economic Analysis Manual, Chapter 3 Valuation of Costs and Benefits, Topic 1 Financial Assumptions and Parameters, Draft #1E* September 19, 2008. These parameters were incorporated into the analysis and are shown in Table 2.4. All dollar values used in the analysis are in 2007 dollars, in order to facilitate comparison of alternatives across different years.

Table 2.4 Economic Parameters

General Parameters	Value
Number of travel days in a year	286
Year of dollar values	2007
Discount rate	5%
Average vehicle occupancy	1.25
Value of Time (Dollars per Hour)	
Value of in-vehicle time	$9.14
Value of in-vehicle time (commercial)	$20.44
Value of out-vehicle time (commercial)	$20.44
Value of out-vehicle time	$9.14
Value of reduced delay time	$9.14
Fuel costs (gallon)	$2.79
Accident Cost (Dollars per Accident)	
Fatality	$4,092,800
Injury	$48,576
Property damage	$2,251
Operating Costs	
Fuel costs (gallon)	$2.79
Nonfuel operating costs (dollars per mile)	$0.09
Noise damage Costs (dollars per mile)	$0.009

3.0 Results of Analysis

This section includes maps and descriptions of the deployment alternatives evaluated along with the results of the IDAS analysis. The financial results of the benefit/cost analysis are presented in both graphic and tabular format. Monetized benefits and costs are presented on an annual basis. The benefit/cost analysis was developed by monetizing different types of benefits including travel time savings in vehicle-hours of travel, reduction in accidents and fuel cost savings. These benefit measures are presented in tabular format and are expressed as daily totals.

3.1 SEGMENT A

Segment A includes the northern end of the overall corridor and in addition to I-94, includes a segment of I-894/I-43. The results of the analysis are shown graphically in Figure 3.1 and in tabular form in Table 3.1. The existing deployments show a benefit/cost ratio of 15 in 2005 and annual net benefits of just under $11.5 million. The proposed deployments add approximately $2.8 million in annual net benefits for the base year to equal a total of $14.3 million with the benefit/cost ratio of 13.8. The benefit/cost ratio of the existing system rises to 19.5 in 2035 and the net benefits increase to above $15 million annually. The existing and proposed systems combined provide roughly $19 million annually in net benefits. The additional capital investment for the proposed additions is about $1.25 million and the additional O&M cost adds $113,252 in total annualized cost.

The majority of monetized benefits in both base and future years are evenly split between travel time savings and accident reduction costs. Fuel operating cost savings are also significant. Performance impacts are presented in Table 3.2.

Figure 3.1 Segment A – IDAS Results

Southeast Corridor ITS Analysis

Segment A - IDAS Results

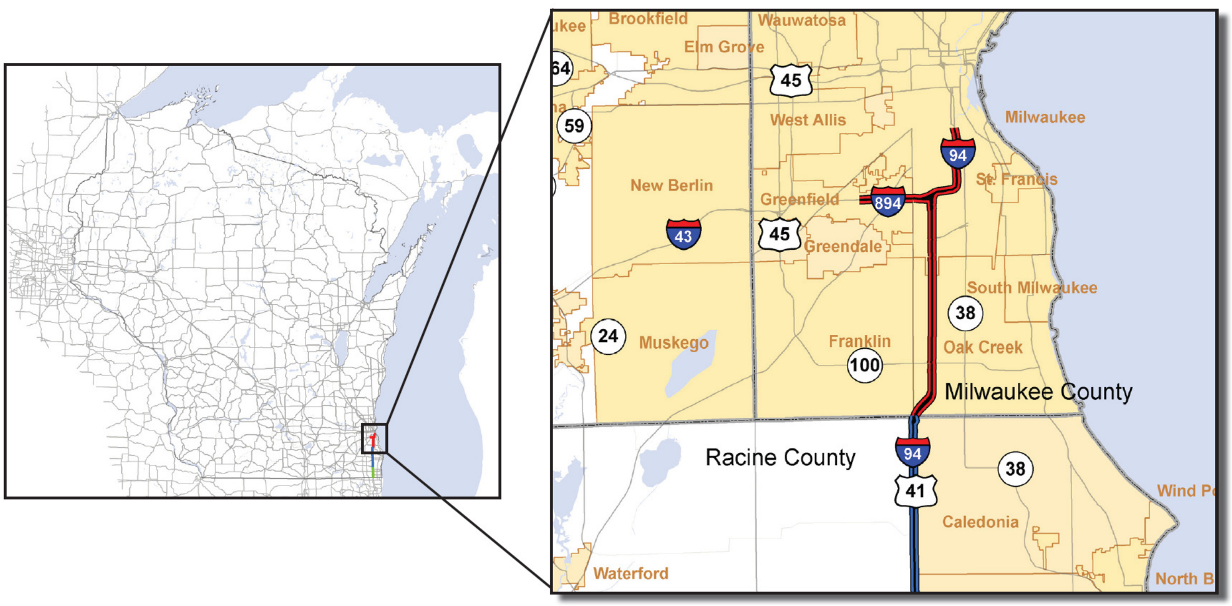
S. 60th Street Interchange/Oklahoma Avenue - Milwaukee/Racine County Line

Description

Segment A consists of I-43/894 from the S. 60th Street Interchange to the Mitchell Interchange, I-43/94 from Oklahoma Avenue to the Mitchell Interchange, and I-94 from the Mitchell Interchange south to the Milwaukee/Racine County line. Existing and proposed ITS deployment options are briefly described below. The benefit/cost ratios for these options (for the base year 2005 and forecast year 2035) are found below, showing how much value will be returned for each dollar spent.

Existing — Includes CCTV and detection, ramp metering, DMS, crash investigation sites, freeway service patrol, and highway advisory radio

Proposed — Adds ramp closure gates, additional CCTV and detection, ramp metering, an additional DMS, and removal of highway advisory radio



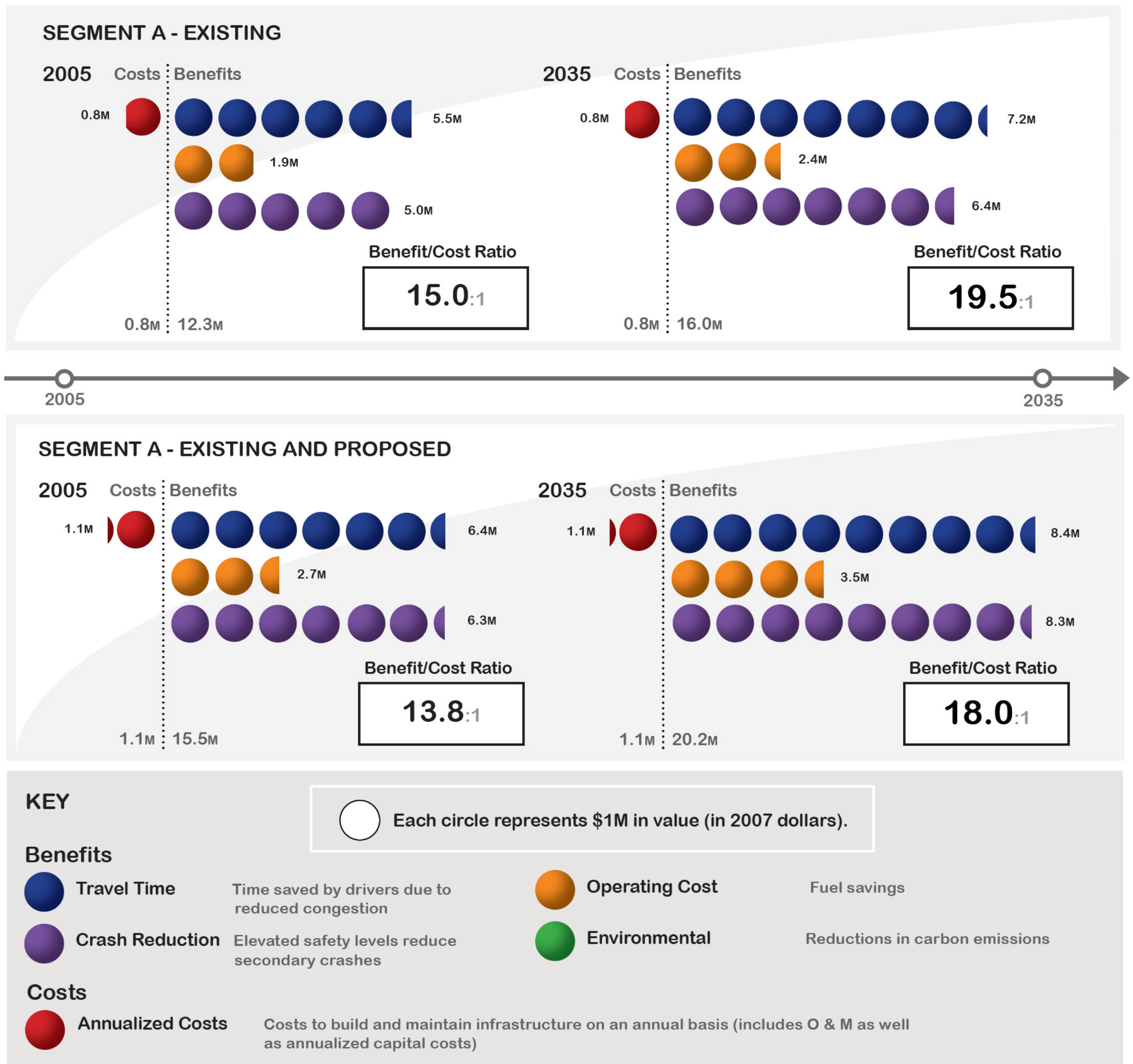

SEGMENT A - EXISTING
2005
Costs
Benefits
0.8M
5.5M
1.9M
5.0M
Benefit/Cost Ratio
15.0:1
0.8M
12.3M
2035
Costs
Benefits
0.8M
7.2M
2.4M
6.4M
Benefit/Cost Ratio
19.5:1
0.8M
16.0M
2005
2035
SEGMENT A - EXISTING AND PROPOSED
2005
Costs
Benefits
1.1M
6.4M
2.7M
6.3M
Benefit/Cost Ratio
13.8:1
1.1M
15.5M
2035
Costs
Benefits
1.1M
8.4M
3.5M
8.3M
Benefit/Cost Ratio
18.0:1
1.1M
20.2M
KEY
Each circle represents $1M in value (in 2007 dollars).
Benefits
Travel Time
Time saved by drivers due to reduced congestion
Operating Cost
Fuel savings
Crash Reduction
Elevated safety levels reduce secondary crashes
Environmental
Reductions in carbon emissions
Costs
Annualized Costs
Costs to build and maintain infrastructure on an annual basis (includes O & M as well as annualized capital costs)

Table 3.1 Segment A – Monetized Benefits

Deployments	Travel Time	Accident Reduction	Operating Cost	Environmental	Total	Annualized Cost	O&M Costs	Initial Capital	Net Benefits	B/C Ratio
Segment A Existing 2005	$5,491,000	$4,967,000	$1,852,000	$0	$12,310,000	$818,000	$313,738	$2,695,146	$11,492,000	15.0
Segment A Existing and Proposed 2005	$6,375,000	$6,337,000	$2,740,000	$0	$15,452,000	$1,120,000	$426,990	$3,942,718	$14,332,000	13.8
Segment A Existing 2035	$7,160,000	$6,424,000	$2,392,000	$0	$15,976,000	$818,000	$313,738	$2,695,146	$15,158,000	19.5
Segment A Existing and Proposed 2035	$8,367,000	$8,258,000	$3,539,000	$0	$20,164,000	$1,120,000	$426,990	$3,942,718	$19,044,000	18.0

All values are dollars per year except Initial Capital Cost

Table 3.2 Segment A – Performance Impacts

	Existing 2005	Existing and Proposed 2005	Existing 2035	Existing and Proposed 2035
Change in VMT	0	0	0	0
Baseline VMT	1,602,453	1,602,453	2,070,673	2,070,673
Improvement VMT	1,602,453	1,602,453	2,070,673	2,070,673
ATIS Savings (hours)	273.73	325.00	347.48	411.67
Baseline Delay (hours)	187.52	187.52	368.19	368.19
Improved Delay (hours)	164.85	160.92	321.75	313.84
Delay Reduction	-22.68	-26.61	-46.43	-54.35
Baseline Fatalities	0.028363	0.028363	0.036651	0.036651
Improved Fatalities	0.026935	0.026457	0.034805	0.034174
Fatality Reduction	-0.0014283	-0.001906	-0.001846	-0.00247682
Baseline Injuries	2.722568	2.722568	3.518073	3.518073
Improved Injuries	2.643649	2.625487	3.415987	3.391278
Injury Reduction	-0.0789186	-0.09708	-0.102086	-0.12679587
Baseline Fuel	81,725.10	81,725.10	105,604.32	105,604.32
Improved Fuel	80,021.68	79,204.43	103,404.22	102,348.18
Fuel Reduction	-1,703.4255	-2,520.677	-2,200.103	-3,256.14651
Baseline HC/ROG (tons)	0	0	0	0
Improved HC/ROG (tons)	0	0	0	0
HC/ROG Reduction	0	0	0	0
Baseline NO_x (tons)	0	0	0	0
Improved NO_x (tons)	0	0	0	0
NO_x Reduction	0	0	0	0
Baseline CO (tons)	0	0	0	0
Improved CO (tons)	0	0	0	0
CO Reduction	0	0	0	0

3.2 SEGMENT B

Segment B includes the middle portion of the corridor including ITS deployments on I-94 and US-41 in Racine and Kenosha Counties. The results of the analysis are shown graphically in Figure 3.2 and in tabular form in Table 3.3. The existing deployments show a benefit/cost ratio of 9.2 in 2005 and annual net benefits of approximately $2.7 million. The proposed deployments increase net benefits to $5.2 million annually for the base year and also increase the benefit/cost ratio to 13.2. Approximately $420,000 in additional capital investment is required.

The benefit/cost ratio of the existing system rises to about 13.2 in 2035 and the annual net benefits increase to $4 million. The existing and proposed systems combined provide roughly $7.6 million in annual net benefits with the benefit/cost ratio rising to 18.9. The additional investment proposed in this segment appears to be highly beneficial as it raises the net benefit level and benefit/cost ratio significantly.

The largest component of monetized benefits in both base and future years is from fuel cost savings, followed by accident reduction costs and travel time savings. Percentage increases between base and future years are similar for all three benefit categories. Performance impacts are presented in Table 3.4.

Figure 3.2 Segment B – IDAS Results

Southeast Corridor ITS Analysis

Segment B - IDAS Results

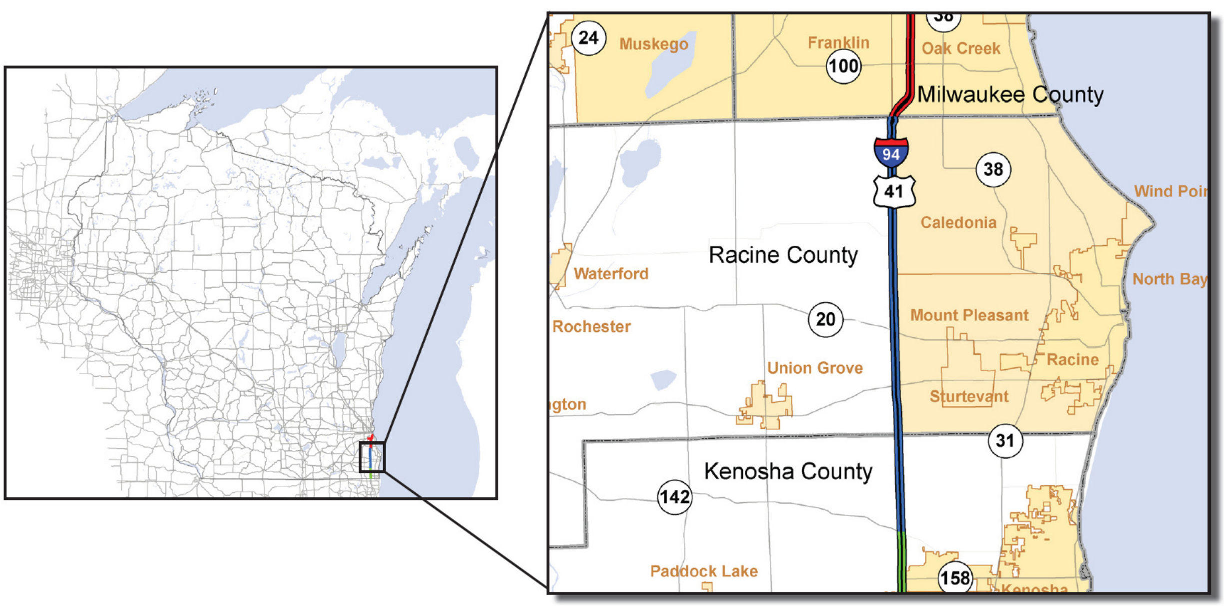
Milwaukee/Racine County Line - State Highway 142

Description

Segment B consists of I-94 from the Milwaukee/Racine County line to State Highway 142. Existing and proposed ITS deployment options are briefly described below. The benefit/cost ratios for these options (for the base year 2005 and forecast year 2035) are found below, showing how much value will be returned for each dollar spent.

<u>Existing</u> Includes CCTV and detection, freeway service patrol, DMS, ramp closure gates, and crash investigation sites

<u>Proposed</u> Adds additional CCTV and detection and an additional DMS



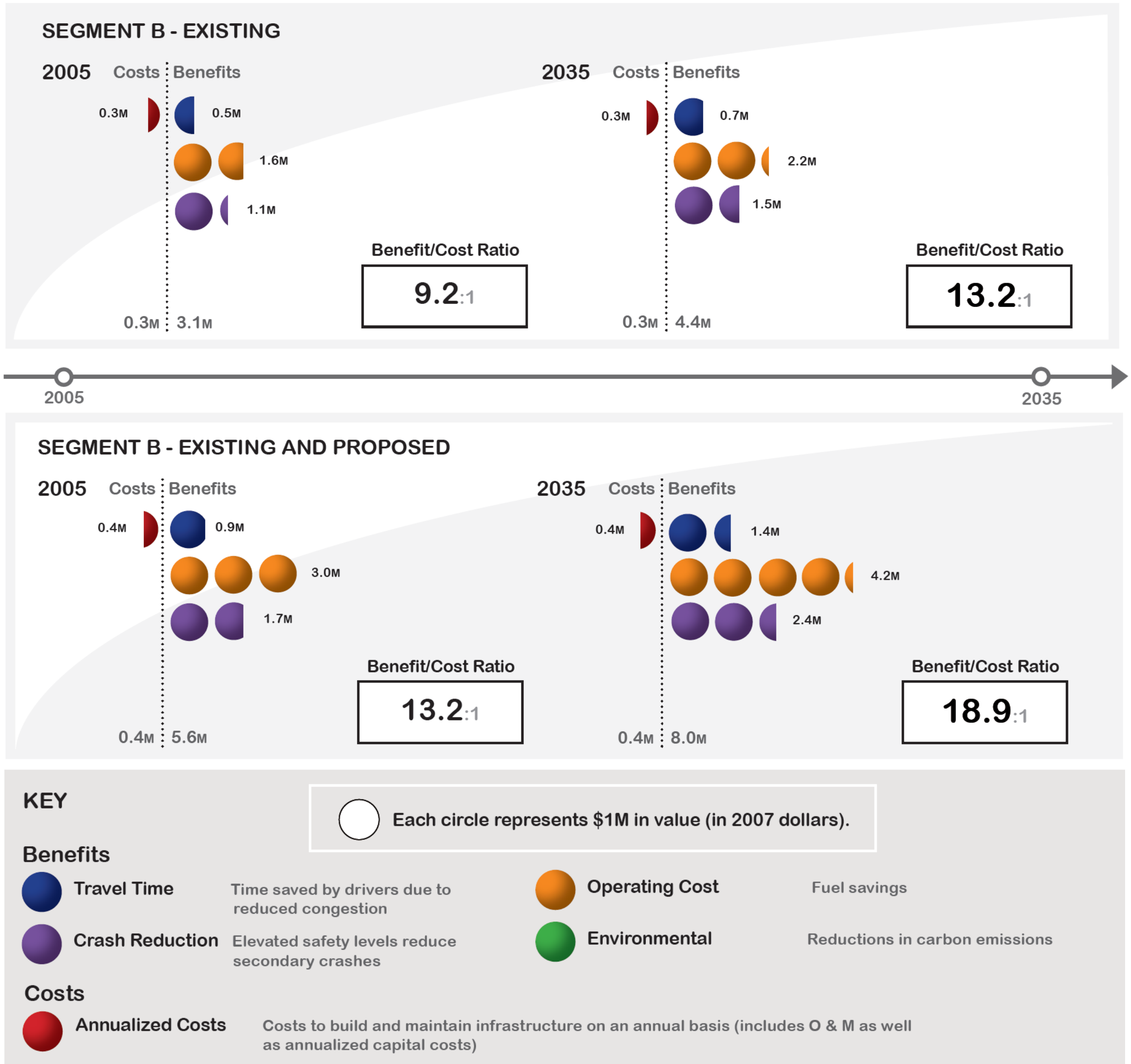

SEGMENT B - EXISTING
2005
Costs
Benefits
0.3M
0.5M
1.6M
1.1M
0.3M
3.1M
Benefit/Cost Ratio
9.2:1
2035
Costs
Benefits
0.3M
0.7M
2.2M
1.5M
0.3M
4.4M
Benefit/Cost Ratio
13.2:1
2005
2035
SEGMENT B - EXISTING AND PROPOSED
2005
Costs
Benefits
0.4M
0.9M
3.0M
1.7M
0.4M
5.6M
Benefit/Cost Ratio
13.2:1
2035
Costs
Benefits
0.4M
1.4M
4.2M
2.4M
0.4M
8.0M
Benefit/Cost Ratio
18.9:1
KEY
Each circle represents $1M in value (in 2007 dollars).
Benefits
Travel Time
Time saved by drivers due to reduced congestion
Crash Reduction
Elevated safety levels reduce secondary crashes
Operating Cost
Fuel savings
Environmental
Reductions in carbon emissions
Costs
Annualized Costs
Costs to build and maintain infrastructure on an annual basis (includes O & M as well as annualized capital costs)

Table 3.3 Segment B – Monetized Benefits

Deployments	Travel Time	Accident Reduction	Operating Cost	Environmental	Total	Annualized Cost	O&M Costs	Initial Capital	Net Benefits	B/C Ratio
I-94 Corridor Segment B Existing 2005	$472,000	$1,055,000	$1,561,000	$0	$3,088,000	$335,000	$175,922	$1,068,932	$2,753,000	9.2
I-94 Corridor Segment B E + Proposed 2005	$940,000	$1,721,000	$2,964,000	$0	$5,625,000	$425,000	$206,311	$1,488,350	$5,200,000	13.2
I-94 Corridor Segment B Existing 2035	$712,000	$1,490,000	$2,204,000	$0	$4,406,000	$335,000	$175,922	$1,068,932	$4,071,000	13.2
I-94 Corridor Segment B E + Proposed 2035	$1,433,000	$2,429,000	$4,184,000	$0	$8,046,000	$425,000	$206,311	$1,488,350	$7,621,000	18.9

All values are dollars per year except Initial Capital Cost

Table 3.4 Segment B – Performance Impacts

	Existing 2005	Existing and Proposed 2005	Existing 2035	Existing and Proposed 2035
Change in VMT	0	0	0	0
Baseline VMT	1,265,067	1,265,067	1,786,096	1,786,096
Improvement VMT	1,265,067	1,265,067	1,786,096	1,786,096
ATIS Savings (hours)	87.29	174.45	127.19	260.07
Baseline Delay (hours)	5.07	5.07	44.25	44.25
Improved Delay (hours)	4.44	4.25	38.80	37.16
Delay Reduction	-0.63	-0.82	-5.45	-7.09
Baseline Fatalities	0.022392	0.022392	0.031614	0.031614
Improved Fatalities	0.021840	0.021392	0.030834	0.030202
Fatality Reduction	-0.00055211	-0.001	-0.00078	-0.00141
Baseline Injuries	2.149348	2.149348	3.034577	3.034577
Improved Injuries	2.144742	2.145190	3.028074	3.028706
Injury Reduction	-0.00460632	-0.004158	-0.006503	-0.00587
Baseline Fuel	64,518.40	64,518.40	91,090.90	91,090.90
Improved Fuel	63,082.41	61,792.04	89,063.29	87,241.48
Fuel Reduction	-1,435.99343	-2,726.361	-2,027.603	-3,849.42
Baseline HC/ROG (tons)	0.00	0.00	0.00	0.00
Improved HC/ROG (tons)	0.00	0.00	0.00	0.00
HC/ROG Reduction	0	0	0	0
Baseline NO_x (tons)	0.00	0.00	0.00	0.00
Improved NO_x (tons)	0.00	0.00	0.00	0.00
NO_x Reduction	0	0	0	0
Baseline CO (tons)	0.00	0.00	0.00	0.00
Improved CO (tons)	0.00	0.00	0.00	0.00
CO Reduction	0	0	0	0

3.3 SEGMENT C

Segment C includes the southern end of the overall corridor including ITS deployments on I-94 and US-41 in Kenosha County. The results of the analysis are shown graphically in Figure 3.3 and in tabular form in Table 3.5. The existing deployments show a benefit/cost ratio of approximately 7.6 in 2005 and annual net benefits of approximately $1.7 million. The proposed deployments increase annual net benefits to $3.8 million for the base year and also increase the benefit/cost ratio to 12.9. Approximately $264,000 in additional capital investment is required.

The benefit/cost ratio of the existing system rises to 10.9 in 2035 and the net benefits increase to $2.6 million annually. The existing and proposed systems combined provide roughly $5.2 million in annual net benefits with the benefit/cost ratio rising to 16.9. Overall the additional investment proposed in this segment appears to be highly beneficial as it raises the net benefit level and benefit/cost ratio significantly.

The largest component of monetized benefits on this segment is fuel cost savings, followed by accident reduction and travel time savings. This is the case for both the base and future years. The proposed deployments change this balance by significantly increasing the travel time benefits. The proposed deployments increase travel time benefits by nearly $1.6 million in the base year and $1.8 million in 2035. Performance impacts are presented in Table 3.6.

Figure 3.3 Segment C – IDAS Results

Southeast Corridor ITS Analysis

Segment C - IDAS Results

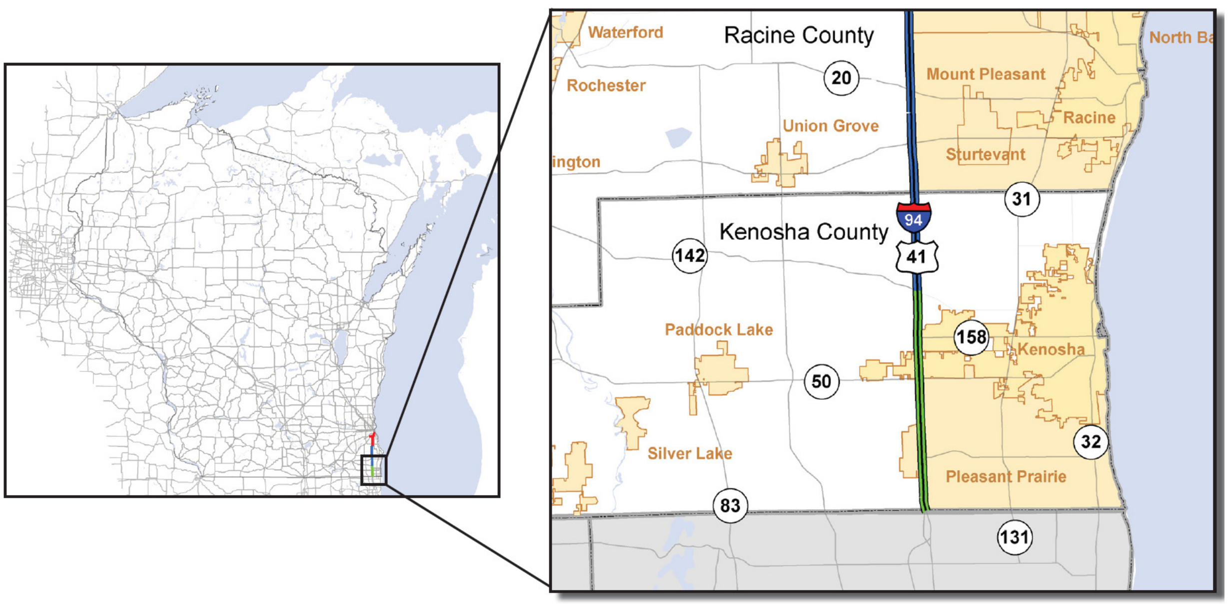
State Highway 142 - WI/IL State Line

Description

Segment C consists of I-94 from State Highway 142 to the Wisconsin/Illinois State line. Existing and proposed ITS deployment options are briefly described below. The benefit/cost ratios for these options (for the base year 2005 and forecast year 2035) are found below, showing how much value will be returned for each dollar spent.

Existing Includes CCTV and detection, ramp closure gates, DMS, freeway service patrol, a crash investigation site, and highway advisory radio

Proposed Adds additional CCTV, ramp closure gates, DMS, and removal of highway advisory radio



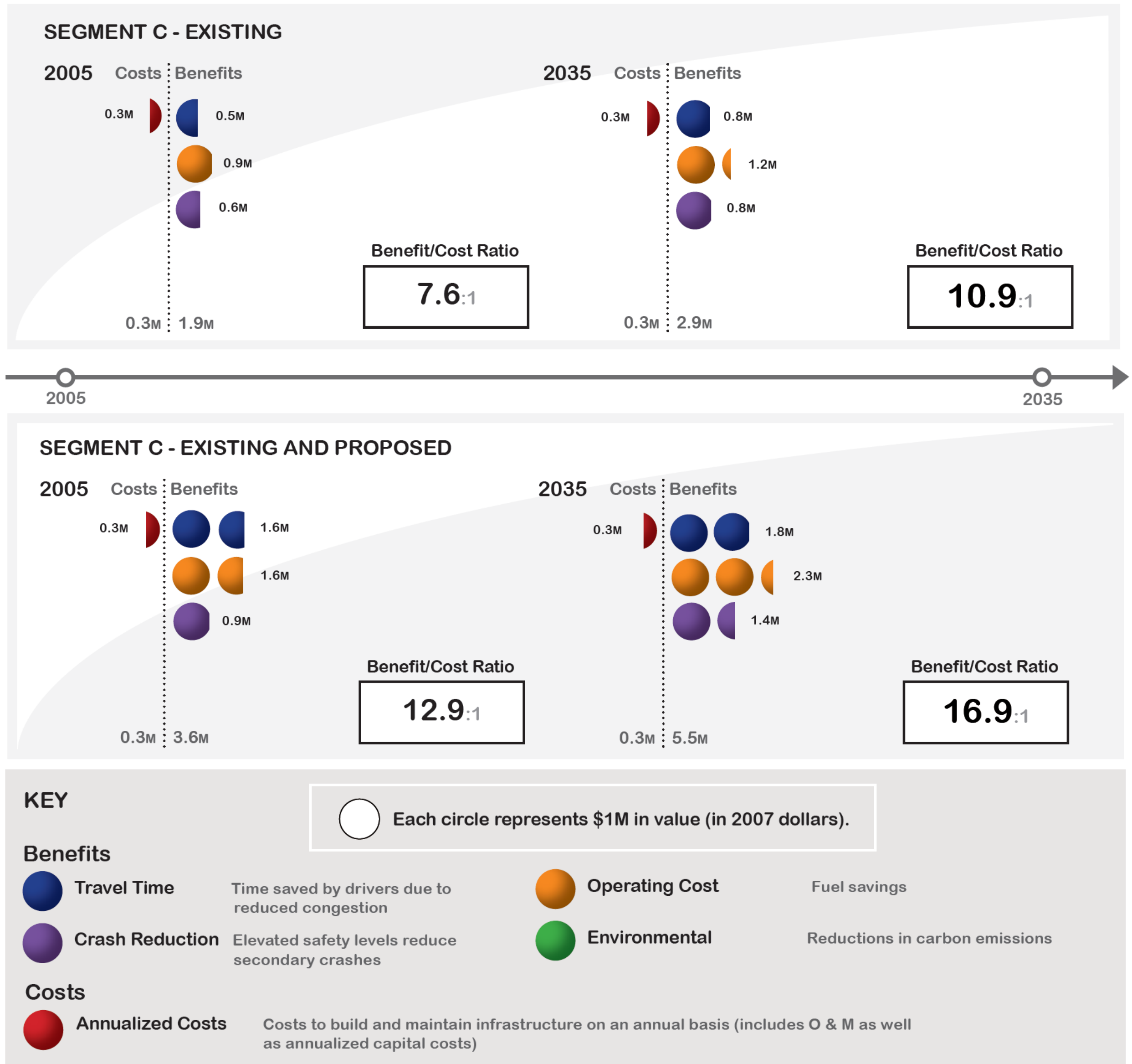

SEGMENT C - EXISTING
2005
Costs
Benefits
0.3M
0.5M
0.9M
0.6M
0.3M
1.9M
Benefit/Cost Ratio
7.6:1
2035
Costs
Benefits
0.3M
0.8M
1.2M
0.8M
0.3M
2.9M
Benefit/Cost Ratio
10.9:1
2005
2035
SEGMENT C - EXISTING AND PROPOSED
2005
Costs
Benefits
0.3M
1.6M
1.6M
0.9M
0.3M
3.6M
Benefit/Cost Ratio
12.9:1
2035
Costs
Benefits
0.3M
1.8M
2.3M
1.4M
0.3M
5.5M
Benefit/Cost Ratio
16.9:1
KEY
Each circle represents $1M in value (in 2007 dollars).
Benefits
Travel Time
Time saved by drivers due to reduced congestion
Operating Cost
Fuel savings
Crash Reduction
Elevated safety levels reduce secondary crashes
Environmental
Reductions in carbon emissions
Costs
Annualized Costs
Costs to build and maintain infrastructure on an annual basis (includes O & M as well as annualized capital costs)

Table 3.5 Segment C – Monetized Benefits

Deployments	Travel Time	Accident Reduction	Operating Cost	Environmental	Total	Annualized Cost	O&M Costs	Initial Capital	Net Benefits	B/C Ratio
I-94 Corridor Segment C Existing 2005	$534,000	$590,000	$866,000	$0	$1,990,000	$263,000	$148,641	$705,049	$1,727,000	7.6
I-94 Corridor Segment C E + Proposed 2005	$1,637,000	$945,000	$1,615,000	$0	$4,197,000	$326,000	$172,039	$969,126	$3,871,000	12.9
I-94 Corridor Segment C Existing 2035	$785,000	$846,000	$1,243,000	$0	$2,874,000	$263,000	$148,641	$705,049	$2,611,000	10.9
I-94 Corridor Segment C E + Proposed 2035	$1,844,000	$1,355,000	$2,316,000	$0	$5,515,000	$326,000	$172,039	$969,126	$5,189,000	16.9

All values are dollars per year except Initial Capital Cost

Table 3.6 Segment C – Performance Impacts

	Existing 2005	Existing and Proposed 2005	Existing 2035	Existing and Proposed 2035
Change in VMT	0	0	0	0
Baseline VMT	675,120	675,120	968,150	968,150
Improvement VMT	675,120	675,120	968,150	968,150
ATIS Savings (hours)	99.01	304.60	142.11	338.40
Baseline Delay (hours)	3.20	3.20	33.95	33.95
Improved Delay (hours)	2.80	2.68	29.73	28.48
Delay Reduction	-0.40	-0.52	-4.22	-5.47
Baseline Fatalities	0.011950	0.011950	0.017136	0.017136
Improved Fatalities	0.011644	0.011405	0.016698	0.016356
Fatality Reduction	-0.0003052	-0.00054419	-0.00043784	-0.00078056
Baseline Injuries	1.147029	1.147029	1.644887	1.644887
Improved Injuries	1.144581	1.144820	1.641377	1.641720
Injury Reduction	-0.002447674	-0.002208681	-0.003509891	-0.003167166
Baseline Fuel	34,431.12	34,431.12	49,375.65	49,375.65
Improved Fuel	33,634.38	32,945.76	48,232.59	47,245.07
Fuel Reduction	-796.7424	-1,485.3648	-1,143.063	-2,130.576
Baseline HC/ROG (tons)	0.00	0.00	0.00	0.00
Improved HC/ROG (tons)	0.00	0.00	0.00	0.00
HC/ROG Reduction	0	0	0	0
Baseline NO_x (tons)	0.00	0.00	0.00	0.00
Improved NO_x (tons)	0.00	0.00	0.00	0.00
NO_x Reduction	0	0	0	0
Baseline CO (tons)	0.00	0.00	0.00	0.00
Improved CO (tons)	0.00	0.00	0.00	0.00
CO Reduction	0	0	0	0

3.4 SUMMARY

Based on the IDAS benefit/cost analysis, the proposed ITS investments in Segments B and C of the Southeast Region I-94 corridor appear to have a larger payoff than the proposed investments in Segment A. A likely reason is that Segment A is currently more built-out with ITS deployments and many of the potential benefits are already being realized. This is supported by the analysis, which shows that net benefits from the existing system in Segment A total nearly $11.5 million, compared to a combined total of approximately $4.4 million in Segments B and C. Proposed investments in Segment A maintain the benefit/cost ratios at current levels while proposed investments in Segments B and C increase the benefit/cost ratio and provide substantial increases in net benefits. However, it is important to note that overall volumes and congestion levels are higher in Segment A so investment in all three segments of the corridor is justified.

A. Spectrum of Deployment Density

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B. Proposed ITS Elements and Field Approach

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C. ITS Elements Maps

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D. ITS Elements Spreadsheets

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E. Traffic Volumes

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F. IDAS Description

IDAS Description

This section presents a brief overview of the ITS Deployment Analysis (IDAS) system software used to conduct the benefit/cost analysis for this project. More detail on IDAS can be found at http://idas.camsys.com/. The tool being used in the evaluation is the. This software package was used to conduct the benefit-cost analysis of ITS alternatives. IDAS is a sketch-planning software and analysis methodology developed by Cambridge Systematics for the Federal Highway Administration (FHWA).

IDAS was developed to assist state, regional and local agencies in integrating ITS into the transportation planning process. Planners and others can use IDAS to calculate relative costs and benefits of ITS investments. IDAS currently can predict costs, benefits and impacts for more than 60 types of ITS investments in combination or isolation.

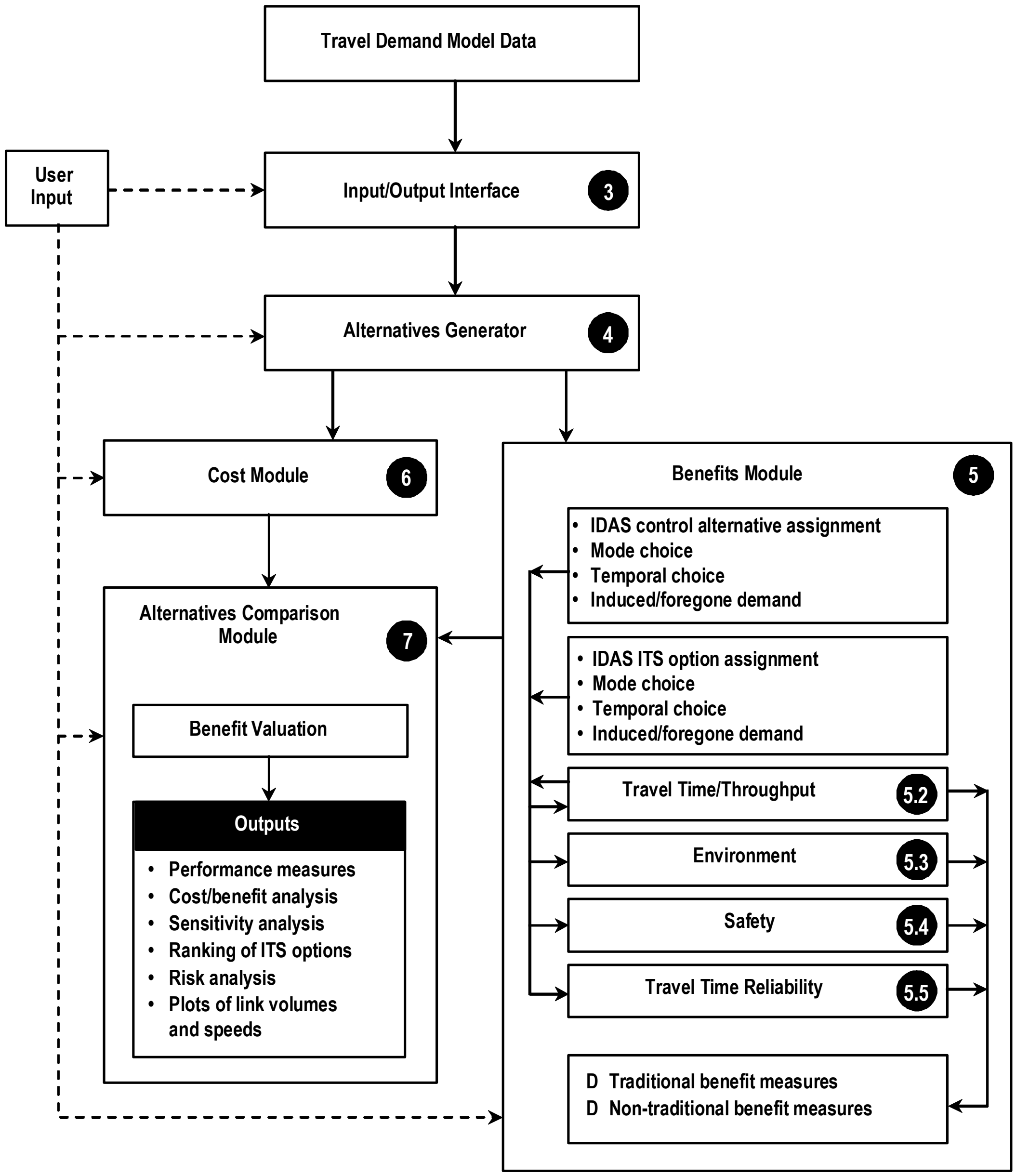
In order to be consistent with current transportation planning processes, IDAS operates as a postprocessor to travel demand models used by Metropolitan Planning Organizations (MPO) and by state Departments of Transportation (DOT). Although IDAS is a sketch-planning tool, it can implement the modal split and/or traffic assignment steps associated with a traditional planning model. These steps are key to estimating the changes in modal, route and temporal decisions of travelers resulting from ITS technologies. For this analysis, the Statewide Planning Model was utilized. Since this model was developed as part of a statewide model development effort, the methodology used is consistent.

There are a wide range of ITS improvements that can be assessed in IDAS, including Freeway Management Systems, Advanced Public Transit Systems, Incident Management, Emergency Management, Advanced Traveler Information Systems and many others. The set of impacts evaluated by IDAS included changes in user mobility, travel time/speed, travel time reliability, fuel costs, operating costs, accident costs, emissions and noise. The performance of selected ITS options can be viewed by market sector, facility type and district. IDAS is comprised of the following five different analysis modules:

- Input/output interface module (IOM)
- Alternatives generator module (AGM)
- Benefits module
- Cost module
- Alternatives comparison module (ACM)

The input/output interface is used to specify and translate the data files provided by the regional travel demand models and convert the data into a format that can be used internally by the IDAS model. The alternatives generator module allows an analyst to use a graphical user interface (GUI) to define and code ITS improvements into IDAS.

IDAS estimates both traditional benefits of ITS deployment, such as, improvement in average travel time and nontraditional benefits, such as reduction in travel time variability. The cost module allows the user to define the incremental costs of the various ITS deployments being studied, including capital costs and operating and maintenance costs. The user can modify IDAS-supplied default values for the proportion of the costs borne by the public and private sectors. Finally, the alternative comparison module provides the analyst with information regarding the value of user benefits from ITS deployments, the associated costs of the deployments and a comparison of the benefits and costs for different ITS deployment options.



The specific performance measures generated by IDAS include the following:

- Vehicle hours of travel (VHT)
- Average speed

- Person hours of travel (PHT)
- Number of person trips
- Number of accidents
  - Fatality
  - Injury
  - Property damage only
- Travel time reliability (hours of unexpected delay)
- Fuel consumption (gallons)
- Emissions:
  - Hydrocarbon and reactive organic gases
  - Carbon monoxide
  - Nitrous oxides
  - PM_{10}

The IDAS benefit/cost summary, details the results of the benefits valuation (value of time saved, value of accident reductions, etc.), cost analysis of the ITS option, net annual benefit and benefit-cost ratio. These include the following:

- Annual Benefits:
  - Change in user mobility
  - Change in user travel time (in-vehicle, out-of-vehicle and travel time reliability)
  - Change in costs paid by users (fuel costs, nonfuel operating costs and accident costs – internal only)
  - Change in external costs (accident costs – external only, HC/ROG, NO_x, CO, PM_{10}, CO_2, global warming, noise, other mileage-based external costs and other trip-based external costs)
  - Change in public agencies costs (efficiency included)
  - Other calculated benefits
  - User-defined additional benefits
- Annual costs:
  - Average annual private sector costs
  - Average annual public sector costs
  - Net benefit (annual benefit minus annual cost)
  - B/C ratio (annual benefit/annual cost)

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