

## Case Study

**Overview:** The National Capital Region Transportation Planning Board (TPB) has conducted five benefit-cost analysis (BCA) case studies of transportation assets within the National Capital Region to demonstrate the cost of inaction, compare low-cost and high-cost solutions, and provide support for the benefits of proactive resilience investment.

**Study Site:** The focus of this case study is the Liverpool Point Bridge in Charles County, MD. This bridge conveys two lanes of vehicle traffic across Beaverdam Creek and is estimated to experience average daily traffic of approximately 400 vehicles.<sup>i</sup>

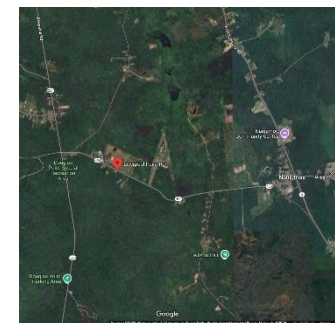
**Context:** The Liverpool Point Road bridge at Beaverdam Creek is at-grade with the roadway. According to flooding projections, the bridge is expected to be overtaken by flood waters in both 1-in-100-year and 1-in-500-year flooding events. Vehicles with a destination on Liverpool Point Road, or that would normally use Liverpool Point Road to travel between the major routes it connects (Riverside Road/State Route 224 and Port Tobacco Road/State Route 6), will need to take a detour to avoid the flooded Liverpool Point Road bridge. This analysis assumes that drivers will instead use Sandy Point Road, driving an additional four miles and four minutes.

**Results:** BCA results suggest that the low-cost and high-cost solutions have discounted (3.1%)<sup>ii</sup> benefit-cost ratios of 0.12 and 0.03, respectively. These results imply that for every \$1 invested, the low-cost solution will return about \$0.12 in flooding prevention benefits. The high-cost solution would result in about \$0.03 in flooding benefits per dollar invested.

**Methods:** For no action flooding impacts, the analysis assumes that nuisance flooding—during which the bridge is impassable to vehicles, but is not damaged—occurs one time per year. Nuisance flooding is expected to make the bridge impassable for one-half of a day (12 hours). For each of these events, Charles County staff are assumed to spend one hour setting up road-side signage to warn drivers of the flooded bridge and point them to detours. The analysis assumes that the county is already in possession of these signs and reuses them. Signage setup thus only occurs a labor cost, which is estimated to be a loaded hourly wage of \$41.44<sup>iii</sup> once per year. In addition, drivers forced to take an

## Key Takeaways

- Flood impacts pose a risk to road users that can be abated by proactive investments.
- Based on this analysis, investment in the Liverpool Point Road bridge for flood prevention does not prove to be cost-effective due to high capital costs and low daily traffic.
- Similar action could be taken at a regional level for other bridges with likely lower capital costs and/or greater average daily traffic to address infrastructure concerns in the National Capital Region.



Aerial view, Liverpool Point Road  
(Google Maps)



alternative route due to nuisance flooding incur a cost for the additional time and mileage driven. Drivers are assumed to reroute to the nearest road that also connects Riverside Road and Port Tobacco Road, Sandy Point Road, which adds an additional four minutes and four miles of driving.<sup>iv</sup> Based on the 2023 hourly value of all-purpose travel time savings<sup>v</sup> and 2023 operating cost per mile of light duty vehicles,<sup>vi</sup> and the estimated average daily traffic of about 400 vehicles over Liverpool Point Road bridge, the cost of the loss of function to drivers each time the bridge experiences nuisance flooding is approximately \$921. Because nuisance flooding is assumed to occur once per year, the labor cost of signage plus the loss of function costs to drivers in terms of additional time and vehicle mileage amounts to an annual cost for nuisance flooding of about \$962.

Examining flood data<sup>vii</sup> along Liverpool Point Road, this analysis identified that 100-year and 500-year storms result in flooding that overtops the bridge. While definitive flood risk is unknown, this analysis assumes that there is a 1% annual risk of a 100-year flooding event that makes the bridge impassable for a full day, and a 0.2% annual risk of a 500-year event that overtops the bridge and requires repairs taking the bridge out of use for 18 months. While not resulting in any necessary repairs, the 100-year flood event results in loss of function and signage setup costs. The loss of function cost plus signage cost for the 100-year is estimated at roughly \$1,880 (\$1,840 in increased travel time and mileage costs, and \$40 in signage labor costs). Multiplied by the 1% annual risk, the annualized cost of the 100-year event is about \$18 per year. The loss of function cost associated with the 500-year event, plus the capital costs to repair the bridge, are estimated at \$1.25 million (\$1.0 million in loss of function costs for 18 months, and \$0.25 million in capital costs). Multiplied by the 0.2% annual risk, the annualized cost of the 500-year event is about \$1850.

This analysis proposes a low-cost and high-cost solution, intended to address the effects of the 100-year and 500-year event, respectively. Both solutions are assumed to also prevent the annual nuisance flooding. For the low-cost solution, this analysis assumes the embankments supporting the bridge are hardened with geosynthetic reinforcement to counteract overtopping that occurs during a 100-year rain event. The high-cost solution requires full proactive replacement of the bridge at a capital cost of about \$617,000, and closure of the bridge for a year, resulting in loss of function costs of about \$673,000.

**Detailed Results:** Results indicate that the no-action scenario leads to roughly \$42,000 (discounted at 3.1%) in flooding-related impacts over a 20-year period. Nuisance flooding and 100-year flood mitigation in the low-cost solution would lead to about \$14,000 (discounted at 3.1%) in gross benefits over 20 years. The construction costs of the geosynthetic hardening are estimated to be about \$115,000. The analysis assumes the low-cost solution does not substantially interfere with traffic on the bridge and loss of function costs are negligible. Thus, the low-cost solution leads to net costs of about \$101,000 over 20 years, discounted at 3.1%. The high-cost solution, in which the entire bridge would be proactively replaced, requiring it to be taken out of commission for a year to prevent 500-year event, 100-year event, and nuisance flooding-related impacts, is estimated to result in about \$1.2 million in net costs over 20 years with a BCR of 0.03, discounted at 3.1%.

**Qualitative Benefits:** The potential investments explored here would likely produce other benefits that were not quantified by this analysis. Firstly, structural requirements and industry standards have changed since the Liverpool Point Road bridge was constructed in the early 20<sup>th</sup> century. Complying with those standards would provide infrastructure benefits, such as seismic activity benefits, that are not captured quantitatively in this analysis. In addition, damages that would be avoided from more

This analysis includes a detailed benefit cost analysis model assessing quantified costs and benefits. For additional information on this case study, or to assess your own site for transportation resilience, please reach out to Katherine Rainone at [krainone@mwkog.org](mailto:krainone@mwkog.org).

frequent storms (e.g., 20-year event, 10-year event) are not all captured here due to data constraints. Investments that decreased the need to detour to other routes would also lead to avoided additional vehicle emissions. Lastly, there would likely be small benefits related to emergency services, which would benefit from fewer detours and faster response times.

**Regional Implications:** The Liverpool Point Road bridge over Beaverdam Creek is a small bridge with limited daily traffic, similar to many other bridges in the National Capital Region. Despite its risk concerns per TPB's National Capital Region Transportation Resilience Improvement Plan,<sup>viii</sup> this analysis shows flooding-focused investment in the Liverpool Point Road bridge would likely not be cost-effective. This stems from the capital costs and loss of function related to construction, which are much higher than the avoided damages and costs in hardening or replacing the bridge, due in part to the relatively low average annual daily traffic at this point. For other bridges, the ratio of avoided damages and avoided costs to drivers compared to repair or replacement costs may be more cost-effective.

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<sup>i</sup> According to National Bridge Inventory data accessed by MWCOG.

<sup>ii</sup> A discount rate is a rate used to determine the present value of future cash flows. As of 2025, the U.S. Department of Transportation recommends a discount rate of 3.1%.

<sup>iii</sup> Based on an hourly rate for a maintenance worker (<https://data.bls.gov/oesprofile/>) and a loading factor (<https://www.bls.gov/news.release/pdf/ecec.pdf>) from the Bureau of Labor Statistics.

<sup>iv</sup> Google Maps. Calculated from the intersections of Liverpool Point Road with Riverside Road and Port Tobacco Road.

<sup>v</sup> Table A-2: Value of Travel Time Savings, <https://www.transportation.gov/sites/dot.gov/files/2024-11/Benefit%20Cost%20Analysis%20Guidance%202025%20Update%20%28Final%29.pdf>. Inflated to 2024 values using suggested values of CPI from BLS: <https://data.bls.gov/pdq/SurveyOutputServlet>

<sup>vi</sup> Table A-4: Vehicle Operating Costs, <https://www.transportation.gov/sites/dot.gov/files/2024-11/Benefit%20Cost%20Analysis%20Guidance%202025%20Update%20%28Final%29.pdf>. Inflated to 2024 values using suggested values of CPI from BLS: <https://data.bls.gov/pdq/SurveyOutputServlet>

<sup>vii</sup> Based on MWCOG analysis of Fathom flood data: <https://www.fathom.global/>

<sup>viii</sup> National Capital Region Transportation Resilience Improvement Plan, last updated January 2025.

<https://www.mwco.org/documents/2024/06/20/national-capital-region-transportation-resilience-improvement-plan/>

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