Stantec Consulting Services Inc.
One West Fourth Street, Suite 820, Winston-Salem, NC 27101

January 30, 2020
File: 175682084

Attention: Virginia Spillman, PE
Water Resources Department, City of Greensboro
2606 S. Elm-Eugene Street
Greensboro, NC 27406

Dear Virginia,

Reference: North Buffalo Creek Watershed Study - PROPOSAL FOR ENGINEERING SERVICES

The City of Greensboro Water Resources Department (WR) recently requested that Stantec Consulting Services Inc. (Stantec) submit a proposal for the referenced project. The proposal is based on our understanding of your needs based on meetings with WR on September 26, 2019 and November 15, 2019 and on January 10, 2020 with the Latham Park stakeholders. The following sections highlight pertinent background information, our proposed scope of services, fee estimate and schedule.

BACKGROUND

The North Buffalo Creek watershed is a highly developed, urbanized basin comprised of residential, public, and commercial properties. Existing data shows several structures in the FEMA regulatory floodway. WR provided Stantec a listing of 26 repetitive loss and severe repetitive loss (SRL) properties, about half of which are located within the watershed. Historically, flooding has been an issue within the North Buffalo Creek watershed. Flooding has been reported at Revolution Mill and several other locations within the watershed. Being relatively small (approximately 15 square miles) compared to large river systems and highly urbanized, the watershed is particularly susceptible to shorter-duration, high-intensity storm events ("cloudburst" storms). In the last few years, flooding has been reported more frequently, in conjunction with these types of storms and the more frequent hurricane impacts in the region. A significant flood event was also reported July 31, 2019.

In 2017, Stantec performed a high-level review of the North Buffalo Creek watershed for the City of Greensboro to assess the potential for feasible flood risk reduction solutions in the watershed. Stantec was provided a one-dimensional, steady state HEC-RAS model. The model is assumed to be the model utilized for a FEMA Letter of Map Revision (Case No. 13-04-6581P) approved in 2014. A hydrologic model utilized to determine flow rates within the Creek was not provided. The 2007 Flood Insurance Study (FIS) update for Guilford County indicated that the North Buffalo Creek within the City was new or revised as part of that study. Therefore, it is expected that a hydrologic model may be available for the watershed, although the method of study was not referenced in the FIS. A simplified gage analysis utilizing Bulletin 17B methodology was conducted on the gage in the creek at Church Street. The results of the gage analysis predicted a 1-percent annual chance (100-year return interval) flood discharge of 3,284 cfs. The HEC-RAS model provided had a flow rate of 6,953 cfs in the model at the same location. The hydrologic and hydraulic modeling included in this proposal will further investigate the difference between these flow rates.

Reference: **North Buffalo Creek Watershed Study - PROPOSAL FOR ENGINEERING SERVICES**

Stantec was awarded an on-call contract with the City on July 16, 2019 for Floodplain Management Services, Hydrologic and Hydraulic Modeling, No-Rise Certification and CLOMR/LOMR, Evaluation of Floodplain Studies, Floodplain Development Permits, Community Rating System (CRS), and LiDAR, 3D Modeling, and Flood Inundation Analysis. Execution of the On-Call Master Services Agreement for Professional Services is underway. It is anticipated that the proposed scope of services that follow will be authorized as a Supplemental Agreement under that contract. In addition, a separate proposal is being prepared concurrently to assist the City with potential opportunities for home/structure flood mitigation efforts. The scope of work for that study includes assisting the City with identification and implementation of potential FEMA grants, such as Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Repetitive Loss, or Severe Repetitive Loss. At the City's discretion, these two proposals may be combined, or performed in parallel to leverage the results of this study for the impacted properties within the North Buffalo Creek watershed.

SCOPE OF SERVICES

The following scope elements are based on our current understanding of the project.

1. Community Outreach

Achieving buy-in from project stakeholders and residents of the watershed is a critical element to the success of the study and forthcoming flood mitigation actions/strategies. As a result, Stantec proposes two-key community outreach tasks, development of a public-facing web application for improved interaction potential with residents, and a series of community and stakeholder meetings. Key stakeholders will include members of the public, significant high-value asset properties within the watershed, the development community, other governmental organizations, etc.

The website will display publicly available GIS information and other data (i.e., project alternatives being considered) to the public. Feedback, general or tied to a specific location on the interactive web-map, can be directly input in the website and will remain private, restricted to only Stantec and WR, or others as desired by WR. Similarly, documents, meeting materials, educational outreach materials, approved deliverables, etc. can be hosted on the website for easy access by project stakeholders. Stantec proposes that this website be complementary in nature to the City's existing web-presence. Further coordination regarding the objectives of the two systems should occur to identify the most practical application of this scope item.

For the public or stakeholder meetings, Stantec will bring presentation materials and assist the City in leading the audience through interactive participation in the meeting to promote feedback and buy-in on potential projects and an understanding of impacts from prior development(s). It is Stantec's intent to provide support and technical backing for the meetings, while WR leads the discussion and serves as the primary contact with the public.

Stantec fully supports the City of Greensboro's commitment to include M/WBE firms in our professional services contracts. Opportunities for minority participation on this project include assistance at public meetings, stream cross-section surveys, and data collection. A detailed plan regarding the meeting times relative to project milestones and objectives of each meeting can be established at the project kickoff meeting. For the purposes of this proposal, Stantec assumes the following public meetings will be held:

- Meeting #1 – Public Kickoff. Scope, schedule, roles of WR, Stantec, and the public will be discussed. Hard-copy maps and multiple stations with the interactive website will be available along with hard-copy maps with markers will be available to collect public input, high-water marks, other relevant information. The City website's role and opportunities for additional input, as well as a general communication plan will be discussed.

- Meeting #2 – Modeling Results/Alternatives/Mitigation Strategies
  - Model Results: Presentation of flood hazards in graphic/animation format of the historic (circa 1980) flooding, existing conditions, and full-buildout potential (future conditions). Discussion will focus on various types of storm events (high-intensity, cloudburst storms, long-duration hurricane-effect storms, along with traditional FEMA 24-hour storm events), evaluation of the watershed's response and susceptibility to different storms, and climate change trends.
  - Alternatives: Individual mitigation alternatives will be presented for feedback and an informal benefit-cost discussion. Input from participants on desired projects, anticipated priorities, project feasibility, rough order of magnitude costs, etc. will help to focus the team on potential mitigation strategies as a blend of multiple approaches/projects.
  - Mitigation Strategies: Following on from the individual project alternatives, the overall strategies for meeting various stakeholder's needs will be discussed. Participants will be solicited for more input as discussions evolve towards prioritization, phasing/sequencing, potential partners, etc.

- Meeting #3 – Proposed Plan Forward. The plan will outline recommended capital, operations, and maintenance improvements. Typical recommended programmatic improvements may include pursing a change in the City's CRS rating, expansion of the stormwater management ordinance, changes in building standards, updates to "hot spot" maintenance plans and implementation of new long-term community partnerships.

Deliverables:

- Provide supporting data for the public-facing elements within interactive mapping website
- Preparation and attendance for three (3) public/stakeholder meetings
- Preparation of community education materials for flood mitigation and water quality

2. Data Collection

Stantec was provided GIS information for available utility information, topographic data, property boundaries etc. during the 2017 modeling effort. Stantec will review this information at a kickoff meeting with WR and request any additional or updated data as necessary. This GIS information will be loaded into an ArcGIS Online platform (the basis of the interactive website described in Task 1), viewable by Stantec and WR. Elements that are desired to be shared publicly can be made available on a public-facing website, as discussed in Task 1. Stantec will work with WR to solicit input into the website, such as drainage concerns, high-water marks, areas of streambank erosion, etc. Similarly, Stantec will pose specific questions tailored to determining the root cause of potential flooding (i.e., how long the flooding persisted, which areas of your home were flooded, how did the floodwaters enter your home-door, floor drain, etc.)

Stantec will review information made available by the City pertaining to other planning and land-use efforts in the watershed, Parks' plans, potential bike paths and walking trails, etc. This information will be utilized

in the development of strategies that aim to identify project partners and create a more holistic watershed solution while meeting the flood mitigation priorities.

Stantec will perform a full-day field reconnaissance to identify watershed parameters for input in the hydrologic and hydraulic analyses, perform a geomorphic assessment of the stream, identify potential safety hazards or utility concerns relating to streambank erosion, and assist in identification of maintenance concerns.

To supplement the available GIS information and cross-sections provided in the hydraulic model, Stantec will perform a limited field survey of stream channel cross-sections. The existing hydraulic model provided to Stantec has about 200 modeled cross-sections through the 61,481 linear feet stream reach. This model was reportedly used for a No-Rise study in 2013 and the cross-section data is believed to be from the effective FEMA model. According to the available FEMA information, the date of the cross-section survey for North Buffalo Creek is mid-2000's for portions and just prior to 2013 on the LOMR portion that covers most of project watershed. Stantec proposes to provide field survey of select channel cross-sections and/or structures. This survey will serve to generally update the model to current conditions and validate or identify potential discrepancies with the effective FEMA information. These surveyed cross-sections may also be used to compare current conditions against prior survey information to evaluate erosion of the channel (either down cutting or widening). During the survey, repetitive loss properties and other potential flood-prone properties will be surveyed to determine their finished floor elevation (FFE) and lowest adjacent grade (LAG). It is assumed that gaining permission to access private property will be overseen and managed by WR staff. Survey services shall be limited to the survey task funding included in this proposal and will be performed by our subconsultant, JC Waller & Associates on a time-and-materials basins at a not-to-exceed amount of $38,000.00.

To support the hydrologic modeling, Stantec will also download and review the most recent USGS gage data within the watershed. Two USGS gages are located on North Buffalo Creek at Westover Terrace and Church Street. Both have continuous historical data from 1999 through 2019. Similarly, rain gage data from the City will be requested and reviewed to assist in the model validation for prior storm events (e.g., July 31, 2019). In addition, as requested by stakeholders, Stantec will add "cork-float" staff gages at existing culverts to collect future rain gage data from approximately 6 upstream tributaries and six rainfall events.

Deliverables:

- One kickoff meeting with WR to review information and identify data gaps
- Support WR with hosting of public input (e.g., high-water marks) on the interactive website (at WR's discretion)
- Existing conditions drawings/basemap from collected data
- Survey points for the stream cross sections (50) and FFE/LAG data at (50) buildings
- Plots of stream cross sections comparing existing conditions (from survey) versus historic cross-sections in the effective FEMA model (believed to be from survey in mid-2000's)
- Culvert rain gage data from six future rainfall events.

3. Hydrologic and Hydraulic Modeling

Currently, a hydrologic model has not been made available to Stantec. However, a gage is located directly on North Buffalo Creek within the watershed study area. FEMA's most-preferred hydrologic method is to utilize gage analyses (instead of a rainfall-runoff model). To develop a rainfall hydrograph, historic storm

events will be analyzed to develop the unit-hydrograph to be assigned to the peak flows determined by the statistical gage analyses. However, gage analyses do not support the evaluation of past (circa 1990) or future (full build-out) conditions or potential storage alternatives as flood mitigation techniques. As a result, the gage analyses will be utilized to calibrate a HEC-HMS, rainfall-runoff model.

To further support the evaluation of flood mitigation alternatives, Stantec will upgrade the existing one-dimensional, steady state HEC-RAS model to a one-dimensional, unsteady state model. This provides the benefit of being able to evaluate attenuation of the peak flows at hydraulic bottlenecks, additional floodplain storage areas, etc. Flow hydrographs from the hydrologic model will be assigned throughout the reach.

The models described above will be utilized to predict the existing conditions flood elevations for various storm events along North Buffalo Creek. Modeled storm events will include the typical FEMA return intervals, 50-, 10-, 2-, 1-, and 0.2-percent annual chance (2-, 10-, 50-, 100-, and 500-year events), with a 24-hour duration. Additional storm events will include cloudburst storms that more closely resemble the recent events (e.g., July 31, 2019) that have caused flooding within the watershed. A series of storm event durations and temporal distributions will be considered to evaluate the watershed response and susceptibility to different types of events and resilience to climate change trends. This information is especially important in the evaluation of a blended mitigation strategy that incorporates large capital improvement projects with smaller, parcel-specific measures.

The HEC-RAS model will be calibrated based on the elevations recorded at the USGS gage and based on available high-water marks and anecdotal information from the City and public input. Special attention will be noted on the more recent events to produce a match that replicates observed conditions with the appropriate level of confidence for decision-making on mitigation alternatives.

To evaluate hydrologic changes over the last 30 years (and potential future impacts of urbanization), an estimate in the change in Curve Number based on percent impervious and land-use trends for the historic time frame around 30 years ago will be developed. The HEC-HMS model will simulate the change in peak flows and hydrograph shape. The modified hydrologic inputs will be utilized to assess the impact on flood elevations within the watershed at key locations as well. Individual detention features and storm sewer systems for the developments will not be considered in the evaluation. In a similar fashion, Stantec will evaluate a full build-out condition to assess future risks associated with development and climate change. This, in concert with updated rainfall runoff models that can assess timing considerations of peak runoff from various portions of the watershed, can be utilized to develop a proactive strategy to manage future development without exacerbating, and maybe even benefitting, current flood-prone areas.

These existing, historic, and future conditions results will be utilized to develop flood hazard mapping, identifying flood-prone structures, depth and/or velocity grids, etc. for the scenarios and storm events analyzed. Graphic outputs and/or animations will be developed to support the community outreach efforts.

Deliverables:

- Unit hydrograph spreadsheet model and Bulletin 17B gage analyses outputs
- New HEC-HMS hydrologic model
- Updated one-dimensional, unsteady state HEC-RAS model
- Existing, historic, and future conditions flood work maps

- Animation and/or graphics (depth/velocity grids) to support public outreach depicting flood risk as it changes over time

4. Flood Mitigation Alternatives Analyses

Based on the existing conditions models, Stantec will brainstorm and assess the impacts for various flood mitigation alternatives. Up to ten alternatives will be considered. The evaluations will be a la carte in nature, i.e., each alternative will be modeled to assess its impact on flood reduction without consideration of multiple combinations of alternatives at this stage of the project. Alternatives to be considered may include:

- Large-scale capital drainage improvements
  - Floodplain storage alternatives (e.g., widening a floodplain valley for attenuation of peak flows)
  - Regional detention basins or in-line storage on North Buffalo Creek or its tributaries
  - Bridge removal/replacement
  - Flood-proofing (e.g., floodwall, levee, site-specific measures)
  - Diversion channels or other drainage area modifications to avoid flood-prone areas.
- Targeted maintenance plans (i.e., debris removal at critical culverts)
- Parcel-specific best management practices (BMPs)/green infrastructure (e.g., applied to X% of parcels or developments)
  - As part of the assessment of these parcel-specific strategies, Stantec will provide various case studies and lessons learned on the impact of green infrastructure for flood control (and for water quality considerations).

A rough, order of magnitude cost opinion will be developed for each option.

The HEC-HMS model will be utilized to evaluate the impacts of in-line storage or detention basins as well as the peak flow reduction from parcel-specific BMPs. Considerations for changes to design standards for BMPs or green infrastructure will also be considered, as these are often designed with a greater emphasis on capture of the “first-flush” through the 90th percentile storm and may also need to consider larger storm events to provide meaningful flood reduction benefits.

Finally, special consideration will be given to preliminarily identifying potential mitigation grant opportunities to be further evaluated as part of the previously mentioned concurrent scope or future task outside this scope of services.

It is anticipated that Stantec, WR, the public, and other stakeholders will collaboratively evaluate the projects considering flood mitigation benefits, cost, as well as social benefits and opportunities (e.g., trails, greenways, water quality improvements, safety enhancements, maintenance considerations, etc.). With input from WR and the public, Stantec will proceed with framing two or three mitigation strategies that blend or combine individual projects, for further development as part of a future task.

Deliverables:

- Individual flood mitigation alternatives. A conceptual figure will be provided along with key metrics such as, flood elevation impacts, order of magnitude costs, and additional considerations (social impacts).
- Draft narratives for two to three mitigation strategies.

5. Project Management

Stantec adheres to a robust, 10-point PM Framework that is ISO:9001 certified and routinely subjected to internal and external audits. Key components of this framework for this project are identified in the deliverables list below.

Deliverables:

- Development of a project plan identifying collective risks, communication plans, key stakeholders, and a detailed schedule
- Monthly progress meetings. Two to three Stantec staff (depending on the agenda) are anticipated at each meeting. Approximately 50% of these meetings may be held by conference call.
- Provide project status, progress, and deliverables to City to continuously display and maintain the restricted-access portion of the project website

ESTIMATED FEE

Stantec will provide the services described on a time and materials basis with a not-to-exceed limit of $226,800.00. Stantec will not exceed this limit without prior written notice from WR. Similarly, any adjustments to the scope will be provided in writing prior to the work commencing. Stantec is also committed to meeting the City's M/WBE requirement as part of this contract. We anticipate an approximate 20 percent M/WBE participation is achievable. Letters of Intent are included as Attachment A to this proposal.

Table 1 provides an estimate for the not-to-exceed limit based on our current understanding of proposed services. Per your request, a fee estimate for additional public meeting participation, including providing materials and or presentations, is included at the bottom of Table 1.

Table 1. Proposed Fee Estimate

No.	Task	Fee Estimate
1	Community Outreach	$29,480
2	Data Collection *(Limited Field survey for channel cross-sections, structures, and floor elevations not-to exceed $38,000)*	$90,560
3	Hydrologic and Hydraulic Modeling	$52,678
4	Flood Mitigation Alternatives Analyses	$36,912
5	Project Management	$17,170
	Total Fee Estimate	**$226,800**
	Estimated Fee Per Additional Public Meeting	$7,000

SCHEDULE

It is anticipated that the schedule will be refined following notice to proceed during project planning and kickoff activities with WR. A proposed milestone schedule is provided in Table 2.

Reference: **North Buffalo Creek Watershed Study - PROPOSAL FOR ENGINEERING SERVICES**

Table 2. Proposed Schedule

No.	Task	Start Date	Finish Date
	Notice to Proceed	Dec. 2019	Dec. 2019
1	Community Outreach	Feb. 2020	Dec. 2020
2	Data Collection	Dec. 2019	Mar. 2020
3	Hydrologic and Hydraulic Modeling	Jan. 2020	June 2020
4	Flood Mitigation Alternatives Analyses	June 2020	July 2020
---	Conceptual Design & Watershed Masterplan	TBD	TBD
5	Project Management	Dec. 2019	Dec. 2020

CLOSING

Stantec appreciates the opportunity to submit this proposal to WR. We are excited about the opportunity to work with you to improve flood mitigation efforts and water quality within the North Buffalo Creek watershed and ultimately improve the quality of life in the City. If you have any questions or require additional information, please contact me.

Regards,

Stantec Consulting Services Inc.

Linda Pass PE
Senior Associate
Phone: 704.488.2171
linda.pass@stantec.com

Bret A. Lavey PE, ENV SP
Senior Principal
Phone: 859.552.4909
bret.lavey@stantec.com

Attachment: A - M/WBE Participation – Letters of Intent
c. file
lb v:\1756\business_development\nc_greensboro\201912_on-call_north-buffalo_watershed-study\proposal\stantec_proposal_nbuffalo-wtrshd-study_rev1.docx