EconWorks Wider Economic Benefits Tools Implementation Assistance Final Report

Rhode Island

Rhode Island Division of Planning

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1 Introduction

Rhode Island was awarded a grant by FHWA through Round 4 of the SHRP2 Implementation Assistance Program. The grant funds were used to demonstrate and document the use of the EconWorks Wider Economic Benefits (W.E.B.) Tools for assessing wider economic benefits by the Rhode Island Division of Planning for a specific application of middle-stage transportation planning. The application selected was an evaluation of investment options as part of the Rhode Island Statewide Freight and Goods Movement Plan (Statewide Freight Plan). The Statewide Freight Plan identifies infrastructure improvements across multiple modes with a goal of optimizing freight movement and travel for individuals in Rhode Island. The EconWorks W.E.B.tools were applied on highway projects, as other modal improvements are difficult to assess with the current tools. The results of the analysis are one element in the overall project selection and prioritization for the Statewide Freight Plan, following on testing done for the EconWorks Project tools.

2 Documentation of Tool Use

Building upon the work completed while testing the EconWorks Project tools developed under SHRP2 Project Case Studies, the study team narrowed the 15 previously identified and tested projects to six projects of varying types, including interchange improvements and capacity expansions. These projects were intended to accomplish different goals and located across the state. Due to the differences in project types and goals, the project team tested each of the three tools for assessing wider economic benefits. As the experience with each tool was different, the next section presents an overview of the user experience for each of the three tools separately. The following table lists the projects identified for testing and the applicable tools.

Table 1: Proposed Projects and Applicable Tools

	Reliability	Accessibility	Intermodal Connectivity
Route 4 at I-95 SB	X		X
Route 146 at Sayles Hill Road	X		
ProvPort to I-95 SB	X		X
Route 6 at Route 10		X	
Post Road onto Route 37	X		
Route 4 at Oak Hill Road	X		

2.1 Reliability Tool

The Reliability Tool was developed to account for research findings that showed travelers value reliability in their trip. Traditional economic assessment only accounts for the value of general travel time and does not place a value on the amount of certainty in trip duration. The Reliability Tool is most appropriate for use in assessing projects that will alleviate congestion on existing roadways, assessing both overall travel time and reliability changes. The Tool accounts for both recurring and non-recurring congestion, differentiating between volume related congestion and incident (crash or otherwise) related delays. Rhode Island is considering several projects that will expand capacity on existing roadways to relieve congestion. Four of the projects identified for analysis with the EconWorks Wider Economic Benefits (W.E.B.) tools appeared suitable for analysis with the Reliability Tool.

2.1.1 Suitability for a Range of Projects

Overall, the project team found the Reliability Tool to be the most suitable of the wider economic benefit tools for assessing projects in Rhode Island. The nature of the built environment in Rhode Island often results in heavily congested roadways. Many of the projects under consideration for the Statewide Freight Plan target congestion reduction, which is best assessed with the Reliability Tool. Proposed projects include improved access to an interstate, adding a lane on an arterial, converting a series of signalized intersections to interchanges, and an interchange reconfiguration.

There are some minor concerns about applying the Reliability Tool to interchange projects, as noted in some of the testing documentation. This may be problematic for Rhode Island, as many of the planned capacity improvements involve alleviating congestion through improved interchange connections or alignments. The Reliability Tool is able to assess these projects, though caution must be used as the process may not be as straight-forward as with other capacity enhancements.

One shortfall in suitability is that some of the proposed capacity improvements create new movements on existing roadways. The tool does not readily have the capability to assess these types of improvements, so they cannot be easily compared to other capacity-improving projects with the Reliability Tool. Additionally, there are some limitations to the tool's use due to the types of improvements associated with the currently existing built environment in Rhode Island, but overall the Tool is widely useful. The limitations include inadequate assessment of interchange projects, the inability to handle projects that create new movements on existing roadways, and the inability to assess any increases in traffic volumes associated with a particular project.

2.1.2 Usefulness for Consensus Building

The Division of Planning collaborated with the Connecticut Department of Transportation and the Southeastern Regional Planning and Economic Development District (SRPEDD) in Massachusetts to present at the American Planning Association 2016 National Conference on the EconWorks W.E.B.tools. The presentation provided the opportunity for the three agencies to share their experiences of the tools with each other and with planners from across the United States. The session was well attended, and much of the discussion centered on the use of the tools as a supplement to standard benefit-cost analyses. Rhode Island believes that the results produced by Reliability Tool will prove useful in discussion with decision-makers and the public to provide tangible, quantitative and quantifiable impacts of various proposed alternatives.

2.1.3 Preparation of Inputs

The project team aimed to keep the inputs as simple as possible to allow for continued use of the tools for the Rhode Island Division of Planning and Department of Transportation (RIDOT). The Reliability Tool requires minimal data development and model calibration, making it a fairly user-friendly tool. The inputs indicate both the existing and proposed characteristics of the roadway, many of which are readily available from RIDOT inventory data and by viewing aerial images of the study area.

The project team was able to gather sufficient information for four of the five projects that were selected for analysis with the Reliability Tool. The project without sufficient information was an interchange reconfiguration on Route 4 at I-95 Southbound that would provide direct access in two ways that do not currently exist, alleviating congestion in the area. For the remaining four projects, data were gathered using traffic volumes and truck percentages provided by RIDOT.

Traffic volumes were held constant for both the base and build conditions, as the documentation notes that the tool cannot distinguish induced demand. The primary differences between the base and build condition were changes in peak capacity for every project. For one project, the road was upgraded from a multi-lane signalized arterial to a freeway. In all cases, the incident frequency and incident duration percentages were held constant for conservative results as sufficient information was not available to accurately calculate the expected reductions. Thus, while the projects *are* anticipated to reduce incident frequency and possibly duration, these *impacts were not quantified*. Additional detail on the collection and preparation of data inputs can be found in section 7.1.

2.1.4 Dissemination and Interpretation of Outputs

The Reliability Tool outputs were fairly easy to interpret because all of the selected projects covered short distances and did not require aggregation of multiple segments. Highway segments are the basic unit of input, and for outputs, segments are aggregated into highway sections.[1] Assessing multiple segments seemingly complicates the tool usage process, including the presentation of the results, as it is unclear how multiple segments are incorporated into the tool as each "scenario" only incorporates one segment. This was not an issue that needed to be addressed for any of the projects considered for Rhode Island, but may be worth clarifying whether the aggregation is to be done within or outside of the model, and whether each segment should be its own scenario.

[1] The User Guide notes that highway segments can be of any length though recommends that they not be so long that characteristics change or so short that inputs are burdensome. Examples of reasonable segments include a freeway between interchanges or a signalized highway between signals. If analyzing a highway corridor improvement project, it would be necessary to aggregate multiple segments to generate results.

Communication of the results was done with a summary of the incremental change between the base and build conditions for each project. This reflects the value of the improved reliability for the existing users of the roadway under the build conditions. The results were also incorporated into the accounting framework to complete the process.

Overall, each of the projects generated a value due to improved reliability in terms of both recurring and non-recurring congestion relief, though the magnitude varied greatly across projects. Additional information on the project-specific results is presented in Section 8 Summary of Outputs.

2.1.5 Ease of Use and Understandability of Outputs

The Reliability Tool was the easiest to use of the three tools tested. The Tool also produced the most readily understood outputs, simply indicating the number of hours of vehicle delay and the total value of that congestion cost, both recurring and non-recurring. Outputs from the tool itself are readily understood and straightforward, at least for the projects selected. Use of the accounting framework easily converted the value of incident-delay per vehicle to a monetized value of total incident delay for the given year.

2.2 Intermodal Connectivity Tool

The Intermodal Connectivity Tool aims to assess wider benefits of projects that are designed to enhance truck movements accessing rail, marine, or air terminals. Two of the proposed projects met this criteria, though limitations of the facilities noted in the tool only allowed for one of them, ProvPort to I-95 Southbound, to be analyzed.

2.2.1 Suitability for a Range of Projects

The primary goal of this analysis was to assess tools in the context of freight related projects, and thus improvements that would benefit passengers were not evaluated. The Intermodal Connectivity Tool lists six total facilities for Rhode Island in its database – three airports (each serving freight and passengers), one marine terminal, and two passenger rail facilities.

For Rhode Island, this tool seems most suitable for projects adjacent to air terminals, particularly T.F. Green Airport in Warwick. Unfortunately, none of the projects considered were related to air freight improvements.

The project team was only able to analyze one of the two proposed marine access projects as the Port of Davisville is not included in the list of facilities. This raised concerns over the information for the Port of Providence, and ProvPort in particular. The Army Corps of Engineers data sources classify all facilities in Rhode Island as the Port of Providence despite their location. Thus, the freight volumes that are the source of some of the calculations may be overstated for Rhode Island facilities. This would be less of a concern if all facilities were located in the same area, but the Port of Davisville is approximately 20 miles from the Port of Providence.

For all of these reasons, the Intermodal Connectivity Tool is only mildly useful for projects under consideration in Rhode Island. Although generally easy to use and understand, the tool may have limited applicability for projects in Rhode Island.

2.2.2 Usefulness for Consensus Building

The results of the Intermodal Connectivity Tool analysis will be incorporated into the final prioritization of infrastructure projects in the Rhode Island Statewide Freight Plan currently under development. Initially the Division of Planning had intended to use the results from the Accessibility and other tools to compare across a number of projects, but limitations of the tools and the data available made this approach unfeasible. Based on the state's experience with the tools, they would be useful during an alternatives analysis.

2.2.3 Preparation of Inputs

The preparation of inputs for the project tested was quite simple and the notes in the tool were very helpful for the user to understand the data needs and purpose. The project assessed was a direct access improvement from the Interstate to the Port Terminal. The data needs were minimal – the name of the facility, the distance from the improvement to the facility, the annual number of trucks and the travel time savings per truck, and share of trucks on the facility related to the terminal. The very straightforward inputs and clarifying instructions within the module made preparation quite simple. Additional detail on the collection and preparation of data needs can be found in section 7.2.

2.2.4 Dissemination and Interpretation of Outputs

The outputs from the Intermodal Connectivity Tool are fairly well structured and straightforward to understand. The Results tab provides well-defined output boxes for each of the facilities evaluated for both container and bulk connectivity with comment annotations explaining each line. The output box summarizes the facility type and location while also providing information on the overall port activity as pulled from the source data, and a summary of the project specific impacts that includes the number of impacted trucks, their time savings, and the dollar value of those savings. This information is provided for all trucks on the roadway that will be improved as well as the trucks accessing the intermodal facility. The connectivity index is weighted based on a factor from the input data and the value of time savings for trucks accessing the facility to generate the weighted connectivity value that is entered into the accounting framework.

The project considered was a marine project that did not have any container activity, so there was no change in container connectivity. The bulk connectivity index outputs seem reasonable, though the team has concerns whether freight volumes from other terminals are included in the results.

2.2.5 Ease of Use and Understandability of Outputs

There are some components of the "Results" worksheet that are confusing, including the values in columns J through L that do not correspond to anything. Additionally, it is unclear whether the weighted connectivity value is a dollar value or some other measure.

The accounting framework is somewhat confusing for the Intermodal Connectivity Tool, as the "weighted connectivity score" that is entered into the spreadsheet becomes zero for the no build situation since it is based on time savings, which would be nothing in the baseline scenario. If different values are to be entered into the accounting framework, it is unclear from the documentation.

2.3 Accessibility Tool

There are two versions of the Accessibility Tool, the Buyer-Supplier Market Access Tool and the Specialized Labor Market Access Tool. The Buyer-Supplier Tool is most suitable for projects that will enhance access between markets, either consumer or producer. For example, this can include enhancing access to places of employment or enhancing delivery access for commodities. The Specialized Labor Market Access Tool is a more specific application that is important when the transportation link under consideration serves an important role in the work commute and the study area is specialized in specific industry sectors. While the improvement tested is an important link for work commutes, the industry distribution of the labor market in Rhode Island is not highly specialized and the improvement is not targeting a specific industry, thus the Buyer-Supplier Accessibility Tool was used. The Accessibility Tool was only tested on one project due to the intensive data requirements.

2.3.1 Suitability for a Range of Projects

The Accessibility Tools appear to be suitable for a wide range of projects that upgrade transportation infrastructure. Any investment that improves access for freight movement or provides better transportation options for residents attempting to access jobs would be suitable for analysis using one of these Tools. The difficulty for application in Rhode Island is that the environment is already well built, and thus infrastructure investments often target congestion alleviation. The Tools may be better suited for larger areas without significant existing infrastructure connecting towns and cities.

2.3.2 Usefulness for Consensus Building

The results of the Accessibility Tool analysis will be incorporated into the final prioritization of infrastructure projects in the Rhode Island Statewide Freight Plan as it will with the outputs of the analyses conducted using the other EconWorks W.E.B.tools.

2.3.3 Preparation of Inputs

The preparation of the inputs for the Accessibility Tool was more difficult than for the other tools because it requires much more information than the Reliability or Intermodal Connectivity Tools. There are six components for data entry that are ideally gathered from a travel demand model, though alternative options are available. These options were utilized for the Rhode Island project as the state's travel demand model could not produce the necessary outputs. Population data from the U.S. Census Bureau, including both existing and forecast data, were utilized as a proxy for the activity data required to run the model. The travel time information used was gathered using Google Maps with assumptions made for the future conditions. These substitutes allowed the project team to assess the proposed improvement, though the reliability of the results may be questionable based on the large number of assumptions required to generate any outputs in the absence of a travel demand model. Additional detail on the collection and preparation of data needs can be found in section 7.3.

2.3.4 Dissemination and Interpretation of Outputs

The outputs from the Accessibility Tool are also the most confusing of the three tools. It is not readily apparent what the effective density/potential access "scores" represent in the tool itself, though the conversion of this information to dollar values in the accounting framework does make a bit more sense. The productivity output was not calculated in the tool itself due to the large number of zones and the need to use a proxy that is not available at the sub-county level. The proxy for gross regional product, which is unavailable at sub-metropolitan statistical area level, is average annual wages. Utilizing the Bureau of Economic Analysis data, as suggested in the documentation, the lowest available level is the county. Since the zones in the analysis are below county level, this was not deemed suitable. It is possible to gain information on income at the city or town level, but this would come from the US Census Bureau, and is recorded by place of residence rather than place of employment, creating an undesirable mix of non-compatible sources. The outputs from the accounting did provide insight into the perceived value of increased market access due to the proposed improvement, indicating that the potential access improvements change the effective density/potential access score to result in a multi-million dollar increase in economic benefits to the state. The effective density/potential access score is not well-defined in the guidance making it unclear what this metric represents.

2.3.5 Ease of Use and Understandability of Outputs

This tool is not as easy to use as the other tools for assessing wider economic benefits. The data needs are much more intensive and while it is easy to input the information once the data has been collected, the results are not intuitive. It is unclear what the effective density/potential access scores represent and without the productivity value in the module, the results are relatively meaningless.

The "output" tab of the spreadsheet module presents effective density/potential access scores for each zone for both the no build and build condition. It aggregates these values to a total as well. While the documentation explains the definition of effective density and that "higher density of activity are assumed to imply more, bigger markets or activity centers that bring buyers and sellers together and also allow for greater input matching, sharing, and learning." Seemingly, higher values are better; this does not clarify what the numbers shown in the effective density/potential access measures actually mean and what type of value or improvement between the no build and build would indicate good access/density.

As noted in the previous section, no output for total productivity was calculated within the spreadsheet module due to data limitations. Had the Gross Regional Product inputs been entered, the model would have also included a dollar value for an increase in productivity. This metric, similar to the information available from the accounting framework, is a tangible and understandable bit of information on the benefit of the improved density/accessibility. Without this information, the value of the "scores" is seemingly less tangible and more difficult to communicate to the public if utilized as part of project planning.

3 Tool Outputs Relative to Other Economic Models

A one-to-one comparison of the various tool outputs to expected outputs from other models was not performed. However, the outputs from the Reliability Tool were compared to the travel time benefits estimated by the travel time savings component of a traditional benefit-cost analysis and the recurring congestion values were found to be similar. This validated the tool outputs and provided reassurance of the additional benefit of the non-recurring congestion reliability for the project team.

While it may be possible to compare the results of the tools to TREDIS, the use of the comparison modules would require a subscription to include the wider benefits among other factors. An additional approach for comparison would be the use of an Economic Impact Model, such as IMPLAN. Given that economic impact models examine the effects of jobs and spending in the economy associated with the transportation investment and would not be added to a standard benefit-cost analysis, no comparison economic impact analysis was completed as part of the EconWorks W.E.B.tools analysis. Economic impacts were estimated for the following projects in the Statewide Freight Plan:

- Route 4 at I-95 SB;
- Route 146 at Sayles Hill Road; and
- ProvPort to I-95 SB.

4 Tool Use for Rhode Island Planning and Project Development

The set of tools for assessing wider economic benefits has helped in the prioritization of potential investments for the Statewide Freight Plan. Although only one component of a much larger set of criteria, the results of the wider economic benefits tools, particularly the Reliability Tool, have been useful in estimating the benefits of various proposed projects. While beneficial, there are some limitations including that the tools only apply to a subset of projects under consideration, making it difficult to make comparisons with projects that do not meet the criteria for use with the modules.

Beyond the specific application of the Statewide Freight Plan, these tools may be an inexpensive way for Rhode Island to assess economic benefits of proposed project alternatives during planning studies and project development for infrastructure investment. When conducting an alternatives analysis on a proposed roadway capacity improvement project, for example, RIDOT or the Division of Planning may consider inputting the traffic data of various alternatives into the Reliability Tool to explore impacts on travel reliability and changes in non-recurring congestion. The results of this tool would provide an estimate of the economic impacts of these changes and could be used as a small piece of the overall selection decision.

The tools may be useful for Rhode Island when planning and evaluating projects that are designed to alleviate congestion and more efficiently serve the state’s intermodal facilities. Financial constraints often limit the ability of the state to conduct economic impact analyses using expensive tools like IMPLAN and TREDIS. These inexpensive, simple tools can be utilized to estimate economic impacts of various alternatives and to provide an additional metric for consideration in project evaluation.

5 Lessons Learned and Recommendations

There were many lessons learned during the testing of these tools, with the experience generating some recommendations for future refinements of each of the tools to enhance the user experience.

The Reliability Tool was easy to use, and the creation of an external spreadsheet that summarized the inputs made it easier to go through and input the information all together to ensure consistency between scenarios where necessary. One issue was that the base year cannot be changed. It may be helpful to provide the user the ability to use something other than the current year as the base year for analysis. This is particularly true as most traffic data is historic. If 2016 truly is the base year, the documentation should note that the user needs to grow any traffic volumes from their actual year to the current value based on their growth rate information.

Additionally, the Reliability Tool may benefit from the ability to change the allocation of hourly traffic throughout the day. While the national data is helpful, peak periods vary by area. For instance, the data for Route 146 and Sayles Hill Road showed that the actual peak periods in the study area are from 7 to 9 AM and 4 to 6 PM, which is different than the peak period allocation in the tool. These differences in hourly volume percentage may influence the overall model results but there is no way to change the hourly volume allocation to reflect the actual conditions. Perhaps a solution would be to allow the user to override the default hourly allocations provided in the model so that they can best assess the reliability improvements associated with their project in their study area.

When first opened, the Intermodal Connectivity Tool did not work. The “Clear Facility” buttons do not actually clear the information. Without deleting the existing information, one cannot select new information from the drop-down menu. The project team eventually figured out how to remedy this situation, but it would be helpful to either note in the documentation that the existing inputs must be manually cleared to select new information, or to fix the functionality of the buttons.

The biggest concern with the Intermodal Connectivity Tool is that the Army Corps of Engineers Marine data does not distinguish between ports within the “Port of Providence.” This is an issue for Rhode Island because of the distance between the Port of Davisville and the facilities located within Providence. This raises concerns about the bulk cargo volumes and the value of the outputs. This is not easily remedied, but a note about this issue in the manual may be helpful. The manual notes that the data can be updated with a little bit of processing of the information from the data source. While it would be very useful to update the data, there is no information on the nature of the processing that would allow these updates to happen. Perhaps a supplementary document about what was done to generate the format of the data would be useful for those interested in utilizing more current information or in disaggregating data for a collection of ports (e.g., Port of Providence) to a single terminal (e.g., Port of Providence and Port of Davisville).

The Accessibility Tool was very cumbersome to use without a travel demand model. The instructions provided in the documentation were very helpful, but it was still difficult to identify the right size and zone for analysis. The availability of proxy data is dependent on the zone selection and may be difficult for a small state that is not heavily reliant on a county-based system. This is true of many states in the Northeast, and the more local a chosen area, the more difficult it is to locate proxy data. For instance, the Gross Regional Product (GRP) proxies could not be calculated for the selected zones without mixing data sources and thus compromising the outputs. The metrics and measures may be difficult to substitute without a travel demand model depending on the zone definition. For instance, the Oak Ridge National Laboratory skim matrix is very helpful for determining the intra-zone impedance, but the lowest level available is a county, which is not as useful for smaller zones. Perhaps a bit of clarification within the documentation about the zone levels and substitutions for travel demand outputs would be helpful.

Similar to the difficulty in selecting the study area and zone information, consolidation of the selected zones to 30 or fewer can be tricky. While the documentation touches on this, users may benefit from some additional guidance on logical zone combinations for analysis. The project team recognizes that this may be difficult as conditions and options vary by location and project.

Finally, the accounting framework that compiles outputs from each of the tools was moderately useful but somewhat difficult to navigate. Several of the tabs noted in the development documentation do not exist. This is very confusing when determining how to utilize the accounting framework, as there is a mismatch between the instructions and the information within the tool.

In addition, the outputs of the accounting framework (Tab 4a) do not actually link to the inputs in Tab 3 – forms. This is problematic if the user updates some of the inputs, for example $ per hour values, as this information does not automatically carry through in the calculation. The user may unwittingly assume that the changes have been considered and not update the outputs sheet to reflect their changes, causing a discrepancy between their expected outputs and their actual results. Possible solutions include linking the outputs to the inputs or notes on the outputs tab that indicate the necessary updates.

A final concern is that the accounting framework requires both a no-build and build “connectivity index” to provide results for the Intermodal Connectivity Tool. Since the inputs for the Tool is “travel time savings” rather than travel time, it is not clear how one would calculate the connectivity index for the no-build scenario as there would be no time savings. This does not allow for any output to be gathered from the accounting framework.

While the single-year snapshot information is useful for project planning, the current state of the tools and the need to run each module for every year of a time-series makes the wider economic benefits less useful for inclusion in a benefit-cost analysis. The information is very helpful and interesting when considering the overall economic impacts of a project, but the repetition and intensity of using the tools at least 20 times to generate results that reflect the life of an infrastructure asset is cumbersome.

6 Team Members

The Rhode Island team has hired HDR and ASG Planning to assist with the testing of the EconWorks W.E.B.tools. The full project team is as follows:

- Chris Witt (Rhode Island Division of Planning)
- Linsey Callaghan (Rhode Island Division of Planning)
- Karen Scott (Rhode Island Division of Planning)
- Meredith Brady (Rhode Island Division of Planning)
- Julie Oakley (Rhode Island Department of Transportation)
- Marissa Birtz (HDR)
- Pamela Yonkin (HDR)
- Anne Galbraith (ASG Planning)

7 Data Needs and Inputs

The data requirements varied by tool, with data for the Reliability and Intermodal Connectivity Tools readily available from aerial images and Rhode Island Department of Transportation (DOT) inventories. The data requirements for the Accessibility Tools are much more intensive. The following section presents a high-level summary of the data needs for each of the tools.

7.1 Reliability Tool

The reliability tool has relatively minimal data needs, with much of the information available through DOT data collection efforts, aerial maps and simple calculations. For simplicity, the project team created an external template to collect the base and build data needed for each of the projects analyzed. This format provides a simple table where the user can collect the necessary data over time to allow for quick input into the actual tool. This format allowed for the external calculation of the peak capacity in a single location. The table below shows the data requirements necessary for use of the reliability tool.

Table 2: Reliability Tool Inputs

Inputs for Reliability Tool	PROJECT NAME	
Inputs	**Base**	**Build**
Year	Year of traffic data	
Time Horizon (# years)	# years to assess future conditions	
Analysis Period	Hours of the day for analysis (selected from dropdown menu)	
Highway Type	Choose Freeway, Signalized, or 2-Lane Rural	
Number of Lanes (one-way)	Number of lanes in one direction	
Segment Length (miles)	Distance of segment, in miles	
Free Flow Speed	Average travel speed with no congestion or adverse conditions	
AADT	Current traffic volume	
Annual Traffic Growth Rate	Percent change in annual traffic volumes	
% Trucks in Traffic	Percent traffic volume that is trucks	
Peak Capacity (pcphpl, one-way)	Capacity determined with *Highway Capacity Manual* procedures	
Reduction in Incident Frequency	Percent change in expected incidents due to implemented programs	
Reduction in Incident Duration	Percent change in incident duration due to implemented programs	

Information on the highway type, number of lanes, segment length and free flow speed should be available from the DOT roadway inventory or from aerial maps. Information on AADT, traffic growth rates, and share of trucks in traffic is available from data collected by DOT. Calculating the peak capacity is the most difficult component of the data collection for this tool, though it is not difficult and this information may be available in DOT stored information. For the projects tested, roadway characteristics were assessed using aerial images and traffic characteristics were provided for various years by Rhode Island DOT.

The reduction in incident frequency and incident duration has a default value of 0% in the model. This value was maintained for each of the projects tested as the exact nature of the improvements generally remains unknown and any estimation of improvement would be speculative. Maintaining the default value of no change results in the most conservative outputs and avoids overstating benefits. The table below summarizes the actual inputs utilized for each of the projects assessed using the Reliability Tool.

One additional point to note about the inputs selected for the Reliability Tool is that in each case, the full day period was analyzed. The identified peak periods for some of the projects do not correspond to the pre-set peak periods in the tool. The project team had concerns about the allocation of daily traffic to these particular time periods and thus opted to evaluate the full day rather than isolate these peak-periods that are not suitable to the study area.

Table 3: Reliability Tool Inputs for Rhode Island Projects

Inputs for Reliability Tool	ProvPort to I-95 SB		Post Road onto Route 37		Route 4 at Oak Hill Road		Route 146 at Sayles Hill Road	
Inputs	**Base**	**Build**	**Base**	**Build**	**Base**	**Build**	**Base**	**Build**
Year	2013	2013	2012	2012	2015	2015	2006	2006
Time Horizon (# years)	10	10	10	10	10	10	10	10
Analysis Period	Full Day	Full Day	Full Day	Full Day	Full Day	Full Day	Full Day	Full Day
Highway Type	2-Lane Arterial	2-Lane Arterial	2-lane Arterial		Signalize d	freeway	Signalized	Signalized
Number of Lanes (one-way)	1	2	2	3	2	2	2	3
Segment Length (miles)	2	2	0.25	0.25	1	1	0.5	0.5
Free Flow Speed	25	25	30	30	50	50	50	50
AADT	13,300	13,300	33,400	33,400	59,700	59,700	55,310	55,310
Annual Traffic Growth Rate	6.40%	6.40%	3.09%	3.09%	0.10%	0.10%	0.14%	0.14%
% Trucks in Traffic	2.3%	2.3%	5.0%	5.0%	5.0%	5.0%	7.8%	7.8%
Peak Capacity (pcphpl, one-way)	829	1,657	4,488	6,732	1,668	4,488	1,646	2,469
Reduction in Incident Frequency	0%	0%	0%	0%	0%	0%	0.00%	0.00%
Reduction in Incident Duration	0%	0%	0%	0%	0%	0%	0.00%	0.00%

7.2 Intermodal Connectivity Tool

The Intermodal Connectivity Tool also has relatively simple and straightforward data needs. For the project that was tested, the data needs were minimal. The first step was to identify the facility near which the improvement is taking place from a dropdown menu. For Rhode Island, there are no rail freight intermodal facilities, so information on the unit lift capacity was not necessary. After selecting the facility, the user enters the improvement inputs in Tab 3. The three pieces of information required are the distance from the proposed improvement to the facility, the number of trucks within the study area, and the time savings per truck. Two optional pieces of information are the dollar value per truck hour saved and the fraction of trucks at the investment site that are associated with the intermodal location. Default values will be used for these two factors in the absence of any user specified information.

The distance from the improvement to the facility can be easily measured using an online mapping tool. Information about the number of trucks in the study area can be found in the RIDOT traffic data and the hours saved per truck can come from a travel demand model of the improvement if available, or be estimated based on the anticipated increase in speed or travel time. For the project tested, the improvement provided a new direct movement to the nearby interstate, thus reducing travel distance and time. The default dollar values and infrastructure-related truck shares were utilized due to lack of additional local information. The table below summarizes the inputs utilized for testing the Intermodal Connectivity Tool.

Table 4: Intermodal Connectivity Inputs for ProvPort to I-95 Southbound Project

Parameter	Value
State	Rhode Island
Facility Type	Marine
Facility Name	Providence, RI
Proposed Investment Description	Enhance Interstate access from the facility
Distance of Improvement to Facility (miles)	2
Number of Trucks Within Study Area	64,500
Hours Saved Per Truck	0.03

7.3 Buyer-Supplier Accessibility Tool

The two Accessibility Tools (Buyer-Supplier and Specialized Labor Market Access) have the most intensive data requirements. These tools are best suited and most easily utilized with the outputs from a travel demand model. These outputs were unavailable for the project analyzed in Rhode Island, and thus proxies were utilized as suggested by the User Manual. Only the Buyer-Supplier Tool was utilized for Rhode Island.

One of the first steps required to utilize the tool is to determine the zones that will be considered. This informs the collection of the remaining data. For the purposes of the selected project, the zones were Rhode Island towns. The project will reconstruct the Route 6 and Route 10 interchange and add a movement from north to west that does not currently exist. Because this is a heavily traveled roadway that provides an alternative to I-95 as well as access to Providence and connections to Connecticut and Massachusetts, the project stands to benefit a large portion of the state. An alternative consideration would be to look only at the immediately adjacent Census Tracts or traffic analysis zones, but this would understate the improvement and the importance of the project.

A maximum of 30 zones can be included in the Tool, so some towns that were adjacent to each other and minimally impacted by the improvement due to their location were combined. Once the analysis zones were identified, information was gathered for a base year and future year. In this case, the information utilized was town population. While employment by place of work would have been a better proxy, good forecast information was not available so the 2010 population and 2030 forecasts were utilized. The model also requires the application of a constant decay factor and a productivity elasticity, with default assumptions provided in the User Manual. The project team chose to analyze the potential access with no activity growth based on the guidance provided in the documentation.

After selecting the parameters, it is necessary to provide input activity and impedance matrices for both the build and no build scenarios. The input activity consisted of the base year population by zone, county in this instance, as well as forecast population for the build year (2030). Because “no activity growth” was selected in the parameters section, the build year forecast reflects the population forecasts provided by the United States Census Bureau.

As a proxy for the outputs from a travel demand model, the impedance matrices were generated using travel times and distances from google maps between towns. The User Manual notes that time or distance can be utilized, but the spreadsheet notes minutes, so time was utilized in the primary analysis and distance was also tested. The intra-zone impedance was set to 0.1 for all areas except for Providence, where the improvement will occur and the value was set to 10 for the no-build condition with an improvement to 8.8 for the build scenario. While the Oak Ridge National Laboratory (ORNL) provides skim matrices to estimate impedance, these are only done at the county level, which is not useful for Rhode Island due to the limited number of counties and the size of Providence County. The value selected for within Providence was based off of the ORNL value for the distance calculation and modified for the time calculation.

The impedance matrix for the build scenario was generated by making minor changes to origin-destination town pairs that would benefit from the proposed project. Towns that have an existing connection utilizing this route (i.e., movements that are not going from north to west) were provided a ten percent travel time savings. Those that would also gain the new connection generated a 12 percent time savings in the build condition. The tables below present the baseline inputs utilized in testing the Buyer-Supplier Accessibility Tool for the Route 6/Route 10 Interchange Improvements project.

Table 5: Buyer-Supplier Market Access Parameters for Route 6/10 Interchange

Parameter	Value
Constant Decay Factor	1
Base Year	2010
Build Year	2030
Productivity Elasticity	0
Calculate	Potential Access with No Activity Growth

Table 6: Input Activity (Population) for Base and Build Years

Zone Name	2010	2030
Barrington	16,310	15,920
Bristol & Warren	33,565	33,290
Coventry	35,014	38,050
East Greenwich	13,146	14,053
Warwick	82,672	77,778
West Greenwich	6,135	8,290
West Warwick	29,191	28,506
Jamestown	5,405	5,640
Portsmouth-Middletown-Newport	58,211	51,987
Little Compton-Tiverton	19,272	20,208
Burrillville-Glocester	25,701	25,923
Central Falls-Pawtucket	90,524	88,254
Cranston	80,387	82,162
Cumberland-Woonsocket	74,692	73,802
East Providence	47,037	42,618
Foster	4,606	4,963
Johnston	28,769	30,007
Lincoln-Smithfield	42,535	46,191
North Smithfield	11,967	12,899
North Providence	32,078	31,486
Providence	178,042	187,614
Scituate	10,329	10,648
Charlestown	7,827	8,915
Exeter	6,425	7,273
Hopkinton-Westerly	30,975	32,572
Narragansett	15,868	16,382
North Kingstown	26,486	28,063
Richmond	7,708	9,842

South Kingstown	30,639	36,105

Table 7: No Build Impedance Matrix, Travel Time in Minutes

	DESTINATIONS	Barrington	Bristol&-arren	Coventry	East Greenwich	Warwick	West Greenwich	West Warwick	Jamestown	Portsmouth-Middletown-Newport	Little Compton-Tiverton	Burrillville-Glocester	Central Falls-Pawtucket	Cranston	Cumberland-Woonsocket	East Providence	Foster	Johnston	Lincoln-Smithfield	North Smithfield	North Providence	Providence	Scituate	Charlestown	Exeter	Hopkinton-Westerly	Narragansett	North Kingstown	Richmond	South Kingstown
ORIGINS																														
Barrington		0.1	20	34	31	29	38	31	55	37	46	49	34	21	36	13	43	27	29	40	30	19	37	56	33	57	47	38	45	50
Bristol-Warren		20	0.1	49	46	43	52	46	37	12	30	65	47	35	54	26	58	42	45	53	45	32	50	61	50	73	49	44	58	55
Coventry		34	49	0.1	14	24	16	10	34	55	63	44	40	26	38	27	31	23	38	37	37	30	20	39	19	24	34	28	23	40
East Greenwich		31	46	14	0.1	20	19	16	24	45	67	45	34	24	34	23	42	19	30	33	34	26	30	33	12	28	25	17	26	28
Warwick		29	43	24	20	0.1	29	23	37	45	58	53	33	22	38	22	42	22	30	37	32	23	33	47	24	38	37	29	36	40
West Greenwich		38	52	16	19	29	0.1	21	33	55	76	44	40	29	40	28	27	24	35	39	36	29	25	28	15	19	34	26	17	34
West Warwick		31	46	10	16	23	21	0.1	33	56	61	43	34	20	34	24	35	20	32	35	34	25	23	40	21	30	34	26	32	37
Jamestown		55	37	34	24	37	33	33	0.1	28	49	65	51	36	49	49	58	33	47	48	45	45	45	31	21	43	19	13	35	24
Portsmouth-Middletown-Newport		37	12	55	45	45	55	56	28	0.1	24	64	44	34	47	26	58	37	40	46	43	33	52	51	41	64	39	34	56	45
Little Compton-Tiverton		46	30	63	67	58	76	61	49	24	0.1	77	57	47	61	38	70	54	53	60	56	46	66	76	60	90	63	57	70	70
Burrillville-Glocester		49	65	44	45	53	44	43	65	64	77	0.1	35	40	30	42	22	29	28	18	31	38	28	67	48	56	60	57	55	67
Central Falls -Pawtucket		34	47	40	34	33	40	34	51	44	57	35	0.1	20	16	18	40	22	11	26	18	16	33	62	35	53	45	40	45	48
Cranston		21	35	26	24	22	29	20	36	34	47	40	20	0.1	25	12	34	12	18	28	19	12	22	44	22	36	35	28	40	36
Cumberland-Woonsocket		36	54	38	34	38	40	34	49	47	61	30	16	25	0.1	30	33	15	16	20	19	22	31	58	35	49	49	40	48	53
East Providence		13	26	27	23	22	28	24	49	26	38	42	18	12	30	0.1	31	17	15	25	17	9	27	50	24	42	35	29	36	40
Foster		43	58	31	42	42	27	35	58	58	70	22	40	34	33	31	0.1	26	35	32	28	31	16	51	38	40	53	45	41	53
Johnston		27	42	23	19	22	24	20	33	37	54	29	22	12	15	17	26	0.1	19	15	12	11	20	45	29	38	37	29	36	43
Lincoln-Smithfield		29	45	38	30	30	35	32	47	40	53	28	11	18	16	15	35	19	0.1	16	15	18	33	55	32	48	45	37	45	48
North Smithfield		40	53	37	33	37	39	35	48	46	60	18	26	28	20	25	32	15	16	0.1	20	25	29	56	35	50	48	40	48	50
North Providence		30	45	37	34	32	36	34	45	43	56	31	18	19	19	17	28	12	15	20	0.1	15	26	58	35	50	50	40	48	50
Providence		19	32	30	26	23	29	25	45	33	46	38	16	12	22	9	31	11	18	25	15	10	28	50	28	41	40	30	45	45
Scituate		37	50	20	30	33	25	23	45	52	66	28	33	22	31	27	16	20	33	29	26	28	0.1	49	34	39	48	44	35	52
Charlestown		56	61	39	33	47	28	40	31	51	76	67	62	44	58	50	51	45	55	56	58	50	49	0.1	24	20	18	25	13	13
Exeter		33	50	19	12	24	15	21	21	41	60	48	35	22	35	24	38	29	32	35	35	28	34	24	0.1	24	21	11	19	22
Hopkinton-Westerly		57	73	24	28	38	19	30	43	64	90	56	53	36	49	42	40	38	48	50	50	41	39	20	24	0.1	31	31	12	29
Narragansett		47	49	34	25	37	34	34	19	39	63	60	45	35	49	35	53	37	45	48	50	40	48	18	21	31	0.1	15	30	10
North Kingstown		38	44	28	17	29	26	26	13	34	57	57	40	28	40	29	45	29	37	40	40	30	44	25	11	31	15	0.1	26	22
Richmond		45	58	23	26	36	17	32	35	56	70	55	45	40	48	36	41	36	45	48	48	45	35	13	19	12	30	26	0.1	19
South Kingstown		50	55	40	28	40	34	37	24	45	70	67	48	36	53	40	53	43	48	50	50	45	52	13	22	29	10	22	19	0.1

Table 8: Build Impedance Matrix, Travel Time in Minutes

ORIGINS \ DESTINATIONS	Barrington	Bristol-Warren	Coventry	East Greenwich	Warwick	West Greenwich	West Warwick	Jamestown	Portsmouth-Middletown-Newport	Little Compton-Tiverton	Burrillville-Glocester	Central Falls-Pawtucket	Cranston	Cumberland-Woonsocket	East Providence	Foster	Johnston	Lincoln-Smithfield	North Smithfield	North Providence	Providence	Scituate	Charlestown	Exeter	Hopkinton-Westerly	Narragansett	North Kingstown	Richmond	South Kingstown
Barrington	0.1	20	34	31	29	38	31	55	37	46	44.1	34	21	36	13	43	24.3	29	40	30	19	37	56	33	57	47	38	45	50
Bristol-Warren	20	20	0.1	49	46	43	52	46	37	12	30	58.5	47	35	54	26	52.2	37.8	45	53	45	32	50	61	50	73	49	44	58
Coventry	34	49	0.1	14	24	16	10	34	55	63	44	40	26	38	27	31	23	38	37	37	30	20	39	19	24	34	28	23	40
East Greenwich	31	31	46	14	0.1	20	19	16	24	45	67	45	34	24	34	23	42	19	30	33	30.6	26	30	33	12	28	25	17	26
Warwick	29	43	24	20	0.1	29	23	37	45	58	53	33	22	38	22	42	22	30	37	32	23	33	47	24	38	37	29	36	40
West Greenwich	38	38	52	16	19	29	0.1	21	33	55	76	44	40	29	40	28	27	24	35	39	36	29	25	28	15	19	34	26	17
West Warwick	31	31	46	10	16	23	21	0.1	33	56	61	43	34	20	34	24	35	20	32	35	30.6	25	23	40	21	30	34	26	32
Jamestown	55	55	37	34	24	37	33	33	0.1	28	49	65	51	36	49	44.1	58	33	42.3	48	45	40.5	45	31	21	43	19	13	35
Portsmouth-Middletown-Newport	37	37	12	55	45	45	55	56	28	0.1	24	57.6	44	34	47	26	58	37	40	46	43	33	46.8	51	41	64	39	34	56
Little Compton-Tiverton	46	46	30	63	67	58	76	61	49	24	0.1	77	57	47	61	38	70	48.6	53	60	56	46	66	76	60	90	63	57	70
Burrillville-Glocester	49	44.1	58.5	44	45	53	44	43	65	57.6	77	0.1	35	36	30	42	22	29	28	18	31	34.2	28	67	48	56	60	57	55
Central Falls -Pawtucket	34	34	47	40	34	33	40	34	51	44	57	35	0.1	18	16	18	36	19.8	11	26	18	16	29.7	62	35	53	45	40	45
Cranston	21	35	26	24	22	29	20	36	34	47	35.2	18	0.1	22.5	12	34	12	16.2	25.2	17.1	10.8	22	44	22	36	35	28	40	36
Cumberland-Woonsocket	36	54	38	34	38	40	34	49	47	61	30	16	22.5	0.1	30	33	15	16	20	19	22	31	58	35	49	49	40	48	53
East Providence	13	13	26	27	23	22	28	24	44.1	26	38	42	18	12	30	0.1	27.9	15.3	15	25	17	9	24.3	50	24	42	35	29	36
Foster	43	52.2	31	42	42	27	35	58	58	70	22	36	34	33	27.9	0.1	26	35	32	28	27.9	16	51	38	40	53	45	41	53
Johnston	24.3	37.8	23	19	22	24	20	33	37	48.6	29	19.8	12	15	15.3	26	0.1	19	15	12	9.9	20	45	29	38	37	29	36	43
Lincon-Simthfield	29	45	38	30	30	35	32	42.3	40	53	28	11	16.2	16	15	35	19	0.1	16	15	18	29.7	55	32	48	45	37	45	48
North Smithfield	40	40	53	37	33	37	39	35	48	46	60	18	26	25.2	20	25	32	15	16	0.1	20	25	29	56	35	50	48	40	48
North Providence	30	30	45	37	30.6	32	36	30.6	45	43	56	31	18	17.1	19	17	28	12	15	20	0.1	15	26	58	31.5	50	50	36	48
Providence	19	32	30	26	23	29	25	40.5	33	46	34.2	16	10.8	22	9	27.9	9.9	18	25	15	8.8	25.2	50	28	41	40	30	45	45
Scituate	37	50	20	30	33	25	23	45	46.8	66	28	29.7	22	31	24.3	16	20	29.7	29	26	25.2	0.1	49	34	39	48	44	35	52
Charlestown	56	61	39	33	47	28	40	31	51	76	67	62	44	58	50	51	45	55	56	58	50	49	0.1	24	20	18	25	13	13
Exeter	33	50	19	12	24	15	21	21	41	60	48	35	22	35	24	38	29	32	35	30.8	28	34	24	0.1	24	21	11	19	22
Hopkinton-Westerly	57	73	24	28	38	19	30	43	64	90	56	53	36	49	42	40	38	48	50	50	41	39	20	24	0.1	31	31	12	29
Narragansett	47	49	34	25	37	34	34	19	39	63	60	45	35	49	35	53	37	45	48	50	40	48	18	21	31	0.1	15	30	10
North Kingstown	38	38	44	28	17	29	26	26	13	34	57	57	40	28	40	29	45	29	37	40	35.2	30	44	25	11	31	15	0.1	26
Richmond	45	58	23	26	36	17	32	35	56	70	55	45	40	48	36	41	36	45	48	48	45	35	13	19	12	30	26	0.1	19
South Kingstown	50	50	55	40	28	40	34	37	24	45	70	67	48	36	53	40	53	43	48	50	50	45	52	13	22	29	10	22	19

8 Summary of Outputs

The tools have two sets of outputs – those from the individual tools themselves and those from the accounting framework. The outputs from the individual tools provide insight to the magnitude of impacts while the accounting framework allows for the calculation of total benefits, aggregating traditional and wider economic benefits. The following tables summarize the outputs from each of the individual tools as well as the results when the information is incorporated into the accounting framework.

Table 9: Reliability Tool Outputs

	Reliability - Future Year (2026) - Incident Delay							
	No Build				Build			
	Pass-enger Delay (vehicle hours)	Comm-ercial Delay (vehicle hours)	Passenger Congestion Cost	Commercial Congestion Cost	Passenger Delay (vehicle hours)	Commercial Delay (vehicle hours)	Passenger Congestion Cost	Commercial Congestion Cost
Route 146 at Sayles Hill Road	43,775	5,339	$946,934	$207,957	541	75	$20,899	$5,072
ProvPort to I-95 SB	6	0	$102,038	$5,793	0	0	$550	$38
Post Road onto Route 37	0	0	$0	$0	0	0	$0	$0
Route 4 at Oak Hill Road	57,631	4,336	$1,193,472	$162,378	24	2	$1,540	$260

The results varied by project tested, with Route 4 at Oak Hill Road showing the largest improvement in incident related delay cost under the build condition.

Table 10: Intermodal Connectivity and Accessibility Tool Outputs

	Accessibility - Potential Access Score		Intermodal Connectivity		
	No Build	Build	Relative Value	Value of Time Savings	Weighted Connectivity
ProvPort to I-95 SB			65.00%	$110,295	682,188.40
Route 6 at Route 10	1,036,551	1,051,440			

These results show that the Route 6 at Route 10 interchange increased potential access under the build condition relative to the existing conditions. The ProvPort project resulted in a travel time savings of $110,295 and a weighted connectivity score of 682,188.4 for bulk cargo.

Table 11 summarizes the outputs when the results from each project are entered into the accounting framework. It should be noted that the inputs from ProvPort resulted in an error due to the lack of ability to assess the connectivity index in the no-build scenario because the Intermodal Connectivity inputs are an increment rather than a base and build value as required by the accounting framework. When comparing the wider benefits across all of the proposed projects, the Route 6 at Route 10 impacts greatly exceed the benefits attributed to the other projects. It is not readily apparent why that may be the case, though it may be due to the nature of the estimates from the Accessibility Tool compared to the values from the Reliability and Intermodal Connectivity Tools.

Table 11: Outputs from Accounting Framework

	Accounting Framework (Sum of All Benefits)
Route 146 at Sayles Hill Road	$1,101,412
ProvPort to I-95 SB	Error
Route 6 at Route 10	$30,526,624
Post Road onto Route 37	$0
Route 4 at Oak Hill Road	$1,390,718

9 Prioritized Projects for Freight Plan

The final list of prioritized projects for the Statewide Freight Plan is forthcoming upon incorporation of the preliminary benefit-cost analyses if so desired by the Division of Planning and the Rhode Island Department of Transportation after review of the draft results. Due to the limited applicability of the various tools, the Division of Planning and RIDOT may choose not to incorporate the wider economic benefits into the overall project prioritization efforts.