Regulatory Benefit-Cost Analysis of Proposed Rulemaking Real-Time System Management Information Program

Section 1201 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) calls for *a real-time system management information program to provide, in all States, the capability to monitor, in real-time, the traffic and travel conditions of the major highways of the United States and to share that information to improve the security of the surface transportation system, to address congestion problems, to support improved response to weather events and surface transportation incidents, and to facilitate national and regional highway traveler information.* DOT proposes to set the parameters and schedule for implementing this Real-Time System Management Information Program through rulemaking.

This document presents a detailed analysis of costs and a high level analysis of benefits from compliance with the proposed rule that would require:

- the States corresponding to the 50 largest Metropolitan Statistical Areas (MSAs) to begin establishing metropolitan real-time information programs including travel time information on Interstates within two years of publication of the final rule;
- all States to establish statewide real-time information programs including roadway and lane closure, construction zone, and roadway weather conditions information on all Interstates including those in small urban and non-urban areas within two years of publication of the final rule;
- all 50 States and the District of Columbia to update their regional architectures within two years of publication of the final rule to reflect the deployment of real-time information program systems.

The scope of this document is the two-year period following the publication of the final rule. As of this writing, it is estimated that the final rule will be published in 2009, so the benefits and costs are estimated from 2011. It is noted that this benefits and costs assessment do not articulate the requirements of the proposed rule that are to be completed within the four-year span following publication of the final rule. Since the States self select the facilities to be monitored within the four-year period, it is not possible to determine a reasonable assessment of those additional costs and benefits.

This document also estimates costs of operating and maintaining real-time information programs serving statewide and metropolitan areas through 2019. This period would reflect the establishment of real-time information programs by the end of 2011, plus a seven-year period of operation. The seven-year period of operation assumes that equipment and supporting material for the real-time information program is fully replaceable after the operational life cycle.

The seven-year period of operation applied to this benefit cost analysis results from the following statement in the NPRM:

There is no requirement for a State to apply any particular technology, any particular technology-dependent application, or any particular business approach for establishing a real-time information program. States and other public agencies instead are encouraged to consider any salient technology, technology-dependent application and business approach options that yield information products consistent with the requirements set forth in this proposed rule.

This establishes substantial uncertainty in approaching a cost estimation methodology, as the method of generating the data typically carries a specific period of operation after which there is a need for full replacement. As will be described further in this analysis, the cost estimation methodology is based on an assumption of inductive loop systems which are commonly used as in-pavement loop detectors for measuring vehicle presence on a roadway lane. This assumption in no way suggests a preference on the part of the Department for generating data. Instead, this approach enabled the cost estimation to proceed based on what is popularly viewed as among the most expensive option for generating data.

The period of operation for inductive loop surveillance is identified as five years in a 2004 report titled "Guidelines for Transportation Management Systems Maintenance Concept and Plans", FHWA Report No. FHWA-OP-04-011.[1] However, in light of the range of technologies that may be applied, some with an operational lifetime of ten years, others with twenty years, a seven year operational lifetime appears to be a reasonable assumption. The actual operational lifetime experienced by a State would depend on what is implemented, how it is implemented and maintained, and the operational environment.

Section 1201 of SAFETEA-LU also requires DOT to set data exchange formats for real-time information programs. The exchange formats are the subject of a separate Interim Guidance[2]. Therefore, the costs of compliance with that rule are not included here.

This Regulatory Benefit-Cost Analysis considers the costs and benefits associated with establishing real-time information as described in §511.309 and §511.311 within a two-year time period. It is recognized that §511.311(d) identifies that metropolitan areas may define "Routes of significance" which will be under the coverage of a real-time information program within a four-year time period. The costs and benefits associated with implementation of §511.311(d) is not considered in this analysis because the "Routes of significance" are an unknown quantity.

This Regulatory Benefit-Cost Analysis is organized in the following manner:

- A discussion on the Analytical Approach applied to defining the scope of the implementation of this program

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[1] This report is available at the following URL: http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13882.html

[2] Further details on the data exchange formats and the interim guidance on their use are available at the following URL: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2007_register&docid=fr15oc07-84.pdf

- A description of the methodology used to estimate compliance costs
- A description of the methodology used to estimate benefits
- A discussion on the estimated economic impact of the benefits and costs of the real-time information program

All monetary values shown in this analysis have been adjusted to Year 2004 constant dollars based upon the Consumer Price Index published by the Bureau of Labor Statistics.[3]

The FHWA requests comments on the economic analysis of these proposed regulations including appropriateness of using the Georgia NaviGAtor study in the "Regulatory Cost Analysis of Proposed Rulemaking" to estimate benefits. Comments, including those from the State DOTs, regarding specific burdens, impacts, costs, and cost-effective use of limited resources would be most welcome and would aid us in more fully appreciating the impacts of substantially increasing the real-time monitoring and reporting capabilities nationwide. FHWA requests comments from State DOT's and others regarding how they anticipate they will comply with these proposed regulations, including the technologies to be used and the estimated cost per center-line mile. Hence, we encourage comments on all facets of this proposal regarding its costs, burdens, and impacts.

A. ANALYTICAL APPROACH

This section of the Regulatory Benefit-Cost Analysis considers the scope of implementing the real-time information program, and the compliance costs for States corresponding to the 50 largest metropolitan areas. Metropolitan Statistical Areas (MSA) were considered in this approach because of the geographic and spatial consistency of reported data obtained from a variety of sources.

The costs for establishing a real-time information program, updating a regional architecture, and operating/maintaining a real-time information program are presented separately.

Establishing a real-time information program in 50 largest MSAs:

A real-time information program monitors the transportation system operations in a metropolitan area according to the coverage, accuracy, and currency parameters defined in this proposed rule. For metropolitan areas, the proposed rule would require that travel speeds on Interstate sections be reported with 85% accuracy, updated every 10 minutes. The cost of establishing a real-time information program in a metropolitan area depends to a large extent upon the existing real time monitoring and reporting capabilities. Based on data from the Intelligent Transportation Systems Deployment tracking program [see www.itsdeployment.its.dot.gov], the Texas Transportation Institute [see http://mobility.tamu.edu] and the 511 Deployment coalition [see

[3] U.S. Department Of Labor, Bureau of Labor Statistics Washington, D.C., Consumer Price Index All Urban Consumers - (CPI-U), U.S. city average (9/19/2007), available at the following URL: http://www.bls.gov/cpi/cpid0709.pdf

www.deploy511.org] regarding existing capabilities, the 50 relevant MSAs can be categorized as high, medium, or low cost to establish a real-time information program.

Establishing a statewide real-time information program:

Outside metropolitan areas, the parameters for a real-time information program would require monitored information to be updated every 20 minutes. Real time travel speed information would be excluded from real-time information programs applied outside the metropolitan areas. Significant additional monitoring will likely not be required for coverage of non-metropolitan area roads. Therefore, the effort to establish a real-time information program for non-metropolitan areas is regarded as analogous to setting up a statewide 511 traveler information system[4] or updating an existing one. Costs of existing statewide 511 systems are used as the basis for that cost estimate.

Updating regional architectures:

The level of effort required to update a regional ITS architecture, as defined by a State and/or a Metropolitan Planning Organization (MPO) is estimated to be roughly a quarter of the effort required to initially develop a regional architecture. Costs of regional architecture development from the Preliminary Regulatory Evaluation that accompanied the rulemaking that resulted in 23 CFR 940 were used as the basis for that cost estimate[5].

Operations and maintenance:

The estimated operating/maintenance costs of the real-time information program would be 10% of the initial capital and labor required to establish the program in a given region. This estimate is based upon case studies of existing 511 traveler information systems and generally accepted systems engineering principles.

B. COST ESTIMATION METHODOLOGY

The following four principal categories of compliance cost were estimated for the

NPRM:

- Cost of establishing a real-time information program in the 50 largest MSAs within two years of publication of the final rule, including travel speeds updated every 10 minutes;

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[4] In 2000, the Federal Communications Commission designated "511" as the national number for traveler information. 511 systems provide traveler information via phone and websites in many states. More information is available at the following URL: http://www.deploy511.org.

[5] The Preliminary Regulatory Evaluation document was part of FHWA Docket No. FHWA-1999-5899. This is available at the following URL: http://dmses.dot.gov/docimages/pdf47/82833_web.pdf

- Cost of establishing a real-time information program statewide within two years of publication of the final rule; including travel and weather information updated every 20 minutes;
- Annual operating and maintenance costs for a real-time information program (statewide and metropolitan area);
- Cost of updating regional architectures to include the establishment of a real-time information program.

B.1 Cost Estimation Methodology for Establishing a Real-Time Information Program in the 50 Largest Metropolitan Areas

Cost data from existing 511 deployments, as well as costs of additional freeway monitoring to meet the requirements of this proposed rule, were used to estimate the cost of compliance with the NPRM's requirements in the 50 largest MSAs. Data from the U.S. DOT ITS Joint Program Office and from the Texas Transportation Institute (TTI) were used to estimate the costs of establishing a real-time information program. Low, medium, and high cost estimates are provided based on the suitability of existing monitoring capabilities to meet real-time information program requirements.

The cost of a real-time information program as described in the proposed rule is considered to be analogous to the cost of creating a new 511 system, or upgrading an existing 511 system. In the medium and high cost cases, this also involves improving the geographic coverage, content, and currency of the data collection feeding the 511 system. More than half of the 50 of the largest metro areas already have some 511 system in place, so an estimate of the cost of starting from "zero" is relevant only for a few of the high cost cities. The cost of improved monitoring of data on real-time traffic and travel conditions, particularly traffic speed information, on Interstates represents the largest proportion of the estimated cost.

Based on deployment data from the 2005 ITS Deployment Tracking Survey[6] and the TTI Urban Mobility Studies,[7] a national cost estimate was developed for deploying real-time information programs in the 50 largest metropolitan areas. Seven cities were determined to be low cost because they are close to meeting the proposed real-time information program characteristics. Eleven cities were determined to be medium cost because they possess some monitoring on more than half of the freeway miles and they already operate a 511 system and/or traveler information Web sites. Thirty-two cities were determined to be high cost because they have limited freeway monitoring and thus have a restricted amount of information to share via a 511 system.

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[6] Data on freeway miles under surveillance as reported by the Metropolitan Areas to researchers from the Oakridge National Laboratory in 2005 is available at http://www.itsdeployment.its.dot.gov. "Freeway surveillance" is the term used by this source for "the capability to monitor" as referred to in section 1201 of SAFETEA-LU

[7] The Texas Transportation Institute (TTI) conducts mobility studies and issues reports annually on their findings. The 2005 report is available at the following URL: http://mobility.tamu.edu/ums/report/

Multiplying the low, medium, or high estimates by 50 to derive a nationwide estimate would not be a realistic estimate, as the conditions for the "low" estimate (existing system is close to compliance with the proposed rule) do not apply to all 50 metropolitan areas, nor do the "high" conditions (existing monitoring/data collection is not close to compliance with the proposed rule) apply to all 50 metropolitan areas.

Information on current monitoring capability was not found for four of the metropolitan areas [Memphis, Richmond, Birmingham, and Rochester], and thus were assumed to be high cost.

The national estimate was made by assigning 7 cities as low, 11 as medium, and 32 as high costs based on actual deployment status of relevant components of a real-time information program. Total number of Interstate miles per city and deployment status was determined from the 2005 ITS Deployment Tracking Survey and the TTI Urban Mobility Studies;

- "low" cost cities have more than 80% of Interstate miles in the MSA currently monitored,
- "medium" cost cities have 50-80% of Interstate miles being monitored, and
- "high" cost cities have fewer than 50% of Interstate miles being monitored.

B.2 Cost Estimation Methodology for Establishing a Statewide Real-Time Information Program in all 50 States

The NPRM requirements for real-time information programs outside metropolitan areas would include construction and weather information, but not real time travel speeds on Interstates. Therefore, new monitoring requirements are likely to be minimal in most States; the primary cost will be formatting the information in standard formats and providing it to the public and other public sector agencies via the 511 system and the Internet. Establishing a real-time information program in a State would be analogous to the cost of a major update of a statewide 511 system. Most States already have 511 systems in place or will by the end of 2008.[8] Based on the cost of a major update of an existing 511 system in Arizona, the estimated cost for these deployments is $1.51 million per State.[9] This does not include the additional cost of metro coverage in that State, so the total cost of the program presented later is the sum of metro area and statewide costs.

The real-time information program would include monitoring certain types of real time information and providing "the capability and means to share that data with State and local governments and the traveling public." The assumption is that real-time information program data will be used by existing 511 systems and incident management

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[8] This claim appears in the following URLs: http://www.deploy511.org/deploystatus.htm OR http://www.fhwa.dot.gov/trafficinfo/511.htm. The statistics provided are used to represent the network and deployment for the Metropolitan Statistical Areas in question. It was found that they are based upon the similar but slightly different Metropolitan Planning Area boundaries for each region.

[9] This cost is based on costs of an actual upgrade to an existing 511 deployment in Arizona. "Interim Analysis Report Model Deployment of a Regional, Multi-Modal 511 Traveler Information System" http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//14248.htm.

systems, as well as other applications. However, the NPRM does not include requirements for any particular applications of the monitored information beyond basic 511 and inter-agency information sharing. Therefore, costs of other possible applications using the monitored data are not included here.

The District of Columbia is assumed to be covered by the real-time information program for the DC MSA, so there is not a separate statewide cost for DC.

B.3 Cost Estimation Methodology for Operating and Maintaining a Real-Time Information Program for Seven Years in the 50 Largest Metro Areas

Based on analysis of annual costs for existing 511 systems, operations and maintenance costs were estimated at 10% of original deployment costs per year. Annual costs include costs for 511 telecommunications, labor, and equipment replacement.

B.4 Cost Estimation Methodology for Updating a Regional ITS Architecture

An analysis of the cost of developing a regional ITS architecture was developed as part of this Regulatory Cost Analysis accompanying the rulemaking that resulted in 23 CFR 940. As part of that analysis, the cost of developing a regional architecture "from scratch" for a large metropolitan area was estimated to be $100,000 on average in 2000 dollars, or $109,698 in 2004 dollars. The cost was based on a survey of staff from impacted Metropolitan Planning Organizations (MPOs). An update should require no more than a quarter as much effort as the original development, given that much of the needed stakeholder coordination should already be in place from the initial architecture development process. Reflecting a new real-time information program should require a relatively modest modification to an existing architecture.

C. BENEFITS ESTIMATION METHODOLOGY

The effects of establishing a real-time information program include both quantitative and qualitative benefits to the general commuting public, the environment, as well as to the subset of traveler who actively acquire and use traffic information.

The methodology applied to estimate mobility, safety, and environmental benefits from the establishment of a real-time information program is based on the outcome of a comprehensive evaluation conducted in the Atlanta metropolitan region of the Georgia NaviGAtor system.[10]

The Georgia NaviGAtor system has deployed extensive monitoring on 150+ miles of Interstate and freeways in order to provide traveler information and to improve freeway management and incident management. The evaluation of the system measured the

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[10] A summary of this analysis may be found at http://www.benefitcost.its.dot.gov/its/benecost.nsf/0/C56D9AB9E2F47E79852572170053B11B?OpenDocument&Query=Home. The full report by URS Corporation, "Benefits Analysis for the Georgia Department of Transportation NaviGAtor Program." August 2006. is available at the following URL: http://www.ops.fhwa.dot.gov/travelinfo/gdotbenefit/index.htm

incident delay savings, emissions reductions, fuel savings, and secondary crash reduction savings from quicker incident detection, response, and clearance through the use of the NaviGAtor system. The analysis of the Georgia NaviGAtor system is particularly thorough in that it used actual incident logs to determine benefits.

The findings from the NaviGAtor system were extrapolated to the 49 other metropolitan regions that would be subject to this proposed rule.

The Georgia NaviGAtor estimation methodology applied a number of region-specific variables including the percentage of truck traffic on the highways, personal vehicle occupancy rate, the cost per hour per person for time spent in travel, the cost per hour per truck for time spent in travel, the personal and commercial vehicle fuel consumption rates, the cost of gasoline and diesel, and the average cost of a two-vehicle property-damage-only crash. In computing the benefits for the 50 largest metropolitan regions, the values of these variables were adjusted to reflect national averages and 2005 Vehicle Miles Traveled data was used.

Sensitivity analyses were also performed regarding the percentage of delay reduction attributable to the advanced information system versus the "Hero" safety patrols deployed on Atlanta's freeways. First, the benefits were calculated assuming that 1/3 of the delay reduction was directly attributable to the advanced information system. Second, the benefits were calculated assuming that only 1/10 of the delay reduction was directly attributable to the advanced information system.

D. ESTIMATED ECONOMIC IMPACT OF THE BENEFITS AND COSTS OF THE REAL-TIME INFORMATION PROGRAM

This section provides details of the specific assumptions and details of calculation methods used to estimate the proposed rule's compliance costs and benefits. The benefit-cost analysis provided here applies the general principles described in Circular No. A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" issued by the Office of Management and Budget in Executive Office of the President.[11]

Preliminary assessment of benefits and costs, applying a Net Present Value Base Case Analysis, in which there is an assumed real discount rate of 7 percent.

D.1 Cost of Establishing a Real-Time Information Program in Metropolitan Areas

The cost of establishing a real-time information program was based on known costs for existing 511 systems, with additional freeway monitoring and data fusion costs estimated for the "medium" and "high" parts of the range.

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[11] The contents of Circular No. A-94 are available at the following URL: http://www.whitehouse.gov/omb/circulars/a094/a094.html

The cost elements include labor, equipment, marketing/outreach, standards compliance, and telecommunications for the 511 system. Additional data needed beyond existing systems in place may be achieved through new data monitoring infrastructure or by purchasing data from the private sector. All 50 metropolitan areas have multiple private sector traveler information data providers.[12]

Based on data from the ITS Deployment Tracking Program, 7 of the 50 largest MSAs already have monitoring on at least 80% of freeway miles and already have 511 and are thus assumed to have "low" cost to establish a real-time information program. Eleven MSAs have monitoring on 50-80% of freeway miles and are thus assumed to have "medium" costs to establish a real-time information program. Four smaller cities where data on existing monitoring is not available are also assumed to have "high" cost. Thirty-two MSAs have monitoring in place on fewer than 50% of freeway miles and will require "high" costs to establish a real-time information program.

Since the cost of additional freeway monitoring is much greater than the cost of setting up a 511 system, based on existing case studies, the main determinant of cost to establish a real-time information program would be the extent and quality of the existing monitoring network. All 50 cities have multiple private sector real-time information data providers, so cities may be able to purchase additional data to establish a real-time information program more quickly, but not necessarily at lower cost.[13]

D.1.1 Cost for "low" cities that already have 511 and monitoring on 80% of freeway miles

For these low cost cities, the estimated cost is the cost of minor upgrades to the existing 511 system in terms of data content, currency, and accuracy. The upgrades may be achieved through either additional monitoring by the State DOT or purchase of data from the private sector.

The cost of additional monitoring is assumed to be $76,789[14] per freeway mile, with an average of 32 miles[15] to be upgraded.

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[12] Including but not limited to Navteq, Inrix, XMNavTraffic, and Westwood One. More than half of the 50 cities have received or will receive funding through the Intelligent Transportation Infrastructure Program (ITIP), which should accelerate the availability of high quality real time travel information by private sector providers. Please see the last section of this cost analysis for a discussion of issues and opportunities for private sector data. More information on the ITIP Program is available at the following URL: http://ops.fhwa.dot.gov/travelinfo/ttidprogram/ttidprogram.htm

[13] It is possible that private sector probe data will be cheaper and more accurate than current monitoring technologies, but we have no data on how much cheaper or more accurate as these probe data technologies are not yet widely deployed in the U.S.

[14] This cost is based on estimates from Business Models and Cost Considerations for 511 Deployment, a 2002 report on 511 deployment costs, which assumed that the monitoring was done with loop detectors, video, CCTV, and/or microwave sensors. The cost per mile for those technologies range from $29,000 to $70,000 per mile per technology, including systems integration and installation costs, but not backhaul telecommunications. Other probe data technologies not available in 2002 could cost significantly less, but that has not been proven. The 2002 costs represent a reasonable, conservative estimate of freeway

Per city:
Upgrade to 511 and Web site to include 1201 information = $1,512,040.[16]
Additional data collection/purchase ($76,789/mi * 32 mi) = $2,530,038.

Total for seven "low" cities at $3.97 million each = $27.78 million.

D.1.2 Cost for "medium" cities that have monitoring on 50-80% of freeway miles and limited 511 capabilities

Each of these 11 cities have existing public sector 511 phone systems and/or traveler information websites, but not necessarily with all of the information content, quality, and currency that would be required by the proposed rule. For these cities, the estimated cost includes major upgrades to the existing 511 and Web site, and significant additional monitoring. The upgrades may be achieved through either additional monitoring by the State DOT or purchase of data from the private sector.

The cost of additional monitoring is assumed to be $76,789 per freeway mile[17], with an average of 149 miles[18] to be upgraded.

As noted earlier, the average of 149 miles of additional monitoring needed is based on data from 11 cities for which deployment status data is available.

Per city:
Major upgrade to website and 511 systems to meet real-time information program requirements = $1,512,040 [19]
Additional data collection/purchase ($76,789/mile*149 mi - $11.44 million)

Total:
11 "511" upgrades @ $1.51 million each = $16.63 million
11 cities of freeway monitoring upgrades @ $11.44 million each = $125.86 million

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monitoring costs with current technology. The full report is available at the following URL: http://www.its.dot.gov/511/511_Costs.htm.

[15] Average number of freeway miles not under surveillance in Houston, San Diego, Minneapolis/Saint Paul, Buffalo, Sacramento, Salt Lake City, and Orlando. Current coverage and total number of Interstate miles per metropolitan planning area were obtained from the ITS Deployment Tracking survey available at the following URL: http://www.itsdeployment.its.dot.gov.

[16] This cost is based on costs of an actual upgrade to an existing 511 deployment in Arizona, from "Interim Analysis Report Model Deployment of a Regional, Multi-Modal 511 Traveler Information System", available at the following URL: http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//14248.htm.

[17] This cost is based on estimates from 2002 report http://www.its.dot.gov/511/511_Costs.htm

[18] Average number of freeway miles not under surveillance in Milwaukee, Providence, Portland, San Antonio, San Francisco including San Jose, Cincinnati, New York New Jersey, Washington, Tampa, and Atlanta. Current coverage and the total number of Interstate miles per metropolitan planning area are from the 2005 ITS Deployment tracking survey, available at the following URL: http://www.itsdeployment.its.dot.gov.

[19] This cost is based on costs of an actual upgrade to an existing 511 deployments in Arizona, from "Interim Analysis Report Model Deployment of a Regional, Multi-Modal 511 Traveler Information System", available at the following URL: http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//14248.htm.

Total for "medium" cities: = $142.49 million

D.1.3 Cost for "high" cost cities that have monitoring on less than 50% of freeway miles
Fewer than half of these 32 cities already have 511 systems, and the existing ones tend to be statewide road closure Web sites that are updated infrequently and appear to lack the characteristics for a real-time information program defined in this rule. Therefore, the cost estimate is based on the cost of new 511 systems for major metro areas.

Per city:
New 511 systems = $1,995,053 each[20]
Additional monitoring is assumed to be $76,789 per freeway mile, with an average of 230 additional miles[21] to be monitored = $17.66 million each.

Total:
32 new 511 systems at $1.99 million each = $63.84 million
32 cities of freeway monitoring upgrades at $17.66 million each = $565.16 million

Total for "high" cities = $629.01 million

D.2 Cost of Establishing Statewide Real-Time Information Programs

Fifty States will be required to establish statewide real-time information programs that provide construction and weather information, including road closures, but not real time travel speed information. The entirety of the District of Columbia would be covered by the metro system for that area, so a separate statewide system would not be required. The assumption is that for statewide systems, monitoring can be obtained from existing systems used for other purposes. For example, existing road weather monitoring station system could be used to provide real time weather information to travelers, and existing work zone management systems could be used to provide road closure information. The cost of establishing a statewide real-time information program is assumed to be similar to that of implementing a 511 system in a State.

The average cost of new statewide 511 systems is about $2.2 million,[22] including planning, implementation, and the first year of operations and maintenance (in 2002

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[20] 511 Deployment Costs: A Case Study", November 2006, 511 Deployment Coalition. Available at the following URL: http://www.deploy511.org/minutereports.htm#511costs. Average costs for new metropolitan area 511 systems in Tampa, Southeast Florida, and Central Florida.

[21] Average number of freeway miles not under surveillance in Philadelphia, Charlotte, Denver, Detroit, Phoenix, Seattle, Los Angeles including Riverside, Austin, Dallas, Chicago, Miami, Kansas City, Baltimore, Nashville, Boston, Indianapolis, Pittsburgh, Columbus, Saint Louis, Hampton Roads, Las Vegas, New Orleans, and Cleveland. Current coverage and total number of Interstate miles per metropolitan planning area are from the 2005 ITS Deployment Survey, available at the following URL: http://www.itsdeployment.its.dot.gov

[22] "511 Deployment Costs: A Case Study", November 2006, 511 Deployment Coalition, available at the following URL: http://www.deploy511.org/minutereports.htm#511costs. Average costs for Utah, Arizona, North Carolina, Virginia, Kansas, and Washington State.

dollars). [This is not much more than the cost of a new metro system from the previous section. Costs of new statewide and metro 511 systems are quite similar, since most of the cost of a 511 system is for disseminating information rather than collecting it.] However, most States already have a 511 system in place or will by the end of 2007.[23] Therefore, the cost of establishing a statewide real-time information program should be analogous to an update of an existing statewide 511 system, or $1.51 million[24] (in 2004 dollars).

Estimated cost of implementing real-time information programs in states:
50 States times $1.51 million = $75.62 million

D.3 Cost of Maintaining and Operating a Real-time Information Program

Based on case studies of existing 511 systems, the maintenance and operating costs for 1201 are assumed to be 10% of the cost of the original implementation each year. This estimate covers labor to maintain the system and replacement hardware and software. If the metro area chooses to purchase data from private sector providers, or an entire turnkey system, the annual cost would be the license fee from that vendor.

Based on the estimates in sections 1 and 2, the total cost of establishing real-time information programs in all 50 major cities plus statewide systems is about $804 million. An operations and maintenance cost of ten percent would be $80 million per year nationwide.

Costs of maintaining expanded metro systems are not included, as the schedule for deployment of expanded coverage will be determined by cost-constrained state plans.

D.4 Cost of Updating a Regional Architecture to Include a Real-Time Information Program

The universe of planning organizations impacted by the NPRM is taken as 50 State DOTs, plus the District of Columbia. The cost of updating a regional architecture to include the real-time information program was considered to be one quarter the cost of developing such architecture in the first place. Given that some of the stakeholder coordination should already be in place from the architecture development process, it seems reasonable to assume that updating the architecture should be no more than a quarter of the effort of developing the original architecture.

The estimated cost of developing a regional architecture, from the Regulatory Evaluation accompanying the architecture rule, is $100,000. That number was based on a survey of planning staff at State DOTs and MPOs circa 1999. It is reasonable to presume that those

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[23] This claim appears in the following URLs: http://www.deploy511.org/deploystatus.htm OR http://www.fhwa.dot.gov/trafficinfo/511.htm.

[24] This cost is based on costs of an actual upgrade to an existing 511 deployment in Arizona (Interim Analysis Report Model Deployment of a Regional, Multi-Modal 511 Traveler Information System), available at the following URL: http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//14248.htm.

locations that have established a regional architecture would have continued to maintain the fidelity of the architecture to reflect current transportation operations. Assuming that the regional architecture is properly maintained, it would be a relatively small effort to complete an update to include enhanced real-time information programs. Therefore, adjusting to 2004 constant dollars, the estimate for updating the architecture to include a real-time information program is $27,425, or a quarter of the cost to create a new regional architecture.

Nationwide estimate: $27,425 times 50 States + DC = $1.399 million

The architecture should be updated as part of the planning process for implementing the system. The systems are assumed to be implemented by the end of 2010. The total costs are discounted, for purposes of this analysis, to 2008 as the base year.

D.5 Total Estimated Cost of Establishing Real-Time Information Programs

This estimate sums the cost of each element of the proposed rule.

Updating regional architecture, 50 States + DC	= $ 1.399 million
Implementing in 50 metro areas	= $799 million
Implementing Statewide	= $76 million
Estimated total national capital cost:	**= $875 million**
Estimated annual nationwide operating cost:	**= $87 million**

Projected Annual Costs, Combined Capital and Operating Costs (rounded):
2009: $ 1.399 million
2010: $875 million
2011: $ 87 million
2012: $ 87 million
2013: $ 87 million
2014: $ 87 million
2015: $ 87 million
2016: $ 87 million
2017: $ 87 million
2018: $ 87 million

Total Combined Cost by 2018:	**$1,576,186,000**
Present Value of Total Cost:	**$1,221,763,000**

D.6 Benefits to Travelers from Real-Time Information Programs

The effects of real-time information program deployments include both quantitative and qualitative benefits to the general commuting public, the environment, as well as to the subset of traveler who actively acquire and use traffic information. The methodology

applied to estimate mobility, safety, and environmental benefits from establishing a real-time information program is based on the outcome of a comprehensive evaluation conducted in the Atlanta metropolitan region of the Georgia NaviGAtor system. This evaluation measured the incident delay savings, emissions reductions, fuel savings, and secondary crash reduction savings from quicker incident detection, response, and clearance through the use of the NaviGAtor system. Findings from the NaviGAtor system were extrapolated to the 49 other metropolitan region. The outcome from this estimation process is summarized in Table 1 in annual cost savings from a fully established real-time information program in the 50 largest metropolitan regions.

The Georgia NaviGAtor system includes both advanced information systems (detection and communication) and a roadside "Hero" program of quick response vehicles deployed on the freeway system. Therefore, sensitivity analyses were performed to examine how the benefits would change if only 1/3 and 1/10 of the delay reductions shown were due to the advanced information system.

Benefits Measure	Benefit	Base NaviGATor expanded	SA 1 1/3 delay reduction due to ATIS	SA 2 1/10 delay reduction due to ATIS
		Cost Savings	Cost Savings	Cost Savings
Mobility	320,677,944 vehicle hours of incident delay savings	$4,430,431,143	$1,476,810,381	$443,043,114
Environment	8,222 tons of HC emissions reduced. 11,581 tons of NOx emissions reduced.	$77,365,881	$25,788,627	$7,736,588
	446,737,789 gallons of gasoline consumption reduced 51,356,246 gallons of diesel consumption reduced	$1,205,607,850	$401,869,283	$120,560,785
Safety	20,599 secondary crashes reduced	$78,139,679	$26,046,560	$7,813,968
TOTAL COST SAVINGS FROM FULL INSTRUMENTATION IN 50 REGIONS:		**$5,791,544,552**	**$1,930,514,851**	**$579,154,455**

All monetary values shown in Year 2004 constant dollars

Table 1. Annual Benefits Summary from 100% Establishment of Real-Time Information Programs in the 50 Largest Metropolitan Region from Reduction in Incident Clearance With Sensitivity Analyses

A previous evaluation of the Atlanta Navigator found that a little over 1/3 of the reduction in a typical incident duration was due to incident detection and, verification, and dispatch (mostly advanced information) and a little less than 2/3 due to reaching the location after dispatch and clearance once at the location[25]. Sensitivity Analysis 1 (1/3 attributable to information systems) causes a 67% reduction in the total savings, and Sensitivity Analysis 2 (1/10 attributable to information systems) causes a 90% reduction in totals savings. Both still produce a B/C ratio greater than 1.

The Georgia NaviGAtor estimation methodology applied a number of region-specific variables including the percentage of truck traffic on the highways, personal vehicle occupancy rate, the cost per hour per person for time spent in travel, the cost per hour per truck for time spend in travel, the personal and commercial vehicle fuel consumption rates, the cost of gasoline and diesel, and the average cost of a two-vehicle property-damage-only crash. In computing the benefits for the 50 largest metropolitan regions, the values of these variables were adjusted to reflect national averages. The Georgia-specific values and the national average values are listed in Table 2 with sources for the national values.

The Georgia NaviGAtor study is based on 141 centerline miles of freeway coverage, however there are 342 centerline miles of freeway in the Atlanta metropolitan region. Therefore, benefits were adjusted to reflect a full real-time information program in the Atlanta metropolitan region. Furthermore, the national variables for the cost per hour per person for time spent in travel, the cost per hour per truck for time spend in travel, the personal and commercial vehicle fuel consumption rates, and the cost of gasoline and diesel were replaced in the Georgia NaviGAtor study and benefits were recomputed. These replacements were made to reflect more recent and nationally appropriate values.

Given the absence of region-specific incident counts, the rate of incidents as a function of freeway vehicle-miles traveled in the Atlanta metropolitan region was applied to the other 49 regions. Consequently, a region with double the annual freeway vehicle-miles traveled in Atlanta is estimated to incur double the cost savings from a fully established real-time information program in that region. The daily vehicle miles of travel on Interstate, other freeways and expressways was acquired from the U.S. Department of Transportation report "Highway Statistics 2005."[26] The specific methodology applied by the Georgia NavGAtor study is presented in the report "Benefits Analysis for the Georgia Department of Transportation NaviGAtor Program.[27]"

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[25] Presley, et al. "Calculating Benefits for NaviGAtor, Georgia's ITS" Paper presented at the 79th Transportation Research Board Annual meeting, Washington DC, 2000.

[26]Office of Highway Policy Information - Federal Highway Administration, U. S. Department of Transportation. "Highway Statistics 2005." Section 5, Table HM 71. The statistics for Federal Aid Urban Area were chosen to represent the Metropolitan Statistical Areas., which are available at the following URL: http://www.fhwa.dot.gov/policy/ohim/hs05/xls/hm71.xls

[27] URS, "Benefits Analysis for the Georgia Department of Transportation NaviGAtor Program." August 2006, available at the following URL: http://www.ops.fhwa.dot.gov/travelinfo/gdotbenefit/index.htm.

Evaluation Variable	Georgia NaviGAtor	National Value	Source/Details
Percentage of trucks on freeways	8.00%	5.26%	2005 Annual Vehicle Distance Traveled by Highway Category and Vehicle Type. "***Highway Statistics 2005***." , All Urban category, Passenger cars and other 2-axle 4-tire vehicles count versus single-unit 2-axle 6-tire or more and combination trucks.
Personal vehicle occupancy rate	1.16	1.14	*No documented information is available on national personal vehicle occupancy rate of vehicles on freeways. National personal vehicle occupancy rate for all trips is 1.63, while for work trips the value is 1.14. The NaviGAtor value of 1.16 is based on home to work trips for Atlanta.
Cost per hour for personal travel	$17.23	$11.20	From Recommended Valuation of Travel Time Saving 2003 update: Emil H. Frankel, "Revised Departmental Guidance: Valuation of Travel Tiem in Economic Analysis," USDOT-Office of the Secretary of Transportation, February 11, 2003. http://ostpxweb.dot.gov/policy/Data/VOTrevision1_2-11-03.pdf
Cost per hour for commercial vehicle travel	$32.15	$32.15	"***Status of the Nation's Highways, Bridges, and Transit: 2006 Conditions and Performance***", U.S. DOT, FHWA. Uses a "conservative" value of $32.15. from the FHWA Highway Economic Requirements System (HERS) Model.
Personal vehicle mileage	25.8 mpg	19.7 mpg	2005 Annual Vehicle Distance Traveled by Highway Category and Vehicle Type. "Highway Statistics 2005." Average fuel consumption per gallon.
Truck vehicle mileage	7.0 mpg	6.7 mpg	2005 Annual Vehicle Distance Traveled by Highway Category and Vehicle Type. "Highway Statistics 2005." Average fuel consumption per gallon.
Cost of Gasoline	variable $1.52 avg. Year 2003	$2.407	Energy Information Administration, Official Energy Statistics from the U.S. Government. Average of Jan-Dec 2006 Regular Grade Retail Price per gallon. http://tonto.eia.doe.gov/oog/info/gdu/gaspump.html - Converted from 2006 $ to 2004 $
Cost of Diesel		$2.535	Energy Information Administration, Official Energy Statistics from the U.S. Government. Average of Jan-Dec 2006 Retail price per gallon. http://tonto.eia.doe.gov/oog/info/gdu/dieselpump.html - Converted From 2006 $ to 2004 $
Cost of a two-vehicle property-damage-only crash	$3,793.36		NaviGAtor study applied data from U.S. Department of Transportation, National Highway Traffic Safety Administration, "**The Economic Impact of Motor Vehicle Crashes 2000.**"Washington, DC: 2002, available at http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf - Converted From 2000 $ to 2004 $
Cost/Ton HC emissions	$1,745		From NHTSA NHTSA Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis (March 2006); Table VIII-5 Lifetime Monetized Societal Impacts, Unreformed CAFÉ, 2008 MY; available at http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20
Cost/Ton NOx emissions	$5,441		

All monetary values shown in 2004 Constant dollars

Table 2. Variables Applied in Calculation of Benefits

It is important to note that these benefits reflect delay savings resulting from improved response to non-recurring events. The authors of the NaviGAtor Program study admit that total benefits estimation was not possible under their study.

*"the NaviGAtor website (www.georgia-navigator.com) currently registers over half a million visits per month, clearly indicating that Georgians derive a significant benefit from the content (images, travel times, incident info, etc.) that it provides. Attempting to quantify the benefits of the NaviGAtor website and other Advance Transportation Information Systems (ATIS), such as the Changeable Message Signs and the *DOT phone service is very complex; however, and was not included in this analysis."*

The benefits estimation does not include traveler information user benefits experienced by routine users of the system to adjust trip time and route in the form of enhanced trip reliability.

Additionally, the establishment of a real-time information program will greatly facilitate and enhance a score of other functionalities such as evacuation planning and implementation, infrastructure maintenance, or motorist assistance operations. These types of benefits, although significant and substantial, are not yet fully quantified through field evaluation either due to their inherent difficulty of assessment or cost of evaluation.

Reduced congestion from even a small percentage of travelers shifting time or route based on real-time information could yield additional benefits to all travelers that cannot be reliably estimated at this time, including reduced costs for new road construction and fewer police-reported accidents. Qualitative "quality of life" benefits might accrue to individual travelers, including reduced stress and ability to avoid congestion by rescheduling discretionary trips. These qualitative benefits are not included in this analysis. Therefore, the actual benefit of real-time information programs will likely be higher than is estimated here.

The Net Present Value of the estimated costs and benefits (excluding expanded coverage) through 2018 represents a $28.98 billion surplus to American travelers and taxpayers (B/C = 24.7). Even if only 1/3 of the total delay reduction found in the Atlanta Navigator study is used for the calculation there is a Net Present Value of $8.84 Billion (B/C = 8.2). If a conservative 1/10 of the total delay reduction found in Atlanta is used the Net Present Value is still $1.80 billion (B/C = 2.5).

This estimate is subject to change, as it is likely some cities will not have full monitoring in place by 2010, so initial deployment costs and subsequent maintenance costs will be spread over a longer period. Table 1 shows that the additional monitoring will accrue a national societal benefit valued at $5.79 billion per year for all 50 cities beginning in 2010. If the deployment is delayed, the benefits will consequently be reduced, but the NPV will still be positive number. The benefit estimate is conservative, as it is only for system level benefits due to reduced delay from faster incident detection and clearance; total benefits including benefits to individual travelers from increased travel time reliability could be an order of magnitude greater.

E. STATEMENT ON THE ANALYSIS

This Regulatory Benefit-Costs Analysis was prepared to satisfy Executive Order No. 12866. The order states that each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.

It is recognized that there are several sources of uncertainty introduced in this analysis. The costs estimation is acknowledged to be based upon a program in which inductive loop surveillance is the means for producing real-time information. This was done in order to avoid underestimating a "high" cost for fully establishing real-time information programs in each metropolitan area and each State. Technological advances and the market for information service providers evolve rapidly, allowing more cost effective approaches to be implemented.

The benefits analysis is dependent upon an extrapolation of the assessed delay-reducing impacts of the Georgia NaviGAtor system. It is clear that there is substantial value in the active management of the nation's transportation assets. The challenge here is to attribute the societal benefits that accrue specifically from the provision of real-time information. It is widely acknowledged that the provision of real-time information enables travelers to make more informed decisions, which allows for more reliable travel.

The delay-reducing opportunity from real-time information enables one to quantify its inherent "value." That value is likely to vary in quality in different areas of the country because of characteristics such as physical features, climatic characteristics, crash rate, presence of traffic and travel conditions data generation, and exposure of travelers to information dissemination media.

The evaluation variables are highly sensitive to geography. Pollution damage per ton, for instance, is known to vary with location. The valuation of pollution damage per ton is varied, and multiple sources express a broad range of values for estimating the total impact. For the final rule on the Real-Time System Management Information Program, the FHWA intends to apply the same value for emissions damage valuation as used in upcoming National Highway Traffic Safety Administration (NHTSA) Corporate Average Fuel Economy (CAFE) rulemaking. The prevention of fatalities and injuries also will vary based on the amount of delay per lane mile generated by local traffic conditions.

What is clear is that further empirical evidence, collected over a long time span, will shed a more accurate light on the full value of real-time information programs. The evidence at hand appears to indicate that there is a positive benefit-cost ratio attributed to the implementation of this rule. It is acknowledged, however, that there is a limited possibility that the costs could exceed the benefits.

States and other reviewers of this regulatory benefit-cost analysis are invited to submit comments on sources and techniques (such as simulation and modeling) that are not indicated here, but otherwise would be valuable for a more in-depth regulatory benefit-cost analysis.

Appendix A: Mileage Estimate for Top 50 Metropolitan Areas and Categorization into "High", "Medium", and "Low" costs.

averages for miles to be covered using ORNL -low	
Orlando	0
Minneapolis	0
Buffalo	0
Salt Lake City	0
San Diego	54
Houston	117
Sacramento	50
average	**31.57**
average for miles to be covered - medium	
Milwaukee	29
Providence	37
Portland	31
San Antonio	91
SFO, including San Jose	177
cincinatti	102
NYNJ	595
DC	178
Tampa	81
Atlanta	168
average	**148.9**
average miles to be covered - high	
Philadelphia	262
Charlotte	56
denver	191
detroit	262
phoenix	115
seattle	220
LA including Riverside	870
austin	60
dallas	447
chicago	450
miami	164
KC	301
baltimore	285
nashville	138
boston	314
Indianapolis	124
pittsburg	329
columbus	147
st loius	372
Hampton (VA Beach)	111
Las Vegas	145
New Orleans	91
Oklahoma City	142
Jacksonville	115
Hartford	131
Lousville	91
Cleveland	277
average	**230.00**

no data: Memphis, Richmond, Birmingham, Rochester. Assume these are "high" cost

Oak Ridge National Laboratory (ORNL) Network Extent (Metropolitan Planning Areas) used in the ITS Deployment Database

Appendix B: Net Present Value (NPV) of Benefits and Costs, including sensitivity analyses

From Appendix B of OMB Circular A-94 (October 1992)
Accessed from the Internet at the following URL: http://www.whitehouse.gov/omb/circulars/a094/a094.html
ADDITIONAL GUIDANCE FOR DISCOUNTING
1. *Sample Format for Discounting Deferred Costs and Benefits*

Base (Assume full Navigator Delay Reduction)

	Year since initiation renewal or expansion	Expected yearly cost	Expected yearly benefit	Discount factors for 7%	Present value of costs Col. 2 x Col. 4	Present value of benefits Col. 3 x Col. 4
	(1)	(2)	(3)	(4)	(5)	(6)
2008	1	$ 1,398,650	$ -	0.9346	$ 1,307,149	$ -
2009	2	$ 874,881,834	$ -	0.8734	$ 764,155,677	$ -
2010	3	$ 87,488,183	$ 5,791,544,552	0.8163	$ 71,416,418	$ 4,727,625,522
2011	4	$ 87,488,183	$ 5,791,544,552	0.7629	$ 66,744,316	$ 4,418,341,609
2012	5	$ 87,488,183	$ 5,791,544,552	0.7130	$ 62,377,866	$ 4,129,291,224
2013	6	$ 87,488,183	$ 5,791,544,552	0.6663	$ 58,297,071	$ 3,859,150,676
2014	7	$ 87,488,183	$ 5,791,544,552	0.6227	$ 54,483,244	$ 3,606,682,875
2015	8	$ 87,488,183	$ 5,791,544,552	0.5820	$ 50,918,919	$ 3,370,731,659
2016	9	$ 87,488,183	$ 5,791,544,552	0.5439	$ 47,587,775	$ 3,150,216,504
2017	10	$ 87,488,183	$ 5,791,544,552	0.5083	$ 44,474,556	$ 2,944,127,574
		$ 1,576,185,951		**Totals**	**$ 1,221,762,991**	**$ 30,206,167,642**

Benefit/Cost Ratio	**24.7**
NPV (B-C)	**$ 28,984,404,652**

SA 1: Assume 1/3 of Delay reduction due to ATIS

	Year since initiation renewal or expansion	Expected yearly cost	Expected yearly benefit	Discount factors for 7%	Present value of costs Col. 2 x Col. 4	Present value of benefits Col. 3 x Col. 4
	(1)	(2)	(3)	(4)	(5)	(6)
2008	1	$ 1,398,650	$ -	0.9346	$ 1,307,149	$ -
2009	2	$ 874,881,834	$ -	0.8734	$ 764,155,677	$ -
2010	3	$ 87,488,183	$ 1,930,514,851	0.8163	$ 71,416,418	$ 1,575,875,174
2011	4	$ 87,488,183	$ 1,930,514,851	0.7629	$ 66,744,316	$ 1,472,780,536
2012	5	$ 87,488,183	$ 1,930,514,851	0.7130	$ 62,377,866	$ 1,376,430,408
2013	6	$ 87,488,183	$ 1,930,514,851	0.6663	$ 58,297,071	$ 1,286,383,559
2014	7	$ 87,488,183	$ 1,930,514,851	0.6227	$ 54,483,244	$ 1,202,227,625
2015	8	$ 87,488,183	$ 1,930,514,851	0.5820	$ 50,918,919	$ 1,123,577,220
2016	9	$ 87,488,183	$ 1,930,514,851	0.5439	$ 47,587,775	$ 1,050,072,168
2017	10	$ 87,488,183	$ 1,930,514,851	0.5083	$ 44,474,556	$ 981,375,858
		$ 1,576,185,951		**Totals**	**$ 1,221,762,991**	**$ 10,068,722,547**

Benefit/Cost Ratio	**8.2**
NPV (B-C)	**$ 8,846,959,557**

SA 2: Assume 1/10 of Delay reduction due to ATIS

	Year since initiation renewal or expansion	Expected yearly cost	Expected yearly benefit	Discount factors for 7%	Present value of costs Col. 2 x Col. 4	Present value of benefits Col. 3 x Col. 4
	(1)	(2)	(3)	(4)	(5)	(6)
2008	1	$ 1,398,650	$ -	0.9346	$ 1,307,149	$ -
2009	2	$ 874,881,834	$ -	0.8734	$ 764,155,677	$ -
2010	3	$ 87,488,183	$ 579,154,455	0.8163	$ 71,416,418	$ 472,762,552
2011	4	$ 87,488,183	$ 579,154,455	0.7629	$ 66,744,316	$ 441,834,161
2012	5	$ 87,488,183	$ 579,154,455	0.7130	$ 62,377,866	$ 412,929,122
2013	6	$ 87,488,183	$ 579,154,455	0.6663	$ 58,297,071	$ 385,915,068
2014	7	$ 87,488,183	$ 579,154,455	0.6227	$ 54,483,244	$ 360,668,288
2015	8	$ 87,488,183	$ 579,154,455	0.5820	$ 50,918,919	$ 337,073,166
2016	9	$ 87,488,183	$ 579,154,455	0.5439	$ 47,587,775	$ 315,021,650
2017	10	$ 87,488,183	$ 579,154,455	0.5083	$ 44,474,556	$ 294,412,757
		$ 1,576,185,951		**Totals**	**$ 1,221,762,991**	**$ 3,020,616,764**

Benefit/Cost Ratio	**2.5**
NPV (B-C)	**$ 1,798,853,773**