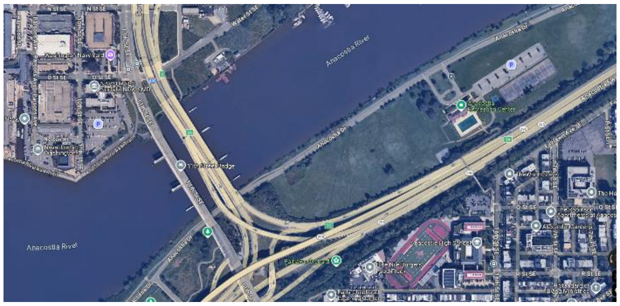
## Case Study

**Overview:** The National Capital Region Transportation Planning Board (TPB) 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 portion of the Anacostia Freeway in Washington, DC, between 11th Street and Pennsylvania Avenue. This section coincides with interstate 295, an auxiliary highway connecting major roadways in Maryland and Washington, D.C. This key access point serves roughly 128,000 vehicles per day[i] and has been identified as at high risk for flooding impacts.[ii & iii]

### Key Takeaways

- Flood impacts pose a significant risk to commuters, particularly on limited access roads where flooding cannot easily be avoided.
- Over 20 years, non-investment could result in nearly $17.3 million in flood related impacts at the Anacostia Freeway location.
- Results suggest a 1.5:1 ROI for proactive investment in a high-cost flooding solution, and 8:1 ROI for the low-cost solution.
- Similar action could be taken at a regional level to address infrastructure concerns in the National Capital Region.



*Aerial view, Anacostia Freeway (Google Maps)*

**Context:** The South-bound and West-bound section of the Anacostia Freeway that ultimately crosses the bridge over the Anacostia River is at high risk of flooding, particularly in sections close to the Anacostia Recreation Center. Flooding in this section, particularly during morning rush hour traffic can snarl access into the city, which has cascading effects throughout the region. Flooding impacts on limited access freeways are particularly troublesome because there are few opportunities to exit the road and slowdowns can extend for miles.

**Results:** BCA results suggest that the low-cost and high-cost solutions have discounted (3.1%)[iv] benefit-cost ratios of 8.40 and 1.49, respectively. These results imply that for every $1 invested, the low-cost solution could return about $8.40 in flooding benefits, and the high-cost solution could result in about $1.49 in benefits per dollar invested. Net benefits for the low- and high-cost solutions are estimated at around roughly $6 to $11 million discounted at 3.1%.

**Methods:** This analysis examines flooding across three discrete scenarios: nuisance flooding, 100-year events, and 500-year events. The analysis assumes that nuisance flooding occurs 2 times per year, with 100- and 500-year events occurring at an annual return interval of 1% and 0.2%, respectively. For nuisance flooding, the analysis assumes that a one-hour event partially closes the road, resulting in an incremental travel time of 30 minutes. The analysis assumes an occupancy rate of vehicles[v] and a value of travel time of $21.72,[vi] and that the impacts occur at rush hour.[vii] These assumptions result in an annual cost of nuisance flooding of approximately $744,000. For the 100-year event, the analysis assumes a one-hour complete closure, requiring that vehicles detour across the Frederick Douglass Memorial Bridge. This detour, an additional 2.8 miles, is assumed to take an extra 30 minutes of travel time as a result of increased traffic. This detour is monetized using the value of travel time as well as using impacts from increased vehicle operating costs ($0.58 per mile).[viii] The annual impact of 100-year events (incorporating the 1% annual likelihood) is estimated to be approximately $112,000. For the 500-year event, the analysis assumes a four-hour complete closure, requiring that vehicles also detour across the Frederick Douglass Memorial Bridge. This detour is assumed to take an extra hour of travel time because of severely increased traffic. This detour is monetized using the value of travel time and increased vehicle operating costs. The annual impact of 500-year events (incorporating the 0.2% annual likelihood) is estimated to be approximately $313,000.

For the low-cost solution, this analysis assumes the installation of rapid deploy barriers to stop flood waters. These barriers lock into each other, rise several feet high, and are easier to deploy and redeploy than the existing Jersey barriers currently deployed along the side of the freeway. The analysis assumes the cost of the barriers is $75 per linear foot[ix] with one mile (5,280 feet) needing protection,[x] resulting in a materials cost of $396,000. This solution is designed to prevent nuisance and 100-year flooding. The analysis assumes eight maintenance workers with a loaded hourly wage of $41.44 will each spend eight hours deploying the rapid deploy barriers, for a total cost of purchase and labor of about $399,000. The high-cost solution is designed to protect against nuisance, 100-year, and 500-year flooding and requires elevation of one mile of the roadway. The analysis assumes a cost to elevate the road of $866 per linear foot,[xi] for a total cost of $4.57 million. Raising the road is assumed to take 180 days, during which one lane at a time of the freeway would be closed for construction, while all other lanes would remain open. The construction is also assumed to occur at night and on weekends, limiting traffic impacts, as the average traffic is much lower during these times. Assuming a delay of ten minutes due to the single lane closure, the loss of function cost during construction is estimated to be about $7.0 million. Combined with the materials cost, the total cost of the high-cost solution is approximately $11.5 million.

**Detailed Results:** Results indicate that the no-action scenario leads to roughly $17.3 million (discounted at 3.1%) in flooding impacts over a 20-year period. Nuisance flooding mitigation in the low-cost solution would lead to about $11 million in gross benefits over 20 years, with 100-year flood mitigation resulting in roughly $1.7 million in gross benefits over the same period. The low-cost solution generates roughly $11.1 million in net benefits over 20 years with a benefit-cost ratio (BCR) of 8.4, discounted at 3.1%. In the high-cost solution, avoided nuisance flooding and avoided 100-year event flooding result in the same benefits, and additional avoided 500-year event impacts result in an additional $4.6 million in benefits. The high-cost solution generates roughly $5.7 million in net benefits over 20 years with a BCR of 1.5, discounted at 3.1%.

**Qualitative Benefits:** The results presented above are conservative and likely represent a lower bound for potential benefits and returns on investment. Additional unmonetized benefits are expected to accrue from proactive investment. Flood prevention measures will almost certainly generate benefits from avoided damages from additional flood events (e.g., 20- and 50-year flood events). Additionally, the analysis likely underestimates detour times from traffic impacts by focusing on a single location.

In reality, flooding substantially snarls traffic in the National Capital Region resulting in significant delays across all major freeways, and could significantly increase benefits by making this section of road a clear detour option. Additionally, there are potential safety benefits not monetized here for commuters that do not have to drive through water and run the risk of becoming stuck, creating safety risks.

**Regional Implications:** The combination of the Potomac and Anacostia Rivers means that access to Virginia and part of Maryland is restricted and requires crossing bridges at several key locations. During flooding events, the roadways near these key locations can flood, creating severe traffic jams and potential safety concerns. There is the potential for similar flood mitigation steps to be taken at additional locations to allow safe corridors for the inflow and outflow of traffic during and after major storms.

[i] Penn Planning. Anacostia River Corridor. https://issuu.com/pennplanning/docs/1223_final_summary_storybook/s/18176535

[ii] Metropolitan Washington Council of Governments – National Capital Region Transportation Resilience Improvement Plan, 2024.https://www.mwcog.org/documents/2024/06/20/national-capital-region-transportation-resilience-improvement-plan/

[iii] Based on MWCOG analysis of Fathom flood data: https://www.fathom.global/

[iv] 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%.

[v] Occupancy assumed to be 1.34 based on US DOT guidance. https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance

[vi] Based on US DOT guidance. https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance

[vii] There are dynamic components of the model that can be adjusted to have the impact occur at a time other than rush hour.

[viii] Based on US DOT guidance. https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance

[ix] Assumes $150 per barrier at 2 linear feet each. https://www.amazon.com/Deployable-Inundation-Protection-Prevention-Barriers/dp/B09FDRP5VZ?source=ps-sl-shoppingads-lpcontext&ref_=fplfs&psc=1&smid=AV16HZDTPF1LD

[x] Based on MWCOG analysis of Fathom flood extent data: https://www.fathom.global/

[xi] Based on estimate for Miami-Dade County Sea Level Rise Strategy: https://miami-dade-county-sea-level-rise-strategy-draft-mdc.hub.arcgis.com/

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@mwcog.org.