Beals Island Bridge - Benefit Cost Analysis

The Beals Island Bridge is a ten span steel beam bridge which spans Moosabec Reach between Jonesport on the mainland and Beals, Maine. Completed in 1958, the structure carries Bridge Street and provides a navigational channel opening of 75 feet wide and 32 feet high from mean high water. It is 1,050 feet long and 22 feet wide, with uniform span lengths of 105 feet. The bridge replacement will be an eight span prestressed concrete girder structure 1,062 feet long by 28 feet wide with a vertical navigation clearance of 33 feet from mean high water

A benefit cost analysis was conducted on replacing the Beals Island Bridge. The analysis looks at the project from the standpoint of society as a whole, and accounts for the net benefits and net costs based on the criteria described in the TIGER VIII NOFA BCA Guidance, February 23, 2016. The analysis presented here addresses benefits from travel time savings, user costs, and emissions reduction. Several benefits of the Beals Island Bridge replacement are difficult to quantify. These un-quantified benefits include increased economic competitiveness, livability enhancement, and response time for emergency vehicles (ambulance and fire).

Base Case Assumption

This benefit cost analysis focuses on replacement of Beals Island Bridge, and compares the replacement to the "no build' scenario, which is the base case assumption. This assumes that the existing bridge would be closed to traffic. The spreadsheets and files pertinent to this BCA are referenced in the BCA spreadsheet and are included in the Appendices to this application. The "No Build" scenario assumed in this BCA is that the Beals Island Bridge would be closed. Existing and future traffic crossing the bridge would be replaced with ferry service that carries motor vehicles.

Project Benefits

Travel Costs

The Beals Island Bridge is the only crossing between the Town of Beals, which is comprised of Beals Island and Great Wass Island, and the mainland (specifically Jonesport). If the Bridge were closed and taken out of service, with no other alternative crossings available to motorists, a ferry service carrying vehicles would need to be provided.

Under this condition, the total change in vehicle-miles-traveled (VMT) was estimated at a reduction of 390,550 miles in 2019. This reduction in VMT is the result of vehicles no longer traveling along the ½ mile span of the existing Beals Island Bridge.

2019 VMT = Annual Traffic x Distance
= 2140 vehicles per day x 365 days per year x ½ mile
= 390,550 VMT in 2019

Under this same condition, the total change in vehicle-hours-traveled (VHT) was estimated at an increase of 182,256 hours in 2019. This increase in VHT is the difference between VHT on the ferry and VHT on the bridge.

The net changes in VMT and VHT were then multiplied by the weighted average user costs ($0.34 and $15.24 respectively) to get the user cost savings. The total annual user costs are estimated at $2,644,874 in 2019, and increasing thereafter based on traffic growth. These operating costs are avoided by bridge replacement.

Safety

In comparison to the existing bridge, the Beals Island Bridge replacement will improve safety for all users. Specifically, the existing 22-foot roadway width will be widened to 28 feet (providing 10 foot lanes and 4 foot shoulders), thereby improving safety for both motorists and pedestrians.

As described above, it is critical to point out that the existing bridge is the only vehicular connection between Beals and the mainland. The town of Jonesport provides emergency service aid to the town of Beals as there are no hospitals, medical treatment facilities, fire stations, pumpers, or other emergency response equipment located on the island. Under the "No Build" scenario with the existing bridge closed, emergency vehicles would be required to service the entire town of Beals via the ferry, increasing the emergency response time by 10 to 15 minutes in each direction. Although, this impact cannot be quantified in the BCA, the increased emergency response time could have serious effects on medical health and/or loss of property where response time is paramount.

State of Good Repair

Estimated annualized maintenance costs for the existing bridge are $6,507. This number was derived from actual costs incurred from 1996 to 2015. If the bridge were closed these costs are avoided. In this BCA the annualized costs are added to user benefits since they are avoided costs to society if a new bridge is constructed.

Sustainability

The avoided air emissions are based on the ferry emissions, the idling vehicles using the ferry, and the reduced VMT from the closure of the bridge. The net emission savings have been calculated for nitrogen oxides, volatile organics, and carbon dioxide. The calculations are based on factors that were applied to the avoided ferry service resulting from closure of the bridge. Data is not available for sulfur dioxide or particulate emissions.

Based on the annual VMT and VHT approximately 6,241 metric tons of CO2, 2.6 metric tons of VOCs, and 63.2 metric tons of NOX, are avoided in the year 2019. These emissions amount to a total of approximately $835,000 in the year 2019 and $1,060,000 in the year 2068. The cost of carbon in CO2 emissions has been calculated in the BCA spreadsheet using the social cost of carbon (SCC) assumptions found in "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866". The reason being that the SCC increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change. In conformity with this viewpoint, this analysis escalates the CO2 portion of the air emissions cost increases. The net present value of air emissions costs is $24 million at 3% discount rate.

Project Costs

Total Construction Costs

The benefit cost analysis uses the replacement construction cost of $21.1 million. This cost has removed the expended Preliminary Engineering and Right of Way costs from the total project cost of $22.4 million. Construction costs also include a minor rehabilitation ($355,000) after 25 years and full major rehabilitation ($930,000) after 50 years. Maintenance and operations costs for the replacement structure are considered negligible (estimated at approximately $1,500 annually), but have been included in the BCA for completeness.

Conclusion

The annual benefits and costs values were discounted at 3% and 7% over a 50 year time horizon. Three percent is the most appropriate rate for the analysis because the bridge has a very long life, and in addition, the alternate use of funds would be a public expenditure as opposed to a private investment. The full analysis can be found in the spreadsheet attachment to this application. A summary of the results of this analysis are as follows.

- Total Benefits of $ 100 million
- Avoided Air Quality Impacts valued at $24.5 million
- Reduced User Costs estimated at $75.4 million
- Avoided Maintenance Costs of $167,000
- Total Costs of $20.9 million
- Benefit-Cost ratio of 4.8

When discounted at 7%, the benefits and costs are lower. A larger discount rate implies that time preference for future amounts are preferentially discounted more severely. The amounts are shown below.

- Total Benefits of $ 58.1 million
- Avoided Air Quality Impacts valued at $18.4 million
- Reduced User Costs estimated at $ 39.6 million
- Avoided Maintenance Costs of $90,000
- Total Costs of $ 19.8 million
- Benefit-Cost ratio of 2.9

The user costs followed by the air quality impacts represent the largest portion of the total annual benefits. These user cost savings are the key drivers of the benefit-cost ratio; the other cost savings, such as maintenance, have a very small influence on the results.