APPENDIX A

BENEFIT-COST ANALYSIS (BCA) METHODOLOGY

VB SWMP Benefit Versus Cost Calculation Methodology

The methodology discussed during the development of the SWMP Criteria was to calculate a Benefit Cost Ratio (BCR) that accounted for the benefit of a given project by identifying the flooding mitigated along public streets and the number of habitable structures saved. Using available data, the benefits of mitigated street flooding and habitable structure flooding cannot be combined into the same calculation. As a result, two separate ratios are used to understand benefit versus cost for SWMP projects. These ratios will play an equalizing role in determining the prioritization of a given project. In recognition that all quantifiable benefits associated with a flood mitigation project cannot be accurately evaluated or accounted for at the master plan level, a series of assumptions were made in collaboration with City staff to develop a methodology that could be incorporated into the SWMP.

Benefit Cost Ratio (BCR):

$$Benefit\ Cost\ Ratio\ (BCR) = 1.0 + \frac{net\ present\ value\ (NPV)\ of\ the\ benefit}{present\ value\ of\ the\ construction\ cost}$$

If the implementation of a SWMP project results in eliminating flooding for one or more habitable structures, the available Federal Emergency Management Agency (FEMA) Flood Loss Estimate Software Hazards US (HAZUS) average annual loss (AAL) data will be used to determine the net present value (NPV) of the benefits realized by eliminating structural flooding.

When HAZUS AAL data is not available:

- The BCR is assumed to be 1.0 as a consistent baseline.

When HAZUS AAL data is available:

- The starting BCR is assumed to be 1.0, for consistency with comparison to those structures/projects where AAL data is not available.
- The BCR calculated in accordance with the equation noted above, will be added to the baseline BCR of 1.0.
- Calculation of the NPV of project benefits will assume a 50-year project design life.
- The NPV will include the AAL in the baseline scenario, which includes no sea level rise (SLR), until 2040 in the 50-year project life cycle. Note that all alternatives will be designed for either 1.5 feet or 3.0 feet of SLR, unless approval is received by the City Engineer.
- If the project eliminates structure flooding with 1.5 feet SLR, the NPV will include the AAL in the scenario with 1.5 feet SLR, beginning in 2040 in the 50-year project life cycle.
    - PW-SWEC made the decision to include the West Neck Creek City-Wide Alignment for designing alternatives for the 100-year storm, eliminating SLR influence on the design tailwater elevation. Even though solutions are designed to the 100-year storm with no SLR, the NPVs of the projects account for the benefits eliminated in the 1.5 feet SLR scenario. The combination of the individual project and the City-wide solution will eliminate future flooding with 1.5 feet SLR.
- If the project eliminates structure flooding with 3.0 feet SLR, then the NPV will include the AAL in that scenario beginning in 2060 in the 50-year project life cycle.
    - PW-SWEC made the decision to include the West Neck Creek City-Wide Alignment for designing alternatives for the 100-year storm, eliminating SLR influence on the design tailwater elevation. Even though solutions are designed to the 100-year storm with no SLR, the NPVs of the projects account for the benefits eliminated in the 3.0 feet SLR scenario. The combination of the individual project and the City-wide solution will eliminate future flooding with 3.0 feet SLR.

Some projects indicate that structural flooding is resolved; however, the structural flooding is not reflected in the BCR. The models used to create the flood-depth rasters were prepared in August 2020. The

HAZUS data was created from models prepared in May 2021. PW-SWEC is constantly updating the City's Master Models with new or updated information. The BCR reflect more accurate information and will allow for better ranking of the projects.

Benefit Ratio (BR):

$$Benefit\ Ratio\ (BR) = \frac{simulated\ linear\ feet\ of\ street\ flooding\ eliminated}{simulated\ linear\ feet\ of\ flooding}$$

HAZUS data does not quantify NPV of mitigating street flooding. If the implementation of a SWMP project results in mitigating street flooding, then a ratio of linear feet of flooding mitigated to the total linear feet of flooding will be used as a Benefit Ratio (BR). By designing the alternatives to achieve the PWDSM design standard of passable roads in the 100-yr storm, most projects will achieve a BR of 1.0.