CITY OF HIGH POINT
AGENDA ITEM

Title: Water Master Plan

From: Terry Houk – Public Services Director
Derrick Boone – Public Services Asst. Director

Meeting Date: June 5, 2017

Public Hearing: N/A

Advertising Date: N/A
Advertised By: On-Call

Attachments: Attachment A – Water Master Plan Proposal

PURPOSE:
The Public Services Department has identified the need and budgeted for a water master plan to review current water demands and long term demands. This plan is required to determine service area needs, flow and pressure requirements in the current service area and future service areas.

BACKGROUND:
The professional engineering services provided for this project involve work associated with updating the hydraulic model, fire flow mapping, storage requirements, current demands and future demands.

BUDGET IMPACT:
Funds for this project are available in the 2016-2017 Budget.

RECOMMENDATION / ACTION REQUESTED:
The Public Services Department recommends approval and asks for the Council to award the professional engineering services to Hazen and Sawyer in the amount of $204,000.00.

FORMAL BID RECOMMENDATION
REQUEST FOR COUNCIL APPROVAL

DEPARTMENT: Public Services - Water Master Plan

COUNCIL AGENDA DATE: June 5, 2017

BID NO.: Supplemental CONTRACT NO.: DATE OPENED:

DESCRIPTION:

The Public Services Department has identified the need and budgeted for a water master plan to review current water demands and long term demands. This plan is required to determine service area needs, flow and pressure requirements in the current service area and future service areas.

PURPOSE:

The professional engineering services to be provided for this project involve work associated with updating the hydraulic model, fire flow mapping, storage requirements, current demands and future demands.

COMMENTS:

Hazen and Sawyer were selected from approved on-call list.

RECOMMEND AWARD TO: Hazen and Sawyer AMOUNT: $204,000.00

JUSTIFICATION:

ACCOUNTING UNIT	ACCOUNT	ACTIVITY	CATEGORY	BUDGETED AMOUNT
421779	527105	421171028120	40207	204,000.00
TOTAL BUDGETED AMOUNT				204,000.00

DEPARTMENT HEAD: Terry Houk Digitally signed by Terry Houk DN: cn=Terry Houk, o=City of High Point, ou=Public Services, email=terry.houk@highpointnc.gov, c=US Date: 2017.05.17 15:04:52 -04'00' DATE: May 17, 2017

The Purchasing Division concurs with recommendation submitted by the Public Services and recommends award to the lowest responsible, responsive bidder Hazen and Sawyer in the amount of $ 204,000.00.

PURCHASING MANAGER: Erik Conti Digitally signed by Erik Conti DN: cn=Erik Conti, o, ou, email=erik.conti@highpointnc.gov, c=US Date: 2017.05.17 15:30:47 -04'00' DATE: May 17, 2017

Approved for Submission to Council
FINANCIAL SERVICES DIRECTOR: Digitally signed by Jeffrey A. Moore DN: cn=Jeffrey A. Moore, o=City of High Point, NC, ou=Financial Services Director, email=jeffmoore@highpointnc.gov, c=US Date: 2017.05.18 16:22:43 -04'00' DATE: May 18, 2017

CITY MANAGER: Greg Demko Digitally signed by Greg Demko DN: cn=Greg Demko, o=High Point, ou=High Point, email=greg.demko@highpointnc.gov, c=US Date: 2017.05.18 16:25:10 -04'00' DATE: May 18, 2017

Hazen and Sawyer
629 Green Valley Road, Suite 200
Greensboro, NC 27408 • 336.292.7490

May 5, 2017

Mr. Terry Houk
High Point Public Services Director
P.O. Box 230
High Point, NC 27261

Re: Water Master Plan Proposal

Dear Terry:

We are pleased to provide this revised proposal for a Water System Master Plan. This project will be a Supplemental Agreement in accordance with the provisions of the Master Professional Services Agreement dated 8/20/2016 between the city and Hazen, and with the provisions of RFQ #17-121212.

Project Understanding

High Point's water system delivers an average of 12.4 million gallons per day (mgd) to over 43,000 metered connections in the city and unincorporated parts of Guilford and Davidson counties. Supply sources are the Ward Water Treatment Plant, which obtains water from City Lake and Oak Hollow Lake, and the Piedmont Triad Regional Water Authority (PTRWA), which treats water from Randleman Lake.

The water system has 615 miles of main including unlined cast iron pipes more than 100 years old. The pipe network includes two pressures zones that serve ground elevations ranging from 720 feet to 960 feet.

The city's Geographic Information System (GIS) maps the existing water system and stores details about pipes sizes, materials and installation dates, as well as the locations of all water meters. Customer billing records include historical water use for each account and location numbers that can be linked to the GIS.

High Point's current hydraulic model uses software called InfoWater. The demands in the model were last updated in 2011 using 2010 billing records. The model's pipe network has been updated for several recent projects but does not align correctly with the current GIS and does not include all the pipes in the GIS.

In May 2016, Hazen updated 2040 water demand projections for the city. These projections used a future service area agreed upon with city staff and population growth data for Traffic Analysis Zones (TAZs).

The proposed project will update the hydraulic model and check its calibration. The study will incorporate recent fire flow mapping and storage evaluations by Hazen, as well as the Ward Water Treatment Plant pump replacement project by Black and Veatch. Water quality modeling will map water age and optimize auto-flusher flow rates. The model will simulate future demands from Hazen's recent projections, identify deficiencies and propose new pipes, pumps and tanks as needed to meet design criteria. Deliverables will include a master plan report and a capital improvements plan with cost estimates.

Scope of Work

Hazen (Engineer) proposes the following scope for the City of High Point (Owner) Water Master Plan:

Task 1 – **Hydraulic Model Update**

The Engineer will **re-build the model's pipe network from GIS.** The new model's coordinates will match GIS, and every finished water main in GIS will be included in the model. The pressure zone boundary will be checked in detail. Model nodes will be added at high and low spots and at each hydrant and large customer. Elevations for new nodes will be assigned using digital topographic data. Software tools will check connectivity throughout the model. The pipe roughness coefficients (C-factors) in the old model will be transferred to the new model for review and adjustments based on field tests and GIS installation dates and pipe materials.

The modeling software will **allocate existing water demands** based on customer billing data provided by the Owner for the ongoing Water Audit project. Using meter coordinates, the software will assign each customer's water usage to the nearest node in the new model. Flusher flows will be assigned using information provided by the Owner. Adjustments for non-revenue water will ensure that the total demand in the model agrees with records of the total amount of water supplied to the system. The ten largest customers and flusher flows will be excluded from the non-revenue adjustments.

Hazen will **check pump curves, tank data and controls** in the existing model and update any information that is not current using information provided by the Owner or from field measurements. Pump curves for new pumps at Ward WTP will be added using the most recent information available from Black & Veatch, the consultant for an ongoing pump replacement project. Data for the proposed tank on Potts Avenue will be based on the most recent information available from CDM Smith, the consultant for the ongoing tank design project. This task also will include updating all pump controls based on SCADA records and interviews with city staff, as well as reviewing and updating all control valve settings.

Hazen and city staff will **meet to review the model** and plan field tests**.** This meeting will provide an opportunity to resolve any problems identified while building the model. A field testing plan will be reviewed with the Owner before field work begins.

Task 2 - **Field Tests**

Hazen engineers will **conduct two hydraulic grade line (HGL) tests** that measure flows and pressures along selected paths of transmission mains. The first test will begin at the PTRWA transfer station and follow the 30-inch and 16-inch transmission mains to the pumps at the I-74 Tank, continuing along the 30-inch pipe west of Ward WTP and the 24-inch pipe in MLK Drive to Ward Tank. The second HGL test will begin at Ward WTP and follow the 24- and 16-inch pipes north and west of the plant to the Lexington Avenue Tank, continuing north to the Sandy Ridge tank and pump station.

Hazen will provide equipment to measure flows and pressures for the HGL tests. The Owner will make accessible existing taps or air valves for inserting pitot tubes into key pipes for flow measurements, or install new taps, if needed. The Engineer will locate no more than two new taps in the field and allow at least 2 weeks for installation by the Owner. Measured pressures will be converted to hydraulic grade lines (HGLs) in order to plot HGLs against distance from sources. These tests show the accumulation of head loss at known flows, providing information to check C-factors, detect restrictions and calibrate the model.

The Engineer will **plan and conduct 10 fire flow tests** consisting of flow and pressure measurements at selected locations. Test locations will be selected to verify fire flow deficiencies, check problem areas identified by the Fire Department, and obtain information for calibrating the model.

Task 3 – **Model Calibration**

The Engineer will **calibrate the model using HGL tests** by preparing charts that compare measured and predicted HGLs along transmission mains, showing where the model needs adjustments, or indicating unusual conditions, such as closed valves. Pump operating points derived from the flow and pressure measurements will be checked against the pump curves in the model. Major discrepancies that cannot be resolved with reasonable model adjustments will be reviewed with Owner to develop a plan for further investigations, including pump tests, if needed. This task will check macro calibration of the model for the most important components of the distribution system.

Hazen will further **calibrate the model using the fire flow tests**. This task will check micro calibration of the model in problem areas where improvements may be needed. The static pressure measurement for each test will be compared to the predicted static pressure to check the model's elevation data and tank water levels. The measured flow from each fire flow test will be simulated in the model. Predicted residual pressures will be compared to the measured residual pressures and model adjustments will be applied as needed to obtain agreement. Major discrepancies that cannot be resolved with reasonable model adjustments will be reviewed with the Owner to develop a plan for further investigations.

The final step will be to **calibrate the model using SCADA** records. Recorded tank water levels will be compared to predicted tank levels from an extended period simulation (EPS). This comparison ensures that the model accurately simulates tank performance, which has a significant impact on water age calculations. This calibration technique was required by EPA for water quality models that were used to select sampling locations for disinfection byproducts.

SCADA records also will be used to **calculate diurnal demand patterns.** Hourly water demands will be calculated from recorded hourly flows from Ward WTP and the PTRWA transfer station, taking into account flows in and out of storage based on hourly changes in recorded tank levels. The diurnal demand curves will be used directly in the model to vary hourly demands when running an extended period simulation (EPS).

Hazen will **meet with city staff to review calibration** with a PowerPoint presentation.

Task 4 – **Evaluation of Existing System**

Hazen will use the fire flow map from the previous Insurance Services Office (ISO) project to identify up to five general areas with low fire flows. Available flows will be compared to needed flows to quantify deficiencies. Needed flows in these areas will be estimated by the Engineer based on information provided by the Fire Department considering building sizes and occupancy. Hydraulic modeling will then test and **identify improvements to increase fire flows,** including new pipes, pumps or tanks, as needed.

The model will **map high and low pressures** to identify areas where pressures are outside design criteria agreed upon with city staff. Recommendations for reducing excessive pressures will be developed to assist the city with reducing non-revenue water. Areas with deficient pressures for current operations will be identified and considered when developing recommendations to supply future conditions.

The Engineer will use the model to **map water age** for existing operation of the system. The model will predict water age based on 30-day simulations of existing average daily demand using current pump controls and operating procedures. The map will highlight areas where water age is excessive. The hydraulic model will **test operational changes** to reduce water age in problem areas. Additional modeling will optimize flow rates from existing auto-flushers. Recommendations to improve water quality may include installing additional flushers, bleeding water at zone boundaries, increasing tank turnover, improving circulation, and changing the operations of pumps and control valves.

Hazen modelers will use software tools to **assess distribution system vulnerabilities**. InfoWater software includes a specialized module that uses valve locations in GIS to assess the criticality of each pipe segment considering the valves needed to isolate each pipe in the event of a main break. The software calculates how much demand cannot be supplied at adequate pressure with each section of pipe closed. The results are then ranked by consequence of failure. If this analysis identifies major vulnerabilities, the Engineer will recommend improvements to reduce the impacts of main breaks.

The Engineer will review power bills provided by the Owner and **evaluate methods of reducing energy costs** by simulating operational improvements such as using storage to reduce pumping rates during hours when on-peak electrical rates apply. Energy optimizing strategies will be integrated with higher level goals of maintaining hydraulic performance, providing fire protection and reducing water age. This task will consider changing energy rate schedules, modifying inefficient pump operation and evaluating potential savings from converting constant speed pumps to variable speed.

Hazen and Sawyer will **meet with city staff to review recommendations** from the evaluation of the existing system.

Task 5 – **Evaluate Future System**

TAZ population data and the future service area identified in a previous Hazen project will be used to **allocate future demands to model nodes** in growth areas. Allowances for new industrial demands will be distributed based on input from city staff.

The demand projections will be used to **evaluate pump and storage capacity** for the system as a whole and in each pressure zone.

Modeling will simulate future demand conditions and identify deficiencies. Further modeling will test alternatives to supply future demands**.** This modeling will **size new pipes, pump and tanks** to meet hydraulic design criteria and maintain water quality. Recommendations will take full advantage of the existing distribution system to minimize costs.

Hazen and Sawyer will **meet with city staff to review preliminary recommendations** considering planning level costs, constructability and community impacts. Final recommendations will be developed based on input from the city.

Task 6 - **Master Plan Report**

The Engineer will **develop a capital improvement plan** (CIP) by prioritizing recommended pipes, tanks and pump stations and estimating costs for 5-year planning periods. The CIP will tabulate recommended improvements with references to a color-coded map of the distribution system. Cost estimates will include construction, land acquisition, contingencies, engineering, legal and administrative costs. CIP project sheets will summarize the reason for the project, demand triggers, and related projects.

Hazen and Sawyer staff will **meet with city staff to review the preliminary Capital Improvements Plan**. Adjustments will be made in response to review comments.

The Engineer will **prepare a draft report** that describes building and calibrating the hydraulic model; identifies existing deficiencies; maps existing water age and pressures; summarizes water demand projections; explains model results for future conditions; and tabulates proposed improvements.

Hazen will respond to review comments and **submit a final report**. Five bound paper copies of the final report will be delivered, along with electronic versions of the report, maps and model.

Task 7 – **Project Administration**

This task includes refining the scope and schedule, managing the project, **documenting quality assurance reviews**, and preparing monthly progress reports that will accompany all invoices.

Compensation

The tasks described in the Scope of Work will be billed on an hourly basis by employee classification. Current hourly rates are shown in in Table 1. Hourly rates will be adjusted on July 1 of each year to reflect increased labor costs, but the annual adjustment for each category will not exceed three percent. Reimbursable project expenses will be billed at cost, including vehicle mileage at the rate allowed by the Internal Revenue Service, currently $0.535 per mile.

Table 1 - Hourly Rates

Labor Category	Rate
Vice President	$230
Senior Associate	$210
Associate	$165
Senior Principal Engineer	$145
Senior Field Coordinator	$135
Principal Engineer	$105
Assistant Engineer	$95
Office Support	$50
Technician	$50

Estimated hours and fees for each task are shown in Table 2. Invoices will reflect actual hours spent on the project each month.

Total compensation to Hazen and Sawyer shall not exceed TWO HUNDRED FOUR THOUSAND DOLLARS ($204,000.00) without additional authorization.

Table 2
High Point Water System Master Plan
Summary of Estimated Hours and Fees

Task	Description	Hours	Fee
100	Hydraulic Model Update	280	$39,650
200	Field Tests	118	$16,920
300	Model Calibration	154	$22,810
400	Evaluation of Existing System	350	$47,340
500	Evaluate Future System	158	$24,120
600	Master Plan Report	302	$44,540
700	Project Administration	42	$8,620
	H&S Subtotal	**1,404**	**$204,000**

Schedule

The chart on the following page is a preliminary project schedule assuming a start date of July 1, 2017.

Please call us if you have any questions about this proposal.

Sincerely yours,

Jeffrey R. Cruickshank, PE
Associate Vice President
Hazen and Sawyer

Preliminary Project Schedule

	Task	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18
1	Hydraulic Model Update												
2	Field Tests												
3	Model Calibration												
4	Evaluation of Existing System												
5	Evaluate Future System												
6	Master Plan Report												
7	Project Administration												

Meetings or Webcasts