Attachment F – Benefit-Cost Analysis

City of Tuscaloosa, Alabama

File Name: AttFBenefitCostAnalysis

The City of Tuscaloosa contracted Walker and Associates (Walker) who sub-contracted Stantec Consulting Services, Inc. (Stantec) to manage and compile the Benefit-Cost Analysis (BCA). Walker worked directly with the city to compile data and information about the proposed activities for the Tuscaloosa grant application. Stantec took the provided information and applied engineering methodology to analyze the lifecycle costs and benefits for each project. The City of Tuscaloosa worked with many community partners to assess community needs, generate solutions, and assess the feasibility and costs of these projects. Walker worked with the City to select and move forward with conducting a BCA for attractive projects. This process involved significant discussions of benefits achieved by each project, which played a large role in the selection process. In other words, final benefits as applied in the BCA spreadsheet were quantified through a broad stakeholder, iterative process.

Stantec then developed analysis methodology and conducted BCAs for a variety of different projects ranging from flood hazard mitigation to community parks and City Walks. Stantec analyzed these projects and developed resources to showcase the BCA computations and methods. Stantec also assisted with developing write ups and establishing standard language. Overall, Stantec handled the technical pieces to the BCA with the City being responsible for quantifying the benefits to capture and quantify the benefits that could not be monetized.

1. Full Proposal Cost

The overall application project cost in net present value (NPV) is $879,438,636.92. The lifecycle costs include estimated operations and maintenance, where available, and utilize a design life ranging from 10 to 100 years depending on the project/benefit type. For example an environmental benefit can apply to well over 100 years of project life whereas a technology (Wi-

Fi) project benefit should only apply to 10 years. Refer to the attached Tuscaloosa BCA spreadsheet for a line item summary of all costs considered in this analysis.

Cost estimates were developed by the City's many partners, applying data from recent bid tabs of local projects of similar profile as well as local developers and contractors. Where local data was not available, cost data was developed utilizing 2016 RSMeans Cost Data indexed to Tuscaloosa locale.

Sources of leverage include both public and private funds. Source of public funds is the City of Tuscaloosa. Private funding is from local business and developers. Refer to Exhibit F -Leverage for a detailed overview of direct and supporting funding partners.

2. Current Situation

Primary Hazards: According to the National Climatic Data Center, climatic factors such as severe heat and storms that contribute to tornadic activity are present. Currently the National Climate Center estimates Tuscaloosa (Tuscaloosa County) has an average of 3.4 tornadoes annually with an estimated potential risk of $118 billion in damages. Other hazards include flooding. A FEMA regulatory floodway traverses the entire pathway of qualified disaster which makes it difficult to build back, acting as a barrier to disaster recovery and resilience in the MID-URN area. Additionally, there are many homes and businesses still existing in the floodways and the City has inadequate funds to initiate a floodway buy-out program for all of the properties.

Unmet Needs: The updated Phase II threshold requirements have identified unmet needs in the city, county, and region exceeding those in the threshold requirement. Tuscaloosa's most

significant unmet needs are located within the proposed NDRC project target area. Unmet needs include: housing - $64.7 million; infrastructure supporting housing and economic revitalization - $629.7 million: and economic revitalization - $227.8 million.

Housing: Data gathered by the University of Alabama's Alabama Center for Real Estate (ACRE) and Engineering department, estimate there are 5,144 housing units (owner, rental, public housing) in the MID-URN area with a median value of homes of approximately $108,500. Multifamily housing represents 32.2 % of all housing units and data suggests that by 2019 there will be an undersupply, in regard to low-income housing, of 2,337 homes. Further data analysis reveals that 32% of households within the MID area have an income of less than $15,000 and that 36% of families fall below the poverty line. Note, during the 2011 storm event it is estimated that 5,000 low income units were destroyed with to-date an estimated 430 having been rebuilt.

Economy and Jobs: According to the Region 3 workforce development agency West Alabama Works, there is a need to bring 1500 new employees to the market within the year based on the new industry coming to region. Additionally, a UA study revealed that by 2030 there will be a deficit of 14,000 jobs across the State due to the lack of workforce development resources in conjunction with the emergence of new industry. There is also a great need to develop curriculum for K-12 students to prepare the workforce, data shows that in the next 10 years 65-75% of all jobs will require a 2 year degree or certificate.

Infrastructure: Resilient infrastructure is needed to ensure our physical, social, environmental, and economic resiliency against future threats. Water and sewer lines in the City are aging (most over 60 years old), improvements to two large drainage systems are needed to reduce flooding in

neighborhoods, and stream restoration and erosion reduction are critical to the railroad systems that run adjacent. In order to provide the capacity needed for the growing population, redundancy in event of line failure that will continue service, reduce flooding along roadways and neighborhoods, and continued operation of two major rail lines, over $35 million in infrastructure needs have been identified.

3. Proposed Project/Program

SMART – Strategy for Making a Resilient Tuscaloosa

Understanding that each community is unique and that each group or subgroup within a community is equally unique means the way resilience manifest itself plays out differently in our 3 unique areas (all within the MID-URN target area); areas that are unique and separate but will be fully connected through a coordinated project; areas impacted by severe storms but also devastated by economic depression, susceptible to flooding/water management issues, and yet surrounded by hope. Whether its families that lost the house they called home, the businessman that invested all he had into a business that closed because the neighboring factory shut down, or the neighborhood that feels trapped due to its isolation from everything necessary to meet basic human needs – this SMART Proposal brings hope through a comprehensive resilience approach. This proposal will incorporate the improvement of a number of individual systems which once in service will decrease risk to vulnerabilities and will make this city a model resilient City.

The SMART proposal provides a preferred prioritized blueprint for development of 50 activities with substantial financial commitment from the community in the form of project leverage. The complete list of these prioritized activities is included in Attachment B and includes activity total, leverage committed, requested funding, and planning and administration.

Project Attributes:

Water Quality and Floodplain Management. Through the water quality and management activities within this proposal there will be a reduction in the effects associated with flooding which is often associated with large scale weather events in this City, region and the state. These activities include improvements to the Brookhaven and Cypress Creek watersheds and will include buyouts of 7-8 firm structures located in the floodway, natural channel design addressing eroded stream banks, enlargement of culverts that are currently undersized serving new and existing development and creation of greenways and habitat. .

Sanitary Sewer Activities. Various sanitary sewer activities which are being proposed to expand the capacity to support residential and economic development while protecting the environment and the health of the community from contamination from sanitary sewer overflows.

Water Distribution activities that are a part of this proposal will provide additional water pressure and fire water pressure to neighborhoods and will provide additional capacity to the neighborhoods served for an indefinite period of time.

Roadway Activities. The proposed roadway activities will significantly strengthen the local economy, provide access to jobs and commerce from the region to the City core, and reduce congestion and the associated environmental impacts.

Key Project Objectives.

Unmet Needs. To address unmet needs from the 2011 disaster.

Connectivity. To connect the community, specifically vulnerable, at-risk populations. The City Walk and the associated technology aspects of this activity will connect populations, neighborhoods, homes to businesses as well as other critical services, providing a path to

enhanced resilience. This project will address unmet housing and economic needs through the creation of greenspace. The path will also provide the City with the opportunity to replenish trees, meeting an unmet environmental need. Each area will benefit from increasing economic opportunity, increased property values and neighborhood connectivity through new commercial activity, the birth of residential neighborhoods, and increased social infrastructure. The City Walk, will not only physically connect people to resources but will also provide co-benefits by putting critical technology in place as well as serving as the conduit for underground utilities.

Housing. To create new affordable, safe and resilient housing stock. The City through strategic partnerships will be creating new housing stock available to vulnerable populations, students and families.

Critical services To address basic human needs and through these activities enhance overall community resilience. Providing basic human needs is the foundation for any resilience plan. The placement of this critical infrastructure will allow for the creation of economic development as well as increased or improved housing opportunities, thus making those vulnerable become more resilient.

Reduce Future Risks. To address or reduce risk to flood risks while maximizing overall resilient dividend. The enlargement of culverts accompanied by adjacent stream and riparian corridor restoration will reduce/eliminate future flooding events while enhancing and protecting the environment. The incorporation of hardened facilities and safe rooms will minimize the loss of life and injury in severe storms and tornadic events. Additionally, stricter building standards with materials to withstand high wind speeds will also significantly address the risks associated with severe weather and tornadic events.

Economy and health. Through the recruitment of new employers and support of existing businesses improve local health while providing opportunities for jobs resulting in vulnerable population opportunities for economic upward mobility.

Measure and Adapt. To monitor, evaluate and adapt to maximize opportunities, lessons learned and ultimately social, environmental, economic and resilient benefits. The University of Alabama will establish an integrated approach for assessing and managing natural disasters from a public project perspective, through the identification of critical success factors (CSFs). These CSFs will be combined with project life cycle analysis, risk assessment theory, social vulnerability and supply chain resilience concepts to determine a Disaster Vulnerability Index value under different conditions.

4. Baseline Risks

a. Long-term Effects

The planning and design phase of a project considers the baseline approach asking the question, "What are the risks if the proposed projects are not implemented?" Communities must weigh the benefits and costs associated with the baseline option. As the extreme nature of weather events are becoming more severe, resulting impacts of damage and loss are also increasing. Staying idle and not rebuilding with recovery, resilience, and revitalization in mind will leave communities like Tuscaloosa vulnerable to increased risk from natural disasters affecting the environment, health, safety, and economy of the surrounding population.

If the recovery and resilience projects are not implemented in the community of Tuscaloosa, Alabama, many neighborhoods will have damaged and abandoned structures

remaining from the 2011 EF-4/5 tornado that touched down through the heart of the region destroying up to 12% of the city. 4,362 residential and 356 commercial structures were impacted by the event and 7,000 people lost their jobs.

Considering the risks associated with inaction, the consequences may be significant. Not only will the visible damage endure from the 2011 natural disaster, but risk of a similar, future event will remain or increase with the evolving weather patterns observed across the nation posing a risk to the health and safety of the community.

Tuscaloosa has a stretch of leveled neighborhoods and abandoned parcels damaged by the tornado that remain as an eyesore and bad memory for those passing by on local streets and highways. Chances are the community could face a comparable situation at some point in the near future (5, 20, 50 years down the road) based on recurrence intervals and the frequency of past observed storm events in the Midwest. According to National Weather Service Storm Prediction Center, the twenty year average for the Tuscaloosa region shows approximately 12 tornado watches per year. The proposed safe rooms across the city are projects designed to mitigate future injury and loss of life. If these rooms are not constructed, then the risk level in the area remains elevated.

Even though the proposed recovery and resilience projects are not expected to prevent all damage or mitigate every risk, the future impacts on the regional economy are likely to benefit Tuscaloosa as opposed to doing nothing. Over time, if the revitalization projects are not implemented and redevelopment does not occur, then the impacted communities may suffer both socially and economically down the road as they are much more vulnerable in their ability to recover from disaster events.

b. Effect on Community

When devastated areas remain, local communities suffer consequences economically and socially. Generally, the areas impacted by natural disasters can affect local property values, and deter future development. The areas impacted by the tornado include those where families of low to moderate levels of income reside. The proposed City Walk will help interconnect all communities allowing those cut off by the tornado's path to be able to reach the entire city including businesses, recreational facilities, residences and other communities. Without constructing revitalization projects like the new train station, City Walk and Jaycee Park enhancements, the community will suffer from lack of connectivity and poor community cohesion.

c. Additive Impacts

The result of not implementing these restorative and rehabilitation projects diminishes additive impacts like local tourism, recreational activities and improved living environment in the Tuscaloosa community. The absence of proposed green infrastructure, educational outdoor classrooms and localized drainage and stream restoration projects will coincide with the absence of potential qualitative benefits like increased standards of living, community cohesion, recreation, health, wellness, and public perception.

Without the construction of additional transit options like City Walk and the train station improvements in the region, additional traffic congestion, and increased gas emissions will remain. Residents without access to private transportation or public transit will not

be fully connected to other locations in the city that could provide jobs, recreation, health care and education.

Without planting the proposed 2,667 trees, additional carbon emissions, storm water runoff, lack of energy savings and lack of aesthetic benefits through property value increases will not be realized.

The educational benefits offered through the outdoor classrooms, improvement to City Schools, workforce development center and the proposed Center of Resilience would be absent. As a result, the communities most at risk from experience a similar, future event will not be adapted from these benefits and may not react in event of a future natural disaster.

d. Impact on Low-to-Moderate Income Areas

This repetitive risk of loss will impede the economic development of the communities due to the continued risk of property damages, having a disproportionate impact on low income, the elderly and other vulnerable populations. Many of the neighborhoods in Tuscaloosa contain pockets of concentrated poverty that will be adversely impacted if these recovery, resilience, and revitalization projects do not go through. Localized flooding events and tornados like the one experienced in 2011 continue to put low income neighborhoods at risk. Using the best available science and data, communities are being encouraged to find the most significant vulnerabilities and risks facing the affected communities and then discover innovative resilience projects to better prepare these communities for future storms and other extreme events. Tuscaloosa is proposing safe

rooms across the city totaling a maximum occupancy of 4,240 people. This benefit will not exist for low income and vulnerable populations if the projects do not go through.

e. Cost Avoidance

For locations that have been negatively impacted by natural disasters in recent years, risk assessment and planning could lead to cost avoidance in the future if/when a qualifying disaster strikes again. Creating the City Walk and underground communication lines will be expenditures now, but the net benefit in the future will be the cost avoidance of having above ground communication lines destroyed. Also, having damaged structures and destroyed neighborhoods remaining where the proposed City Walk is to be constructed may diminish the local economy and inhibit potential development. Building proposed safe rooms and shelters now like the ones proposed at City Hall and the Department of Transportation buildings will cost money now, but has the potential to avoid future costs through the mitigation of future injury or loss of life.

5. Benefits and Cost

This section describes the methods used to quantify the life cycle costs and resiliency, environmental, social and economic benefits of projects. Benefits which can't be quantified or are difficult to quantify are discussed qualitatively elsewhere. The breakdown by years is not anticipated, as most of our benefits are consistent year over year and are able to be discounted at one time through the NPV calculation.

Lifecycle costs for each project consider both initial capital costs as well as annual expenses required to maintain a project over the project life. Capital costs and annual expense estimates are based on local knowledge and resources. Based on this information, a net present value (NPV) representing the lifecycle cost was computed based on a discount rate of 7% and a design life appropriate for the project.

The methodology used to estimate resiliency value varies based on the type of benefit being quantified. Annualized benefits are converted to a net present value based on a discount rate of 7% over the design life of the project.

a. Removal of flood prone properties from risk area resilience benefit is quantified by applying appropriate USACE depth damage curves with FEMA BCA methodology for a range of flood events including the 1-, 2-, 10-, 50-, 100- and 500-year return interval events. FEMA FIS data was used to determine the flood water surface elevation during each event and the building first floor elevations were based on the available elevation data for the area and knowledge of whether the building has a slab, crawlspace or basement foundation. Using this information and assessed values for improvements for properties, damages for each event were calculated and an annualized damage estimate was developed for both the building and the building contents. Because this type of resilience project assumes the at-risk property will be purchased and removed, there will be no damage associated with the property after completion of the project. The resilience benefit is simply the NPV of the annualized damage to the properties under existing conditions over a project life of 50-years.

In addition to building and content damages, displacement costs were estimated using a similar methodology. Displacement costs use the same inundation depth data used with the USACE depth damage curves, but instead use FEMA BCA curves for displacement time, rental costs and disruption costs to calculate the annualized cost of displacement during cleanup from a flood event. Again, the resilience benefit is simply the NPV of the annualized displacement cost under existing conditions over a project life of 50-years.

b. Reduction of flood water levels resilience benefit is quantified as an annual benefit per acre for riparian restoration projects using FEMA estimates for the monetary benefits of riparian area inflated to 2015 dollars as described in FEMA Mitigation Policy - FP 108-024-01. A number of projects include stream restoration as a means of increasing stream capacity and stopping bank erosion problems, however detailed hydraulic modeling is not available to quantify the flood hazard reduction benefit of the projects using USACE depth damage curves, so flood hazard reduction service value was included when quantifying riparian area benefits to account for it. The resilience benefit is simply the NPV of the annual benefit estimated using the FEMA values over a project life of 50-years.

c. Reduction of Human Suffering and Life Loss through tornado shelters and safe rooms resilience benefit is quantified by conducting a tornado shelter analysis using FEMA's Benefit Cost Analysis 5.2.1 software. The shelter analysis includes the size of the shelter and number of people expected to utilize it as well as a number of other factors including the relative safety of where people using the shelter are coming from and the type of construction of the shelter and whether it is a community or

private shelter. These factors are used by the FEMA BCA software to estimate the number of deaths or injuries with a shelter when compared without the shelter and assign a NPV based on a 50-year design life.

The methodology used to estimate environmental value varies based on the type of benefit being quantified. Annualized benefits are converted to a net present value based on a discount rate of 7% over the design life of the project.

a. Enhanced Riparian Areas or Added Open Green Space environmental benefit is quantified as an annual benefit per acre for riparian restoration projects or added green space projects using FEMA estimates for the monetary benefits of riparian area inflated to 2015 dollars as described in FEMA Mitigation Policy - FP 108-024-01. The FEMA estimates are broken out into individual environmental services such as aesthetic value, air quality, habitat, flood hazard reduction, etc. Each project was reviewed and only the appropriate environmental service benefits were included the benefit calculation. The environmental benefit is simply the NPV of the annual benefit estimated using the FEMA values over a project life of 50-years.

b. Reduced Vehicle Emissions environmental benefit is quantified based on the estimated commuter miles saved per year due to pedestrian/bike way projects using pollution reduction benefits from the TIGER BCA Resource Guide. The number of added people biking or walking to work is based on the population within 0.5 mile of the project from the 2010 census and typical values from the American Community Survey, 2013 for Tuscaloosa for the number of people walking or biking to work and

average travel distances/times. The environmental benefit is simply the NPV of the annual benefit of pollution reduction values over a project life of 30-years.

c. Tree Replacement environmental benefit is quantified as an annual benefit per new planted as part of a project using USDA Forest Service net benefit per tree per year estimates. The USDA Forest Service benefit estimate accounts for many different services provided by an individual tree including energy savings due to shade, air purification, stormwater runoff reduction, aesthetics, etc. The environmental benefit is simply the NPV of the annual benefit over a project life of 120-years.\

d. Storm water treatment from GI environmental benefit is quantified based on the reduced treatment cost at the WWTP. The current treatment rate per gallon was provided by Tuscaloosa and applied to the estimated annual gallon reduction benefit expected to be provided by the GI projects to get an annual benefit due to reduced treatment cost. The environmental benefit is simply the NPV of the annual benefit over a project life of 50-years.

While many of the projects discussed in this BCA provide significant social benefit, these are not currently quantifiable and are only discussed qualitatively.

The methodology used to estimate economic value varies based on the type of benefit being quantified. Annualized benefits are converted to a net present value based on a discount rate of 7% over the design life of the project.

a. High speed broadband network economic benefit is quantified based on an estimated GDP increase per capita in the service area. The estimated GDP increase is 1.1% of

the current GDP per capita obtained from a study conducted by Analysis Group entitled "Early Evidence Suggests Gigabit Broadband Drives GDP." The existing per capita GDP was obtained from the 2010 census and multiplied by the number of people to be served and the per capita GDP increase to get an annual GDP increase for the broadband. The economic benefit is simply the NPV of the annual benefit over a project life of 10-years.

b. Property Value Increase due to parks and green space economic benefit is quantified based on an estimated increase in property value for properties in close proximity to the project. According to a 2009 study by P. Asabre entitled "The Relative Impacts of Trails and Greenbelts on Home Price" properties within 0.5 mile of parks and green space experience approximately a 5% increase in property value. Parcels within the proximity of the park or greenspace features were identified and the property value increase applied to them as a fixed one-time benefit.

6. Project Risks

The major uncertainty in the analyses is climate change. At this time, the projects do not account for climate change as a factor in design, cost or benefit analysis. For flooding hazards, if climate change results in more frequent extreme precipitation events, the benefit of property buyouts or other flood hazard reduction projects may be improved. Conversely, if the opposite were to occur, flood hazard risk reduction projects may make less sense to complete. A similar issue exists with Tornado hazards and shelter benefit analysis. If climate change results in more frequent tornados, the benefit of installing tornado shelters will be increased. If knowledge regarding the specific impacts of climate change in the Tuscaloosa area is improved to the point

where frequency estimates of extreme flood or tornado events can be updated, the analyses can be readily updated to incorporate the changes.

Another uncertainty in the analyses relates primarily to the use of benefit or cost estimates based on studies conducted in other areas. It is assumed in many cases than average benefits for similar projects in other parts of the country or averaged nationwide are readily applicable to the Tuscaloosa area. A particular project may have greater benefit or less benefit if all local factors were to be accounted for, but it would be impractical to attempt to do so. If additional studies more applicable to the project area are developed the analyses can be readily updated to incorporate the new information.

The final major uncertainty relates to the detail of current analyses. The benefits of some projects such as flood hazard reduction or reduction of combined sewer overflow values are based in some cases on approximate or preliminary modeling. As these projects proceed from conceptual design to planning level design or full design the specific results on which benefits are calculated will be known with greater certainty. As the project evolves the benefit analyses can be readily updated to incorporate the new information.

7. Challenges

The proposed projects, activities and programs proposed as part of the City's SMART proposal have been evaluated for risks that may prevent their implementation as part of the application development process. The City of Tuscaloosa as part of responding to this grant opportunity has facilitated an extensive political or stakeholder process and through this process believes have significantly reduced any associated risks that could affect implementation. Risks reduced include not obtaining the support of key internal and external

community stakeholders. Internal stakeholders include Mayor, City Council, and various water, wastewater, parks and recreation and transportation department leaders. External stakeholders included but were not limited to the general public, the University, regulatory (State and Federal) community, minority populations and environmental groups.

Evaluation of the proposed SMART projects, activities and programs has identified no technical or legal risks to implementing the City's proposal.

Appendix H Table

BCA OVERALL DATA TABLE

BCA MASTER SPREADSHEET