



Haverhill-Plaistow MBTA Commuter Rail Extension Benefit-Cost Analysis

Rockingham County, New Hampshire

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for the Rockingham Planning Commission

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1. INTRODUCTION

1.1 Background and Purpose

The proposed Haverhill-Plaistow MBTA Commuter Rail Extension project is expected to enhance service and provide other quantifiable benefits, such as increased ridership due to the service improvements. Travelers induced to take rail, instead of driving or taking the bus, will mean fewer users on the roadways, resulting in a reduction in emissions, congestion, vehicle operating costs, accidents, and pavement wear and tear.

In addition to the improvements associated specifically with the new service, this project includes the construction of a layover facility. Currently, one train per day travels from Boston, Massachusetts, to Haverhill, Massachusetts, to begin its service to North Station. The other 5 trains come from a layover facility that is located approximately 0.7 miles away from the Haverhill station in Bradford, MA. The new layover facility will result in operating cost savings because the new facility will be located in closer proximity to the rail station.

The Benefit-Cost Analysis described in the following sections estimates the benefits and costs associated with completing the expansion of MBTA commuter service to Plaistow, New Hampshire, and building the new layover facility. The project is evaluated as compared to the current system, which is considered the baseline, and a future scenario without major capital improvements.

1.2 Summary of Benefit-Cost Results

Using the TIGER guidance recommended discount rate of 7 percent, this project will result in:

- Total benefits of \$83.7 million in present value terms;
- Total costs of \$35.6 million in present value terms;
- Total net present value of \$48.1 million, with a benefit-cost ratio of 2.3 at a 7 percent discount rate.

A benefit-cost ratio (BCR) of 2.3 at a 7 percent discount rate indicates that the benefits of the project outweigh the costs, suggesting that the project is economically justifiable. For comparison purposes, the BCR was also calculated at a 3 percent discount rate, resulting in a BCR of 3.9 for the rail extension and layover facility.

1.3 Organization of the Report

This report provides the framework of the benefit-cost analysis in Section 2. Information related to the traffic estimation utilized in the analysis is provided in Section 3. Benefits and costs are detailed in Section 4, and Section 5 presents the results with a conclusion evaluating the findings of the study. Figures and tables are provided throughout the report to better illustrate the analysis.

2. FRAMEWORK OF THE ANALYSIS

A comparison of the benefits and costs of a project can give an indication of whether or not a project is worthwhile. To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs on a present value basis; and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate. A fundamental tenet of the benefit-cost analysis approach is that only those incremental benefits directly attributable to the construction and operation of the project are included in the estimation of benefits and costs.

For this analysis, the cost to build and operate represents the foregone value of an alternative investment. The benefits of the project refer to the improvement in the social well-being delivered by the project.

2.1 Benefit-Cost Analysis

The Haverhill-Plaistow MBTA Commuter Rail Extension benefit-cost analysis estimates benefits for current and future users on an incremental basis; that is, the change in welfare that consumers and, more generally, society derive from access to the improved rail system, as compared to the current situation. As with most transportation projects, the benefits derived from the implementation of infrastructure projects are actually a reduction in the costs associated with transportation activities. For example, the reduction of costs due to the service expansion affects users differently, depending on their preferences and the way the project changes their individual transportation costs.

The benefits of a project are the cost reductions that may result from the project's implementation. These cost reductions may come in the form of reductions in the operating expenses, reduction of pollution or, more generally, a combination of these effects.

2.1.1 Principles

The Benefit-Cost Analysis was conducted by HDR| Decision Economics using methods and parameters consistent with the US Department of Transportation and the Transportation Investment Generating Economic Recovery (TIGER) and TIGER II Discretionary Grants guidance. The following principles guide the estimation of benefits and costs in the analysis:

- Only incremental benefits and costs are measured.
 - Incremental benefits of the project include transportation cost savings for users of the rail service, as well as highway users who benefit from the improved service that would be offered between Plaistow and Boston.
 - Incremental costs of implementation of the project include initial and recurring costs. Initial costs refer to capital costs incurred for design and construction of the rail expansion and layover facility. Recurring costs include

incremental operating costs and maintenance expenses. Only additions in costs to the current operations and planned investments are considered in the analysis.

- Benefits and costs are valued at their opportunity costs.
 - The benefits stemming from the Haverhill-Plaistow MBTA Commuter Rail Extension are those above and beyond the benefits that could be obtained from the best transportation alternative.

2.1.2 Measurement Data and Assumptions

As part of the TIGER II grant application process, which was the impetus behind this analysis, benefits and costs associated with specific long term outcomes criteria were estimated. Table 1 presents the benefits measured in this project application as they relate to the five long term outcomes identified in the TIGER II grant guidance: State of Good Repair; Economic Competitiveness; Sustainability; Livability; and, Safety.

Table 1: Benefits and Description of Evaluation Criteria Identified in Long Term Outcomes

Criteria	Benefit(s)	Description
State of Good Repair	Pavement Maintenance Savings	Pavement maintenance savings by diverting traffic from highway to rail
Economic Competitiveness	Long Term Employment	Value of long-term jobs and whether they will be created in areas of economic distress
Livability	Congestion Cost Savings to Remaining Highway Users	Door-to-door trip time savings to rail users
	Benefits to Existing Rail Users	Vehicle operating costs, parking expense, travel time, and rail fare
	Benefits to New Rail Users	Vehicle operating costs, parking expense, travel time, and rail fare
Sustainability	Emissions Reductions	Reductions in pollutants and green house gases due to auto and truck use reductions relative to the no-build condition

Safety	Accident Reduction	Reductions in property losses and injuries and deaths due to diversion of vehicle traffic off of roads
Job Creation and Economic Stimulus	Short Term Employment	Value of new short-term jobs created

2.1.3 Valuation

The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for non-pecuniary benefits. For instance, the different components of time are monetized by using a “value of time” that is assumed to be equivalent to the user’s willingness to pay for time savings in transit. United States Department of Transportation (USDOT) valuation guidance on the preparation of TIGER II applications was used in the analysis. Where USDOT has not provided valuation guidance or a reference to guidance, standard industry practice has been applied.

All benefits and costs are estimated in 2010 dollars in the analysis, and annual costs and benefits are computed over a long-run planning horizon of 30 years and summarized through a lifecycle cost analysis.

2.1.4 The Opportunity Cost of Capital

The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. A 7 percent real discount rate is used in the analysis, with a sensitivity test at 3 percent.

2.1.5 Model Structure

When conducting a benefit-cost analysis, a baseline scenario is compared to an alternative. For this study, the current rail service is considered the baseline and the expanded service is the alternative. Data from numerous sources are combined using a variety of relationships and TIGER II guidance to develop benefit and cost estimates.

2.1.6 Sensitivity Analyses

In addition to variation in the discount rate, two further sensitivity tests were conducted to account for the possibility that there may be variation from the expected outcome. The two sensitivity tests are on ridership projections and congestion relief benefits. Further information may be found in Section 3 for ridership and Section 4 for congestion relief benefits.

3. TRAFFIC ESTIMATION

Benefits and costs in the analysis are generated by several key drivers. Current ridership, as well as the estimated new ridership with the expanded service, affects the benefits for existing and new users. Other benefits are generated by changes in vehicle miles traveled (VMT) when existing highway users shift to rail and remove their vehicles from the roadways.

3.1 Ridership

Ridership estimates were used for two specific scenarios: a “no build” scenario and a “build” scenario. The “no build” scenario assumes the rail service remains the same and is not expanded to Plaistow, resulting in zero ridership at the Plaistow station. The “build” scenario assumes that the rail service is expanded to Plaistow and that a new layover facility is constructed.

In the “build” scenario, ridership estimates were generated by the MBTA and checked for feasibility by the Rockingham Planning Commission. These estimates assume that 24 percent of ridership at the new Plaistow station would be due to diversion from the existing Haverhill station, and the remainder would be new riders who formerly drove to their destination. Table 2 below shows the one-way ridership estimates assuming ten daily trips, including existing riders diverted from Haverhill, new riders, and total riders for various future years.

Table 2: Projected Plaistow Commuter Rail Ridership

	2017	2026	2035
Diverted Riders	350	418	499
New Ridership	1,106	1,322	1,580
Total Ridership	1,456	1,740	2,079

As a sensitivity test, ridership was reduced by 20 percent to test if the project was still economically beneficial even if ridership did not reach expectations. Even with this 20 percent reduction, the project still generates a benefit-cost ratio of 1.9 at a 7 percent discount rate.

3.2 Vehicle Miles Traveled

The road user benefits estimated in the benefit-cost analysis are due to reduced auto VMT that result when some drivers choose to ride the train, in response to the new service to Plaistow. Using the VMT data, as well as other information provided by the TIGER II grant guidelines and other sources, estimation of benefits for the analysis was completed.

4. BENEFITS AND COSTS ASSOCIATED WITH HAVERHILL-PLAISTOW MBTA COMMUTER RAIL EXTENSION

The benefit-cost analysis expresses benefits and costs monetarily in “present value” capturing the flows of benefits and costs over the project horizon. The most common metrics of benefit-cost analysis are the Net Present Value (NPV) and Benefit Cost Ratio (BCR). The NPV is the sum of the present value of future cash flows less the present value of the project’s cost including operations and maintenance expenditures. The BCR is expressed as the ratio of benefits of a project relative to its costs, both expressed in present-value terms. A BCR above 1.0 suggests that benefits exceed costs, in which case the projects create a positive return on investment.

4.1 Benefits

The benefit-cost analysis for the commuter rail extension measures five primary categories of benefits:

- Benefits to Existing Rail Users
- Benefits to New Rail Users
- Pavement Maintenance Savings
- Accident Reduction savings
- Congestion Savings to Remaining Highway Users and Emissions Reductions Savings

These benefits categories are discussed below.

4.1.1 Benefits to Existing Rail Users

These benefits include the travel time savings that accrue to riders who currently travel on the Haverhill-Boston line. While the rail speed will not be improved, the users who currently drive from New Hampshire into Haverhill, Massachusetts will receive a benefit from having a shorter drive to the train station. Route 125 in New Hampshire, the primary route traveled to the current Haverhill station is the most congested in the area. By no longer having to travel on this road, the existing users that are diverted to Plaistow will receive benefits in the form of reduced vehicle operating cost due to reduced mileage, travel time savings due to the lack of congestion on the rail line, and savings in parking costs, assuming a cost of \$2 at the Plaistow station compared to the \$4 at Haverhill.

Also taken into account for the existing users is the additional rail fare that they would have to pay due to the extension of the trip from Zone 7 to Zone 8 on the MBTA Commuter Rail system. The Zone 7 fare is \$7.25 per ride or \$235 per month, while the Zone 8 fare is \$7.75 per ride or \$250 per month.

4.1.2 Benefits to New Rail Users

These are the benefits for induced rail passengers who are expected to use the service after the extension. This benefit accounts for travel time, vehicle operating costs (i.e., fuel, oil, depreciation, tire wear, maintenance/repair), and rail fare. For travelers to Boston and other destinations where parking is relatively more expensive, parking savings will also be achieved; for example, parking at the new Plaistow Station is expected to be \$2 daily, as compared to an average of \$20 in Boston.

4.1.3 Pavement Maintenance Savings

As vehicles are removed from the roadways, the vehicle miles traveled is reduced. Fewer cars mean less wear and tear on the highways and lower future highway maintenance costs. This benefit is estimated on a cost per mile basis using data and guidance provided by the Federal Highway Administration (FHWA).

4.1.4 Accident Reduction Savings

The reduction of accident costs, like other variable costs, is dependent on the reduction of vehicle-miles. With the extended rail service, some vehicles will be removed from the roadways as drivers opt to use rail instead of driving their cars. The reduction in vehicles on the road is combined with a multiplier, which is a weighted average of fatal, injury, and property damage only (PDO) accidents. This calculation provides an estimate of the accident reduction benefits associated with the expanded commuter rail service.

4.1.5 Congestion Savings to Remaining Highway Users and Emissions Reductions Savings

These benefits are due to reduced auto Vehicle Miles Traveled (VMT), based on estimates of increased passenger traffic on rail. The value of these savings was generated using the actual traffic on Interstates 93 and 495 in Massachusetts. These two roads are highly congested, and given the availability of the data, a customized congestion relief analysis was conducted for this area. The reduction in VMT relieves congestion for those vehicles remaining on the highway, both auto and truck, resulting in reduced travel time and fewer vehicle hours traveled (VHT).

As a sensitivity test, the marginal congestion relief rate according to the Federal Highway Administration Cost Allocation Study of 1997 was applied to the savings in VMT to determine the value of savings in the absence of actual traffic data in the area. With the sensitivity test on congestion, the benefit-cost ratio is still positive, with a value of 1.1 at a 7 percent discount rate.

Additionally, there are emission savings produced from the reduction in auto and truck VMT. Emissions measured include volatile organic compound (VOC), carbon monoxide (CO), carbon dioxide (CO₂), nitrogen oxide (NO_x), sulfur dioxide (SO₂), and particulate matter (PM₁₀), varying by auto and truck. Finally, the reduction in auto VMT results in a savings of future highway pavement maintenance costs.

4.2 Construction and Operating and Maintenance Costs

The costs of the project consist of initial construction costs associated with expanding the rail service and building the new layover facility, as well as operation and maintenance (O&M) costs. The rail service upgrade is expected to cost \$29.5 million. Operating and maintenance costs for the rail are estimated to be \$24.8 million.

4.3 Employment

A discussion of employment benefits related to the Haverhill-Plaistow Commuter Rail extension is provided in the application narrative, though not in the summary tables in this document.

5. BENEFITS AND COSTS ESTIMATION

5.1 Estimation of Benefits and Costs

The following section provides detail on the benefits and costs to railroad and highway users, as well as society generally. For the purpose of estimating the costs and benefits, it is assumed that the project construction will begin in 2011 and be completed in 2013. Operating and maintenance costs occur annually, while construction costs are only incurred in the relevant construction period. Benefits increase annually as well.

5.1.1 Benefits to Existing Rail Users

The Rockingham Planning Commission assumes that 24 percent of the ridership at the new Plaistow station would be diverted from the existing Haverhill line. This would result in approximately 263 daily boardings or alightings at the new station in 2014. The total benefit to these existing users is \$11.3 million using the ridership projection provided by the Rockingham Planning Commission. Using the 20 percent reduced ridership, the total benefit is still \$9.0 million. The primary savings to these existing users is in vehicle operating costs.

5.1.2 Benefits to New Rail Users

There are benefits and costs to both rail and highway travel. In order to be induced to switch from highway travel to rail, the net benefits of riding rail must exceed the net benefits of traveling by automobile. Based on commuting data and other inputs, HDR estimated the projected number of induced or new riders with the extension to Plaistow. According to the analysis, in 2014, 833 new passengers per day would choose to take the train if the service was expanded. For sensitivity, that number was also reduced to 667. To calculate the incremental benefit to these new riders, three categories of benefits and the cost of ridership were examined. The benefits include vehicle operating cost savings, parking cost savings, and travel time savings.

There are differing costs for highway and rail travel. For highway travel, vehicle operating costs include fuel, oil, and depreciation costs, while the primary cost of rail is the fare and parking. Vehicle operating costs (VOC) are an integral element of the generalized cost of traveling. These costs are typically the most recognized of user costs because they usually include some out-of-pocket expenses associated with owning, operating, and maintaining a vehicle. The cost components of VOC measured in this analysis include: fuel and oil consumption, maintenance and repairs, tire wear, and vehicle depreciation.

Even though the operating cost is only associated with personal vehicles, fares may be considered equivalent components of cost for rail users to the extent that they affect mode choice decision-making in almost the same way as vehicle operating costs. Additionally, a parking fee has been implemented for a fraction of passengers boarding in Plaistow. The fee has only been assessed to a portion of the riders because it is assumed that some passengers will be dropped off, walk, or arrive by other means.

In the analysis, the net benefits to new rail users are estimated to be \$87.8 million. Vehicle operating cost savings represent the largest portion of this benefit, \$137.3 million in savings. Parking cost reduction savings are also quite significant (\$73.7 million), reflecting the diversion of passengers from highway to rail who are traveling to the Boston metropolitan area, and the relatively more expensive parking in that region. In order to accurately determine the benefits to the new riders, travel time changes and the cost of rail fare must also be considered. In this case, the travel time via rail is slightly longer, resulting in some additional cost. However, given the level of congestion on the roads in the area, and the vehicle operating cost savings, rail is still beneficial and offers approximately \$7 per user in benefits from switching to rail.

As a sensitivity test, the reduction in total ridership of 20 percent was applied, reducing the overall benefits to new riders to a value of \$70.3 million.

5.1.3 Pavement Maintenance Savings

Pavement maintenance cost reductions are another benefit of reduced vehicle traffic. In addition to the costs that individual drivers incur for auto and truck trips, there are costs in terms of damage to the road surface. Based on the Federal Cost Allocation study of 1997, a pavement maintenance cost of \$0.001 (in 2010 dollars) was used for autos. A reduction in traffic leads directly to a reduction in these maintenance costs.

Pavement maintenance savings are estimated to be a total of \$0.33 million. With the reduced ridership, the pavement maintenance savings are \$0.27 million.

5.1.4 Accident Reduction Savings

Accident reduction benefits accrue from a reduction in vehicle-miles. The reduction in vehicles on the road is combined with a multiplier or per-unit cost of accident. This multiplier is a weighted average of fatal, injury and property damage only (PDO) accidents. The rate of fatalities and injuries per 100 million VMT are from the NHTSA "Economic Impact of Crashes 2000." The benefits from the reduction in accidents are accrued based on the removal of autos and reduction in VMT due to passenger rail improvements. The larger the reduction in VMT, the less likely accidents are to occur and thus the larger the savings.

In the analysis, cumulative accident reduction savings are \$45.6 million. With reduced ridership, this value is \$36.5 million.

5.1.5 Congestion Savings to Remaining Highway Users and Emissions Reductions Savings

Congestion reduction benefits accrue to the users that remain on the highway, both auto and truck. The reduction in VMT due to diversions reduces congestion on the road, which alters the demand to capacity ratio, generally allowing for a higher speed and therefore reducing travel time. The demand to capacity ratio indicates the number of highway users that are on the roads compared to the space available for their vehicles. As with those who switched from auto to rail, there is a value of time that is used to compute the benefit of this reduction in vehicle hours traveled.

Emissions reduction savings are calculated as the difference between emissions cost per commuter, before and after the implementation of the project, and for riders that diverted from auto to rail. Emission rates used were from the Environmental Protection Agency values of grams per mile of emission, and were converted to a dollar value based on Victoria Transportation Policy Institute's and FHA's HERS values of dollars per ton of emission. While the diversion from auto to passenger rail does reduce vehicle emissions, adding train service slightly increases the amount of emissions per train mile. This counteracts a small portion of the emissions benefits, though the savings from removing autos exceeds the cost of emissions from the rail. Thus, the emission benefits are considered in terms of dollars per mile savings.

Total congestion reduction benefits of \$155.3 million and emissions reductions of \$10.0 million are estimated to be generated by the proposed commuter rail extension project. The congestion reduction with reduced rail ridership is \$124.4 million and the emissions reduction is \$8.0 million.

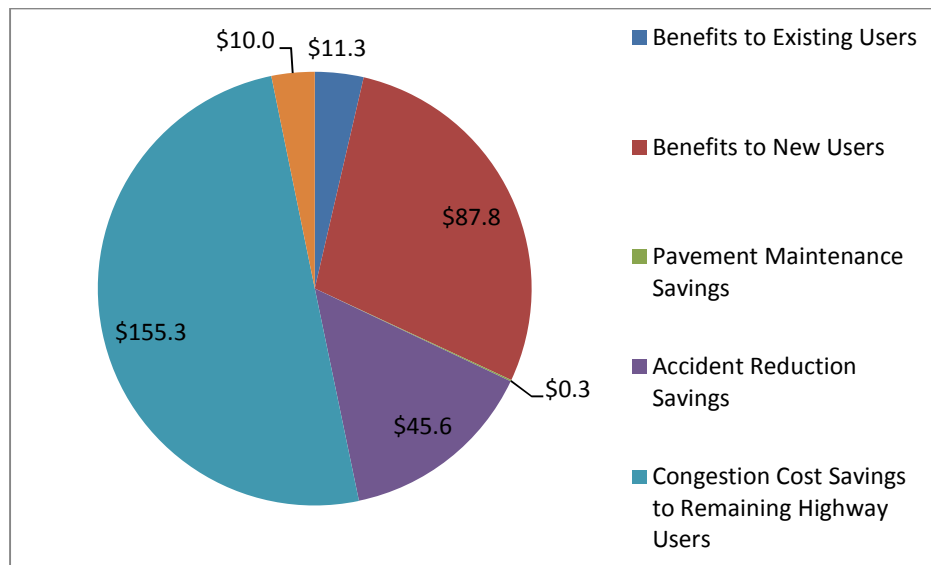
The results of the sensitivity test on congestion, which uses the FHWA Highway Cost Allocation valuation of marginal congestion impacts of \$0.06 per vehicle mile results in a congestion savings of \$17.8 million and when reducing the ridership, this number falls to \$14.3 million.

5.1.6 Summary of Benefit-Cost Results

The Plaistow-Haverhill Commuter Rail extension will result in total benefits of \$83.7 million, when discounted by 7 percent. The present value of total costs associated with this project is \$35.6 million, and the net present value is \$48.1 million. The BCR is 2.3 at 7 percent and 3.9 at a 3 percent discount rate.

As shown in Figure 1, the project will have the most significant impact on congestion, representing 50 percent of total benefits. Benefits to new train riders are also relatively significant, 29 percent of the total.

Figure 1: Total Benefits of Haverhill-Plaistow Commuter Rail Extension



A summary table of the benefits and costs associated with the rail upgrade project is provided in Table 3.

Table 3: Summary Table of Benefits and Costs for Haverhill-Plaistow Commuter Extension

7% Discount Rate		3% Discount Rate	
BENEFITS		BENEFITS	
	Millions of 2010\$		Millions of 2010\$
Benefits to Existing Users	\$ 11.3	Benefits to Existing Users	\$ 11.3
Benefits to New Users	\$ 87.8	Benefits to New Users	\$ 87.8
Pavement Maintenance Savings	\$ 0.3	Pavement Maintenance Savings	\$ 0.3
Accident Reduction Savings	\$ 45.6	Accident Reduction Savings	\$ 45.6
Congestion Cost Savings to Remaining Highway Users	\$ 155.3	Congestion Cost Savings to Remaining Highway Users	\$ 155.3
Environmental Benefits	\$ 10.0	Environmental Benefits	\$ 10.0
TOTAL BENEFITS	\$ 310.4	TOTAL BENEFITS	\$ 310.4
PV of Total Benefits	\$ 83.7	PV of Total Benefits	\$ 168.3
COSTS		COSTS	
Maintenance Costs	\$ 24.8	Maintenance Costs	\$ 24.8
Capital Costs	\$ 29.5	Capital Costs	\$ 29.5
TOTAL COSTS	\$ 54.2	TOTAL COSTS	\$ 54.2
PV of Total Costs	\$ 35.6	PV of Total Costs	\$ 43.3
Net Present Value (NPV)	\$ 48.1	Net Present Value (NPV)	\$ 125.0
Benefit-Cost Ratio (BCR)	2.3	Benefit-Cost Ratio (BCR)	3.9

5.1.7 Sensitivity Analyses Summaries

The first sensitivity analysis examines the impact of a 20 percent reduction in ridership. This results in total benefits of \$67.0 million at a 7 percent discount rate, total costs remain unchanged, and the net present value is \$31.4 million. This results in a benefit-cost ratio of 1.9 at a 7 percent discount rate and 3.1 at a 3 percent discount rate.

Figure 2 below shows that the relative benefit of each category remains unchanged, while the dollar values are reduced. Table 4 below shows a summary of these results at 7 and 3 percent discount rates.

Figure 2: Total Benefits of Haverhill-Plaistow Commuter Rail Extension, 20% Ridership Reduction

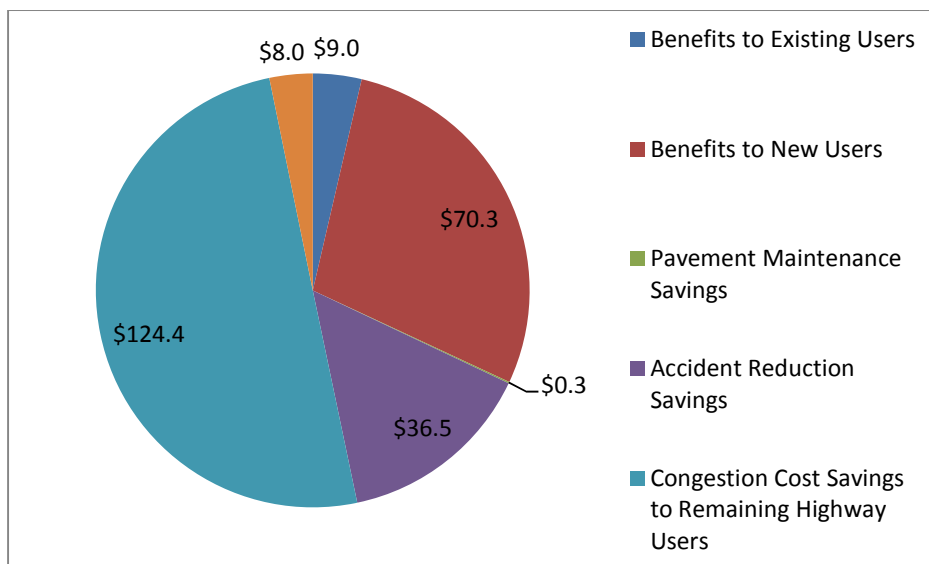


Table 4: Summary Table of Benefits and Costs for Haverhill-Plaistow Extension, 20% Ridership Reduction

7% Discount Rate		3% Discount Rate	
BENEFITS	Millions of 2010\$	BENEFITS	Millions of 2010\$
Benefits to Existing Users	\$ 9.0	Benefits to Existing Users	\$ 9.0
Benefits to New Users	\$ 70.3	Benefits to New Users	\$ 70.3
Pavement Maintenance Savings	\$ 0.3	Pavement Maintenance Savings	\$ 0.3
Accident Reduction Savings	\$ 36.5	Accident Reduction Savings	\$ 36.5
Congestion Cost Savings to Remaining Highway Users	\$ 124.4	Congestion Cost Savings to Remaining Highway Users	\$ 124.4
Environmental Benefits	\$ 8.0	Environmental Benefits	\$ 8.0
TOTAL BENEFITS	\$ 248.4	TOTAL BENEFITS	\$ 248.4
PV of Total Benefits	\$ 67.0	PV of Total Benefits	\$ 134.7

COSTS			COSTS		
Maintenance Costs	\$	24.8	Maintenance Costs	\$	24.8
Capital Costs	\$	29.5	Capital Costs	\$	29.5
TOTAL COSTS		\$ 54.2	TOTAL COSTS		\$ 54.2
PV of Total Costs		\$ 35.6	PV of Total Costs		\$ 43.3
Net Present Value (NPV)	\$	31.4	Net Present Value (NPV)	\$	91.4
Benefit-Cost Ratio (BCR)		1.9	Benefit-Cost Ratio (BCR)		3.1

A second sensitivity test was to use the reduced congestion cost. This was applied to both the analysis with full and reduced ridership. In the scenario where ridership reaches expected projections, the total benefits are \$38.7 million at a 7 percent discount rate. This brings the net-present value to \$3.1 million. The benefit-cost ratio is 1.1 at a 7 percent discount rate and 1.7 at a 3 percent discount rate.

As shown in Figure 3 below, in this scenario Accident Reduction benefits are now the largest share, accounting for 35.9 percent and the benefits to new users accounting for 34.5 percent.

Figure 3: Benefits of Haverhill-Plaistow Extension with Congestion Sensitivity

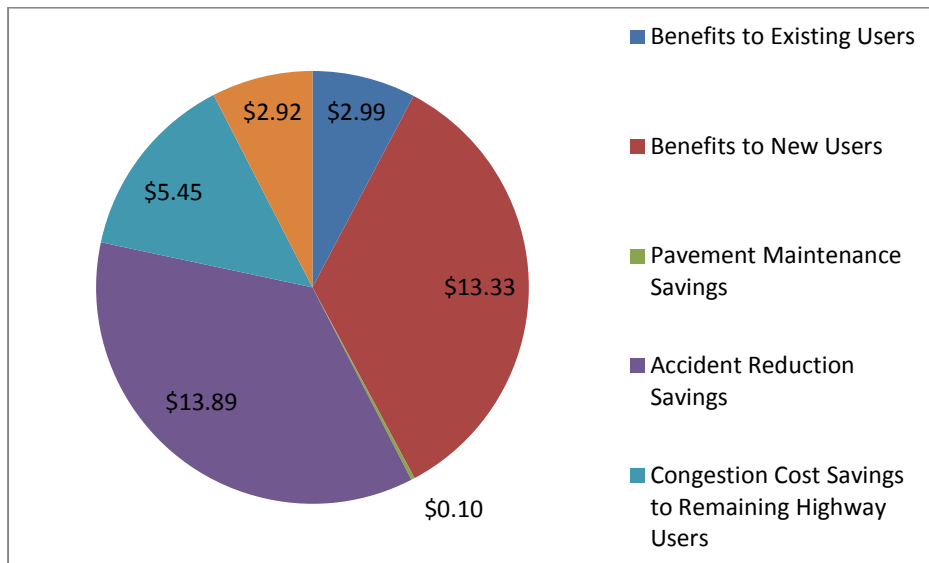


Table 5 below shows the summary of benefits at a 7 and 3 percent discount rate for this analysis.

Table 5: Summary of Benefits and Costs with Congestion Sensitivity

7% Discount Rate		3% Discount Rate	
BENEFITS		BENEFITS	
	Millions of 2010\$		Millions of 2010\$
Benefits to Existing Users	\$ 9.9	Benefits to Existing Users	\$ 9.9
Benefits to New Users	\$ 46.9	Benefits to New Users	\$ 46.9
Pavement Maintenance Savings	\$ 0.3	Pavement Maintenance Savings	\$ 0.3
Accident Reduction Savings	\$ 45.6	Accident Reduction Savings	\$ 45.6
Congestion Cost Savings to Remaining Highway Users	\$ 17.9	Congestion Cost Savings to Remaining Highway Users	\$ 17.9
Environmental Benefits	\$ 10.0	Environmental Benefits	\$ 10.0
TOTAL BENEFITS	\$ 130.6	TOTAL BENEFITS	\$ 130.6
PV of Total Benefits	\$ 38.7	PV of Total Benefits	\$ 73.6
COSTS		COSTS	
Maintenance Costs	\$ 24.8	Maintenance Costs	\$ 24.8
Capital Costs	\$ 29.5	Capital Costs	\$ 29.5
TOTAL COSTS	\$ 54.2	TOTAL COSTS	\$ 54.2
PV of Total Costs	\$ 35.6	PV of Total Costs	\$ 43.3
Net Present Value (NPV)	\$ 3.1	Net Present Value (NPV)	\$ 30.3
Benefit-Cost Ratio (BCR)	1.1	Benefit-Cost Ratio (BCR)	1.7