Stantec

# Memo

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| To: | Steve Wilson, PE, PS<br>Maumee Watershed Conservancy District | From: | David Hayson, PE, SI<br>Stantec Consulting Services Inc. |
| File: | 174316204 | Date: | April 6, 2020 |

**Reference: Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

Dear Mr. Wilson,

Stantec Consulting Services Inc. (Stantec) is pleased to submit this technical memorandum updating the benefit-cost analysis (BCA) of the currently proposed Hancock County Flood Risk Reduction Program (Current Program) including hydraulic improvements along the Blanchard River and the Eagle Creek Dry Storage Basin. The Current Program is a subset of the larger "Final Program" described in the "*Hancock County Flood Risk Reduction Program, Final Report: Data Review, Gap Analysis, USACE Plan and Alternatives Review, and Program Recommendation*" report dated April 3, 2017 and the follow-up report, "*Hancock County Flood Risk Reduction Program – Draft Proof of Concept Update*" dated July 9, 2018. Both of these documents can be found at www.HancockCountyFlooding.com.

This memorandum provides a summary of the project's Benefit-Cost Analysis (BCA), the methodology used for this analysis, the results of the analysis, and Stantec's conclusion. This memorandum also provides an estimated stand-alone Benefit-Cost Ratio for the Eagle Creek Dry-Storage Basin project as requested by the MWCD.

## BACKGROUND

The proposed Eagle Creek Dry-Storage Basin is designed to provide storage during flood events to reduce the peak flow rates in Eagle Creek and the Blanchard River, thereby reducing downstream water surface elevations and associated flood risk. The proposed basin is located within Eagle Township in Hancock County, Ohio, approximately 4 miles south of the City of Findlay's downtown. The proposed basin has progressed through multiple iterations with the latest concept summarized in the memorandum titled, "*Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin Project Alternatives Review*" and dated October 31, 2019. Figure 1 displays the location of the Eagle Creek Dry-Storage Basin and the proposed project extents.

The Current Program also includes Phases 1 and 2 of the Blanchard River Hydraulic improvements. Phase 1, currently under construction, includes excavation of a floodplain bench and removal of four in-line low-head dams / riffle structures. Phase 2, currently under design, is assumed to include reconstruction of the Norfolk Southern Railroad Bridge with three spans.

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

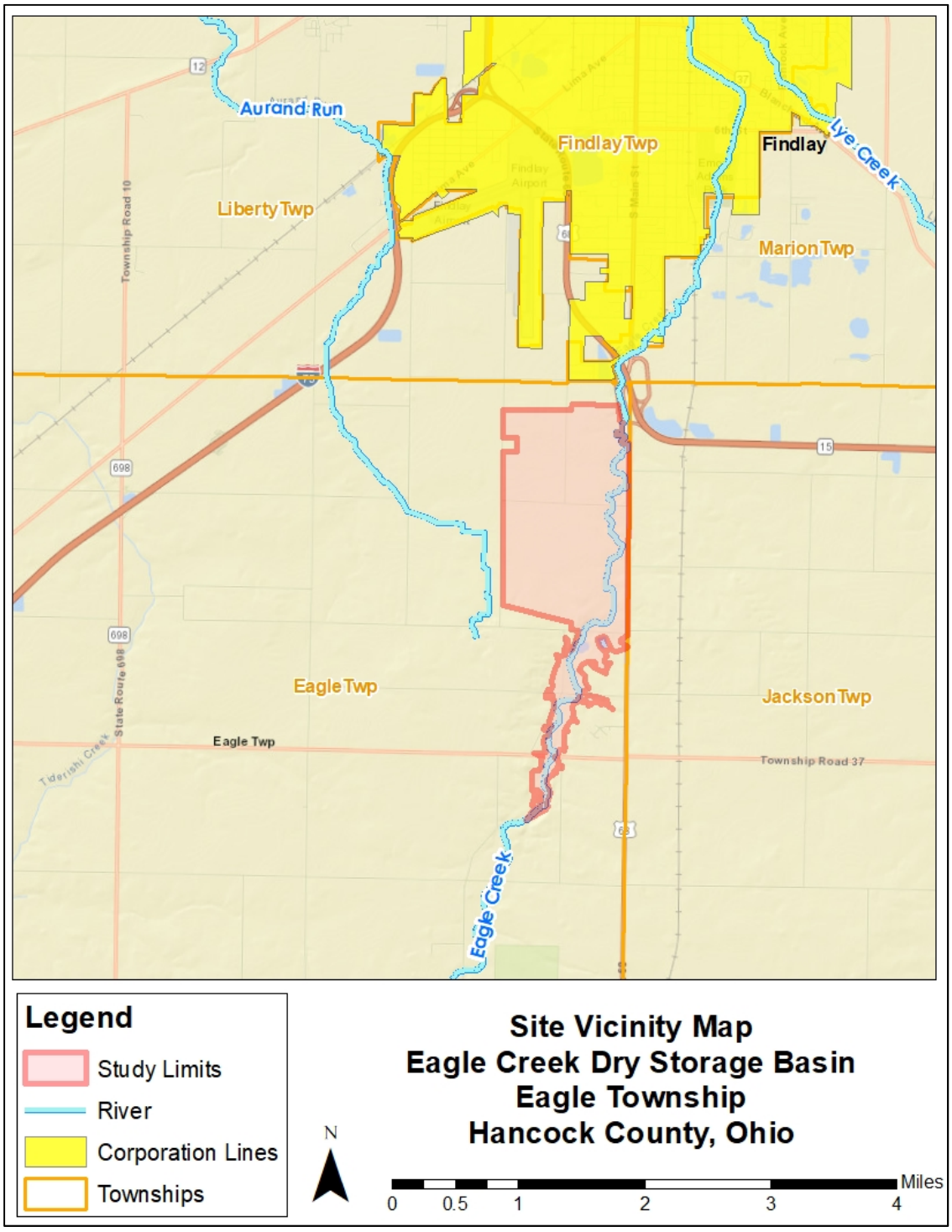


**Figure 1 – Site Vicinity Map**

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

## PREVIOUS BENEFIT-COST ANALYSIS

Jack Faucett Associates (JFA) produced a benefit cost analysis of the "Final Program" and its expected reduction of flood risk and subsequent damages. This analysis was summarized in the JFA report titled, "*Hancock County Flood Risk Reduction Program: Updated Benefit Cost Analysis (June 2018)*" which was an appendix to the 2018 *Proof of Concept Update*. The BCA for the "Final Program" demonstrated a benefit-cost ratio (BCR) of 2.94 (2.21 without considering environmental benefits).The text below provides a summary of the previous BCA methodology used. The full report is provided as Attachment A.

A BCA is an economic tool used to evaluate a project's monetized benefits compared to the capital and lifecycle maintenance costs of a project. A BCA determines whether the value of benefits exceeds the value of the costs, allowing stakeholders to distribute resources efficiently. The BCR is determined by dividing the net present value of total estimated economic benefits by the net present value of estimated costs of the recommended improvements.

The BCA included the following primary benefits/avoided damages:

- Structure Damages
- Content Damages
- Motor Vehicles

Damages to structures, contents, and automobiles typically account for the majority of damages that result from a flood event. These categories generally provide the foundation for the economic evaluation of flood risk reduction projects. The US Army Corps of Engineer's Hydrologic Engineering Center's Flood Damage Analysis (HEC-FDA) software was used in JFA's analysis to estimate damages to structures, contents, and automobiles for without-project and with-project alternatives of the updated HCFRRP.

To estimate expected annual damages (EADs) from flooding, eight flooding event frequencies were modeled, representing a range of recurrence probabilities. The HEC-FDA program compiled data generated from hydraulic analyses, as well as the structure inventory and its associated data. The HEC-RAS model generated water surface profiles for each stream, for each of the eight exceedance probability flood events: 50% (2-year), 20% (5-year), 10% (10-year),4% (25-year), 2% (50-year), 1% (100-year), 0.5% (200-year) and 0.2% (500-year) Annual Chance Exceedance (ACE) flood events.

The analysis used an inventory of structures available through the Hancock County Geographic Information System (GIS) department for locations within the modeled floodplains. Structures within the planning model's 0.2% ACE floodplain were selected for analysis.

The HEC-FDA model processed the structure inventory and the hydraulic model's water surface profiles for both "Existing Conditions" and with the "Final Program" for the structure, content, and motor vehicle items listed above. The difference between the "Existing Conditions" and the "Final Program" damages are the reduction in damages due to implementation of the Final Program. Other benefit categories analyzed included:

- Transportation
- Emergency Response
- NFIP Administrative Cost
- Business Losses (Income)

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

- Business Losses (Cleanup)
- Business Losses (Emergency-Plan)
- Agricultural
- Environmental & Land Use

The benefits and damages listed above were calculated for the same range of flooding recurrence intervals for both "Existing Conditions" and the "Final Program".

The 2018 JFA report provided the net present value of the individual benefit categories, for each year over the expected 50-year program analysis period. The projects comprising the "Final Program" had to be phased in over the analysis period due to the anticipated timing of design and construction. Benefits were assumed to occur incrementally after the early stages of The Program were completed. Since results were only available for "Existing Conditions" and the "Final Program", the effectiveness of each individual project component was estimated. Table 1 provides the starting and ending years for costs incurred at each phase of The Program. Construction for Phase 1 of the Hydraulic Improvements project began in 2018. Initial benefits derived from the interim completion of the Hydraulic Improvement began at the end of 2018. The Hydraulic Improvements Projects (Phases 1 & 2) and the Eagle Creek Dry-Storage Basin projects were estimated to provide approximately 67% of the "Final Program's" benefits based on water surface elevation reductions at Main Street near the center of downtown Findlay. The percentage of total benefits derived for the analysis is provided in Table 2.

**Table 1 – JFA 2018 - Program Schedule by Phase of Project**

| Project | Phase 1 Hydraulic Improvements | Phase 2 Hydraulic Improvements | Eagle Creek Dry-Storage Basin | Potato Run Dry-Storage Basin | Blanchard River Dry-Storage Basin |
|---|---|---|---|---|---|
| Timeline (Year) | 2018-2019 | 2020-2021 | 2020-2025 | 2022-2029 | 2023-2029 |

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

**Table 2 – JFA 2018 - Percentage of Program Benefit Provided by Year**

| Year | Benefits (%) | Note |
|---|---|---|
| 2018 | 10 | In-line Low-Head Dams / Riffle Structures Removal |
| 2019 | 25 | Floodplain Bench Widening |
| 2020 | 25 | |
| 2021 | 33 | NS Railroad Replacement / Widening |
| 2022 | 33 | |
| 2023 | 33 | |
| 2024 | 33 | |
| 2025 | 67 | Eagle Creek Dry-Storage Basin |
| 2026 | 67 | |
| 2027 | 67 | |
| 2028 | 67 | |
| 2029-2078 | 100 | Potato Run / Blanchard River Dry-Storage Basins |

## SIMPLIFIED BCA METHODOLOGY – EAGLE CREEK STAND-ALONE BCR

Stantec used the 2018 JFA analysis and reporting of the "Final Program" BCR as the basis for estimating the benefits associated with just the Eagle Creek Dry-Storage Basin project.

Stantec extracted floodplain depth grids from HEC-RAS associated with the 1% ACE (100-year) flood event for the following scenarios:

- "Existing Conditions";
- "Phase 1 Hydraulic Improvements";
- "Phase 1 & 2 Hydraulic Improvements"
- "Hydraulic Improvements and the Eagle Creek Dry-Storage Basin" (Current HCFRRP); and
- "Final Program".

The depth grids were produced using the Digital Elevation Model (DEM) created by Kucera International with the data obtained from the aerial survey they performed. The DEM was derived from Light Detection and Ranging (LiDAR) data collected in 2016.

Based on the structure locations (denoted as points), the depth grids were used to extract a structure specific depth of flooding for each of the alternative scenarios. The analysis assumed the ground elevation adjacent to a structure was constant since the study area terrain has minimal elevation change. Therefore, the depth of flooding at each structure was assumed to represent maximum depth of flooding at each structure. Since most structures in the study area are damaged by overland flooding, the begin damage point for each structure was assumed to be the elevation of the adjacent grade. For overland flooding, flood water would not be anticipated to impact a structure until water reached the foundation of the structure.

**Reference: Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

Flooding depths were divided into 0.1 foot increments for each alternative scenario. The flooding depths ranged from 0 feet to 8 feet at the structure points for the 1% ACE recurrence interval. The depths of flooding and water surface elevation reductions experienced during the modeled 1% ACE event were assumed to be similar for the other seven recurrence intervals used as part of the 2018 JFA analysis. For each 0.1 feet of flooding depth, the number of structures were compiled into their respective statistical bins.

In order to estimate the incremental benefit provided by the Eagle Creek Dry-Storage Basin, Stantec first calculated the benefit provided by the Hydraulic Improvements projects by finding the difference in depths at impacted structures between the Existing Conditions and Hydraulic Improvements (Phase 1 and 2) scenarios. This calculated result was then subtracted from the modeled scenario that included both the Hydraulic Improvements (Phase 1 & 2) projects and the Eagle Creek Dry-Storage Basin to estimate the benefits provided by the Eagle Creek Dry Storage Basin.

Figure 2 presents the number of structures with flooding depths greater than a specified value for each alternative scenario. Figure 2 shows there is a large reduction in the number of structures impacted by flooding between the Hydraulic Improvements Phase 1 and 2 scenario and the Eagle Creek Dry-Storage Basin scenario.

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

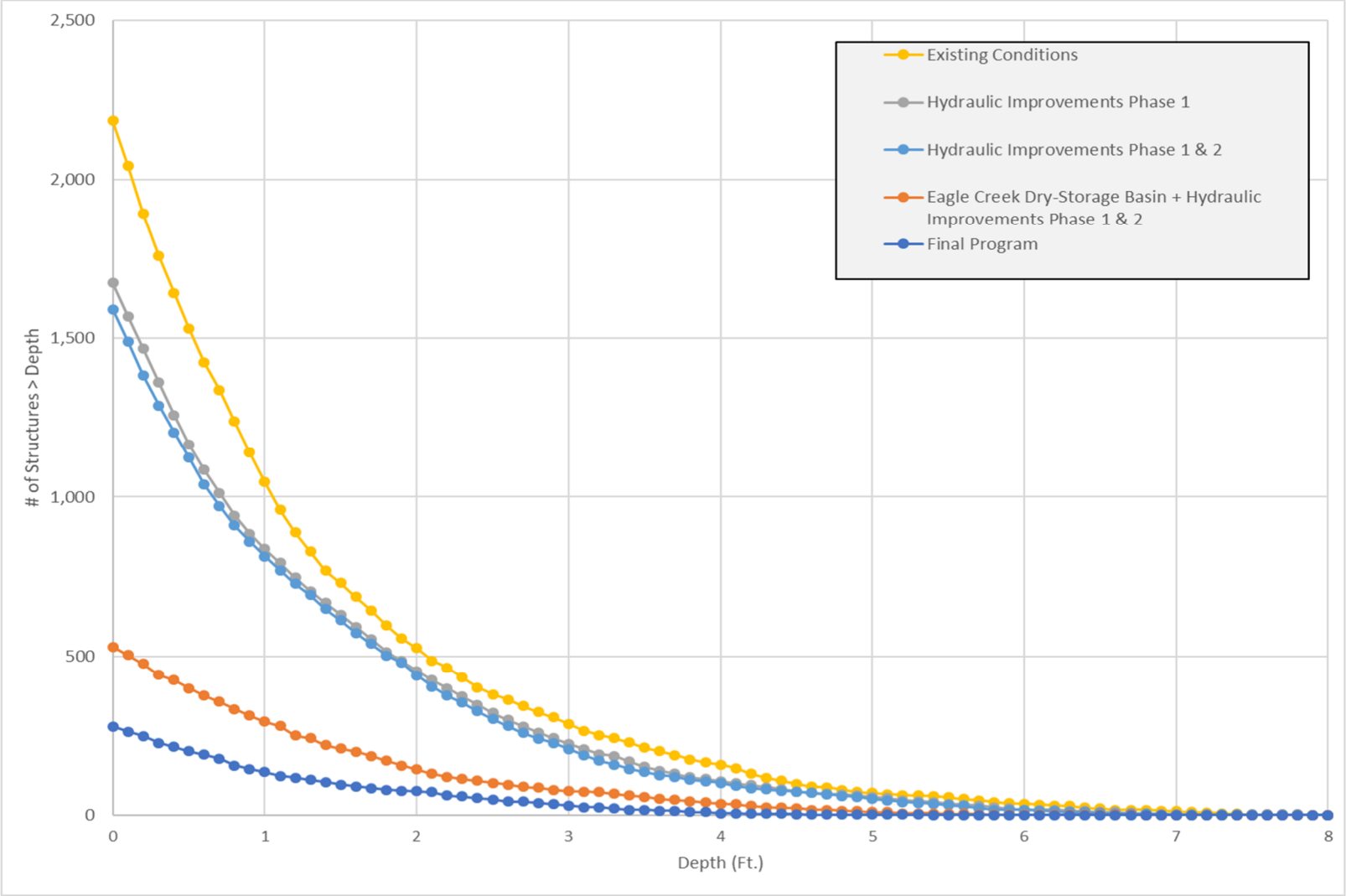


**Figure 2 – # of Structures Greater Than Specified Flooding Depth for each Alternatives (1% ACE Flood)**

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

The number of structures within each bin were then multiplied by the associated incremental depth. The summations of the cumulative products were compared between the analyzed scenarios. Table 3 shows that the Hydraulic Improvements (Phase 1 and 2) and the Eagle Creek Dry-Storage Basin Project comprise approximately 84% of the "Final Program" benefits. The Eagle Creek Dry-Storage Basin project alone is estimated to account for approximately 56% of the Final Program benefits.

**Table 3 – Structures by Incremental Depths and Approximate Percentage of Calculated Benefit**

| | # of Structures x Depth | Difference from Existing Conditions | % of Final Program |
|---|---|---|---|
| Existing Conditions | 2,986 | 0 | **0%** |
| Ph. 1 Hydraulic Improvements | 2,360 | 626 | **24%** |
| Ph. 1 & 2 Hydraulic Improvements | 2,248 | 738 | **28%** |
| Estimated Eagle Creek Dry-Storage Basin for Stand-alone BCR | -- | -- | **56%** |
| Eagle Creek Dry-Storage Basin and Hydraulic Improvements Phase 1 & 2 | 777 | 2,210 | **84%** |
| Final Program | 358 | 2,629 | **100%** |

The HCFRRP schedule and estimated percentage of Program benefits were updated as part of this simplified BCA. Table 4 shows the revised dates for the Eagle Creek Dry-Storage Basin project. The Hydraulic Improvements are assumed to be already constructed for this stand-alone BCR. The other two dry-storage basins were removed from the schedule.

Table 5 shows the estimated benefit percentages by year based on the results of the simplified BCA data shown in Table 3.

**Table 4 – Stantec 2020 - Program Construction Schedule by Phase of Project**

| Project | Phase 1 Hydraulic Improvements | Phase 2 Hydraulic Improvements | Eagle Creek Dry-Storage Basin |
|---|---|---|---|
| Timeline (Year) | 2018-2019 | 2020-2021 | 2022-2024 |

**Table 5 – JFA 2018 - Percentage of Final Program Benefit Provided by Year**

| Year | Benefits (%) | Note |
|---|---|---|
| 2018-2023 | 0 | |
| 2024-2073 | 56 | Eagle Creek Dry-Storage Basin |

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

Because Stantec is using a simplified approach to calculate the BCR, only the structure and content damage reductions were used to estimate the Project's BCR. The data from the *Updated Benefit Cost Analysis* (June 2018) performed by JFA was used to find a percentage of the primary benefits for these two categories:

- Structure Damages
- Content Damages

## CONSTRUCTION AND MAINTENANCE COSTS

Maintenance costs for the Eagle Creek Dry-Storage Basin were assumed to begin in the year following its initial year of construction. Maintenance costs for the Eagle Creek basin were assumed to begin in 2023. The maintenance costs for the basin are estimated at $75,000 per year.

Opinion of probable construction cost was calculated as $75,600,000 based on the Eagle Creek Option 1BC, 1,100 cfs from the Stantec technical memorandum, "*Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin Project Alternatives Review (October 2019)*"

## DISCOUNT RATE

Future costs are converted to their present values (or discounted values) by using a discount rate. This updated BCA used a discount rate of 0.4 percent. The discount rate allows for comparison of the buying power of one future dollar to the purchasing power of one dollar today. The discount rate for costs and benefits applied in this analysis is sourced from the annual US Office of Management and Budget (OMB) publication, *Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses* (November 2019).

## RESULTS

The net present value for the Eagle Creek Dry Storage Basin construction and maintenance costs (excluding Hydraulic Improvements Phase 1 and 2) total approximately $77,197,000.

The net present value for the Eagle Creek Dry Storage Basin benefits for only the structure and content damage reduction (excluding Hydraulic Improvements Phase 1 and 2) totals approximately $169,623,000.

The estimated standalone Eagle Creek Dry-Storage Basin project scenario demonstrated a BCR of 2.20 as part of this updated analysis.

## CONCLUSION

Data from the *Updated Benefit Cost Analysis (June 2018)* performed by JFA was used to calculate a stand-alone BCR for the Eagle Creek Dry-Storage Basin project. The simplified BCA methodology produced a BCR of 2.20, indicating that the Project's flood risk reduction benefits outweigh the costs.

Additional BCA categories that were previously calculated by JFA but not included in this analysis, would increase the benefits, and the corresponding BCR associated with the Eagle Creek Dry-Storage Basin project. As it stands, the anticipated range of expected BCR for the proposed Eagle Creek Dry-Storage Basin Project is well beyond the minimum 1.0 BCR threshold, indicating a cost-effective project.

**Reference:** **Hancock County Flood Risk Reduction Program – Eagle Creek Dry-Storage Basin – Benefit-Cost Analysis (Stand-alone Eagle Creek BCR)**

**Stantec Consulting Services Inc.**

**David Hayson** PE, SI
Senior Project Engineer

Phone: 513 842-8214
David.Hayson@stantec.com

**John Menninger** PE
Senior Principal

Phone: 513 842-8218
John.Menninger@stantec.com

Attachment: Attachment A - Hancock County Flood Risk Reduction Program: Updated Benefit Cost Analysis (JFA, June 2018)

c. Derek Dalton – Stantec