Scope of Work

Capital Area Ground Water Conservation Commission (CAGWCC):

Phase 2: Long Term Strategic Planning for Water Resources

Fall 2020

The CAGWCC has engaged the Institute and the USGS to support the Commission in the development of a strategic plan for long-term sustainable groundwater resources management.

Phase 1 (almost complete) focused on developing a vision for water resources in the District based on the current set of problems, development of fundamental objectives with associated metrics, and identifying a set of alternatives to be evaluated for long-term strategic planning (see accompany attachment: Framework for a Long-Term Strategic Plan for the Capital Area Groundwater Conservation Commission). In addition, Phase 1 includes a state of the science and associated gaps report which will support Phase 2 in evaluating the alternatives and forecasting the consequences (see accompany attachment: State of the Science to Support Long-Term Water Resource Planning).

The Water Institute of the Gulf has technical expertise in groundwater as well as experience in evaluating and developing science that specifically supports decision-makers. The Institute and the USGS take an unbiased approach to producing science in support of resource management decisions, which make them ideal partners to work with the CAGWCC. The Water Institute, along with the USGS and other partners who have expertise in decision support, analysis, and strategic planning are proposing to move forward with Phase 2 to support long-term strategic planning for water resources development in the District.

PROJECT OBJECTIVES

Objective 1: Work with the CAGWCC and other technical stakeholders to identify and evaluate feasible, realistic, and cost-effective science-based alternatives which meet long-term water resource needs. (Phases 1 and 2)

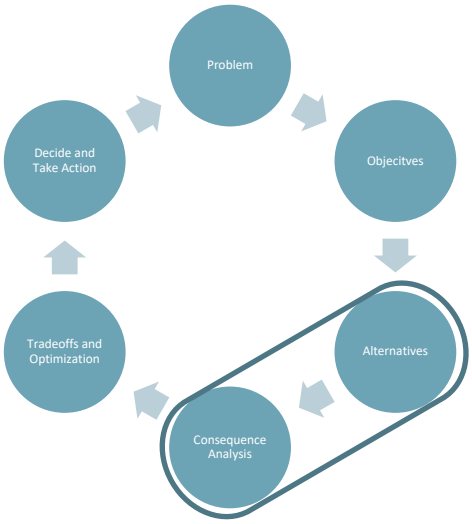
Objective 2: Evaluate the state of the science/information related to groundwater use and aquifer conservation needed to evaluate alternatives and inform decisions. (Phase 1)

Objective 3: Work with the CAGWCC to identify management alternatives that are economically feasible and acceptable, and develop a strategic plan for the long-term water supply for the District. (Phases 1, 2, and 3)

PROPOSED APPROACH

The Institute and USGS propose to meet project objectives following the PrOACT cycle. PrOACT is a useful framework for structuring decisions:

- Defining the Problem
- Determining the Objectives
- Identifying Alternatives
- Evaluating alternatives and forecasting the Consequences
- Evaluating the Trade-offs
- Making the decision and taking action



Phase 2 Overview

While Phase 1 focused on the Problem, Objectives, and development of initial Alternatives with the Commission for its long-term strategic plan, Phase 2 includes evaluating the identified alternatives to determine the best combination of actions (i.e., strategy) for meeting the CAGWCC's identified fundamental objectives. Evaluation of alternatives necessitates additional work, such as understanding supply and demand and evaluating the economics related to different actions incorporated in the alternatives. Phase 2 also includes forecasting the consequences of each alternative based on sound data and science, therefore the evaluation includes additional modeling as well as other social and economic modeling/evaluation, and identification of possible tradeoffs (economic or others) between objectives.

To successfully complete Phase 2, a number of tasks must be undertaken which necessitates a variety of skillsets and partners, working together in a collaborative partnership, and support development of a realistic cost-effective long-term strategic plan based on the best available science. Tasks include coordination and technical oversight, forecasting supply and demand, evaluating the economics and costs of various alternatives, education and outreach, analyzing subsidence, as well as legal and policy analysis necessary to support implementation in Phase 3. All of the tasks are associated work needing to be done to evaluate the alternatives selected by the Commission (Appendix A) and their ability to meet the fundamental objectives with the associated performance metrics. The Commission has come to consensus on five fundamental

objectives with some initial set of associated performance metrics (however, additional work is needed to finalize these performance metrics):

Objective 1. Achieve and maintain sustainable and resilient groundwater withdrawal rates from the Southern Hills Aquifer within the District boundaries

> Performance metric: Spatial extent and water levels of the cone of depression in each sand. This objective will be achieved when the withdrawal rate in each sand is less than or equal to the recharge rate to that sand. If the spatial extent and water levels of the cone of depression remain stable over time, then the withdrawals would be sustainable. Many different combinations of spatial extent and water levels could achieve this criterion, but they might not all confer the same degree of resilience. Further work is needed to define the desired level at which to hold the average water level in each sand. In order to definitively quantify the sustainable yield of each sand, additional modeling will be needed. A simplified mathematical model could be utilized in the near term to provide preliminary sustainable yield values, while more detailed models are refined and used to provide higher fidelity results to guide future sustainability decisions.

Objective 2. Manage the aquifer to maximize availability of healthy, high-quality drinking water equitably to all residents of the District indefinitely

> Performance metric: Volume of water per year that is available for public supply at an acceptable cost, and that meets quality standards relating to salt, hardness, taste, impurities, and health risk. Many of the aspects of quality could be met with alternative sources of water, but the taste profile and the public's perception of the purity of the water are best met with groundwater. Some work to understand the importance of these aspects of quality is needed and can be accomplished through public surveys and social research.

Objective 3. Manage the aquifer to maximize availability of clean and inexpensive water to commercial and industrial users in the District indefinitely

> Performance metric: Some work is still needed to finalize the appropriate measure of this objective. An important consideration for industry is the total cost of water for their specific purposes, including both the direct cost of the water and the cost of secondary or tertiary treatment to meet the requirements for the specific industrial use. A source of water, like groundwater, that is very low in impurities does not require much further treatment. But other sources of water can be treated to reach the same degree of purity, albeit at higher cost. A possible metric is the mean total cost per gallon of water, where the total cost is the industry- and use-specific cost to acquire and treat water to the degree needed, and the mean is taken over industries and uses, weighted by the volume of use.

Objective 4. Reduce the movement of saltwater into the Southern Hills Aquifer and slow or halt the advance of the existing saltwater plume

> Performance metric: Mass of salt in each sand. The total mass of salt in each sand is a measure of the degree of intrusion. Continued intrusion will increase the mass; mitigation

strategies like scavenger well will decrease the mass. The desire would be for the mass of salt to stabilize in each sand, so there is no continued increase in net salt. An alternative metric, which is subtly different, would be the horizontal area (say, in acres) of each sand for which the chloride concentration was about some threshold amount; this has the advantage of also conveying the degree of movement of the saltwater plume.

Objective 5. Minimize the risk of subsidence

The Commission did not settle on a specific performance metric for this objective. The plain reading of the objective would suggest a metric like the probability of subsidence of greater than x inches per year in any part of the District, but it might be difficult to identify an appropriate threshold rate of subsidence and it might be difficult to forecast how that could change in the future. Whiteman (1980)[1] estimated local subsidence of 1.26 feet over the period 1935-1976, and it is possible subsidence has continued at about the same rate in the 40 years since then. The Commission suggests research to identify water levels at which the risk of damaging subsidence is very low (perhaps by comparing to pre-consolidation stress levels). Then, those levels could be used to set limits to the sustainable level at which each sand is held under Objective 1.

Phase 2 Tasks

Phase 2 has been divided into two sub-phases: Phases 2A and 2B. Phase 2A includes tasks to (1) evaluate the existing data and information that the Commission has already invested in (2) initiate tasks CAGWCC needs to support short-term science-based decisions in advance of 2B, and (3) identify any gaps that need to be filled for 2B or future Phases. It is expected to take approximately 8 months. Phase 2B will follow and include tasks that (1) fill gaps identified in 2A, (2) are a continuation of 2A that require additional time to complete, and (3) evaluate the alternatives and will need to be completed to support the long-term strategic planning process. This includes tasks associated with Groundwater Availability Modeling (GAM), additional public outreach, estimating costs of alternatives, legal and policy analysis.

TASK 2A.0: COORDINATION AND PROJECT MANAGEMENT
COST: $61,173

Phase Two information needs are complex, and will require the identification and sourcing of expertise and data from across a range of technical areas. To deliver products capable of

[1] Whiteman CD. 1980. Measuring local subsidence with extensometers in the Baton Rouge area, 846 Louisiana, 1975-1979. *Water Resources Technical Report* 20. Baton Rouge, LA: Louisiana 847 Department of Transportation and Development. 21 p. 848 https://la.water.usgs.gov/publications/pdfs/TR20.pdf

facilitating the evaluation of alternative strategies, TWI will ensure the requisite level communication and coordination between the technical teams and partners (including USGS, LSU, Freese and Nichols, Commission staff and all Commissioners), as well as provide oversight to both the process and final products. Further, TWI will regularly engage with the CAGWCC and ensure that the interests and needs of the District are fully represented throughout Phase 2.

Subtask 2.0.1 Participate in project status calls, internal team meetings, and continued oversight of technical work and teams. This includes bi-weekly project status calls of the technical team, as well as regular internal team meetings, to keep the project team updated on the progress and coordinate technical information exchange across technical tasks and subtasks.

Subtask 2.0.2 Attend a minimum of 12 CAGWCC meetings (in-person) including the kickoff meeting and various other meetings to ensure the Commissioners and sub-committees are up to date on progress and able to provide feedback on progress.

Subtask 2.0.3 Documentation and progress report updates.

TASK 2A.1: EVALUATION OF EXISTING DATA/INFORMATION AND FINALIZING ALTERNATIVES

COST: $218,496

For the Commission to proceed with long-term planning, investments have to be made in (1) evaluating the existing investments by the Commission as well as (2) finalize the alternatives which will be evaluated in 2B. As part of Phase 1, the Commission articulated a draft set of alternative strategies for managing the SHAS. Key elements from this set require further specification to facilitate evaluation. The set of performance metrics, which render the fundamental objectives operational from an evaluation standpoint, need to be finalized as well. To assist the Commission in completing these tasks, TWI will provide a set of deliverables that provide the requisite background materials, a preliminary assessment of aquifer dynamics and a recommendation of the performance metrics.

Subtask 2.1.1 Summarize existing data and modeling output on potentiometric and chloride levels to assist with the delineation of zones across the District in support of further alternative specification. Create updated piezometric, pumping level and chloride concentration maps for each of the aquifer sand units. During this process, collect information to inform monitoring network efficacy and design in Task 2.6.1**.**

Subtask 2.1.2 Synthesize existing literature and technical expertise to finalize performance metrics related to:

a. Subsidence metric. Better understand potential impacts to water storage and transfer given differing degrees/rates of subsidence, and thus compaction of aquifer sands and clay confining units; document subsidence risk measures in other water management Districts, and anticipate surface water flooding in the District as a result of a lowered ground levels. Couple this background information with an analysis of District wide leveling data and other technical tasks herein to develop a threshold for groundwater withdrawal that represents an acceptable level of risk of subsidence.
b. Economical water for industry. A direct measure is the mean total cost per gallon of water, where the total cost is the industry- and use-specific cost to acquire and treat water to the degree needed, and the mean is taken over industries and uses, weighted by volume of use. A possible means for determining whether this cost is economical is to compare against the price paid by industrial users that lack access to usable groundwater. Subtasks 2.3.2 and 2.5.2 supports developing an understanding of economic parity.

Subtask 2.1.3 Develop Darcy flow analysis to compute a flow deficit calculation for the entire District and surrounding areas (e.g., Mississippi where the SHAS is near ground level). This subtask is necessary to support finalization of alternatives in advance of investments in 2B to analyze the alternatives. Analysis output will provide initial estimates of groundwater yield for each sand, and thus water budgets can be calculated. From this preliminary information the Commission will be able to make science-based management decisions in the near-term, while a more detailed Groundwater Availability Model (GAM) is being developed (2B).

The Commission will be better placed to provide values for the volume of water needed to be supplied by the development of alternate water sources, production caps where required in a particular strategy alternative, and potentially other management actions, including public outreach. While this Darcy flow analysis will not consider saltwater intrusion explicitly, inference can be made from output on water levels in proximity of the southern fault. The ability to perform the analysis will depend on the availability of current and historic water level data in each of the aquifer sand units. The analyses will require the creation and/or modification of existing current and historic potentiometric surfaces for each of the sand units to be analyzed. This analysis will be useful for near-term decision support to help finalize select aspects of the alternatives. A more robust GAM model capable of estimation at greater resolution, scale and across all the variables contained in the set of performance metrics with associated alternatives is required for a full evaluation. This type of GAM model is outlined under Task 2.2 (2B).

Subtask 2.1.4 Convene Commission to review output from the Darcy flow analysis computations and background research, and finalize alternatives to allow for an initial evaluation in 2B. This includes discussions on various operational needs as outlined in the current strategy narratives in the planning framework (e.g., defining industrial users, zones, caps, etc.) along with

considerations of staffing and funding for the CAGWCC in the future. Review output and finalize water supply alternatives to be considered for an initial evaluation. Coordinate with CAGWCC to review the list of potential future alternative water supply options available to meet the future demand. Identify the key alternative water supply options that CAGWCC intends to consider in the strategy portfolio evaluation for 2B.

TASK 2A.3: EVALUATING WATER DEMAND ACROSS THE CAPITAL REGION
COST: $59,280

Water demand is dynamic, with factors such as population and economic growth, technology, weather and consumer behavior affecting patterns of use. Long term planning requires an appreciation of its dynamic nature, and the appropriate means for evaluating demand considers such factors. For use in strategic decision making and modeling, factors will need to be quantified and estimated through a range of possible outcomes, first looking at historical demand and evaluation of water use.

Subtask 2.3.1 Understanding Historical and Current Domestic Demand.

Activity 2.3.1.1 Quantify historical and current water demand, which requires water consumption data from public suppliers across the District. Collect census data from 1980-2010 and American Community Survey (ACS) data through 2017.

Subtask 2.3.2 Understanding Historical and Current Industrial Demand.

Activity 2.3.2.1 Develop a survey methodology to be distributed to the industrial water users within the CAGWCC area. TWI will develop the methodology and the materials required to conduct the survey. CAGWCC will distribute the survey by means of electronic emails campaign and sending physical copies to the industrial water users. The information generated from the survey will be compiled to develop an estimate of the water cost for the current supplies used by the industry. This cost will be used to setup a baseline to compare all the future alternatives.

Activity 2.3.2.2 Use information collected in the industrial water users survey to summarize the location, current use of industrial water and identify their current plans for expansion of alternative (non-groundwater) supplies. This information is used to identify trends in industrial water use data and partition the trends into groundwater and surface water components.

TASK 2A.4: PUBLIC UNDERSTANDING OF GROUNDWATER RESOURCES
COST: $54,934

Subtask 2.4.1: Evaluating Public Attitudes and Uses Related to Groundwater Management. To engage public as part of conservation and understanding of long-term groundwater management, one first must survey the public for their current and historical views. This task includes developing and implementing a series of survey instruments, interviews, and targeted focus groups to gauge public awareness, attitudes and preferences for water management strategies, potable water supply and willingness to conserve water resources. The purpose of this Task is multi-fold: a) to inform educational/social marketing campaigns to better target audiences and content, b) to gauge public acceptance for select water management options, including alternate sources of potable water, and c) to better understand how people use water to design conservation measures or alternate sources, and d) gauge public interest in various incentive programs, such as rebates. This supports Activities 2.3 and 2.7 and informs discussions relevant to possible means to augment supply.

Activity 2.4.1.1 Summarize existing pubic understanding on the economic and social consequences of saltwater encroachment and groundwater resources in the Baton Rouge area for the public and other stakeholders. This information will be used to guide the development of activities 2.4.1.2 and 2.4.1.3 and assure that the CAGWCC long-term strategic plan addresses issues relevant to sustainability, i.e., "the development and use of ground water in a manner that can be maintained for the present and future time without causing unacceptable environmental, economic, social, or health consequences."

Activity 2.4.1.2 Develop and implement a series of survey tools to understand public views on the uses of local groundwater and proposed alternatives for the future. The Office of Conservation previously commissioned two surveys to establish a baseline of public knowledge about groundwater and groundwater management in the Baton Rouge area, one in December 2012 and the other in September 2014. These evaluate shifting public opinions on groundwater management and to assess the effectiveness of public awareness and outreach campaigns previously undertaken in the Baton Rouge area. TWI will work with the CAGWCC to update the 2012 and 2014 survey tools to incorporate and assess public views on the long-term strategic planning efforts.

TASK 2A.5: ECONOMIC ANALYSES

COST: $146,522

Subtask 2.5.1 Evaluate Alternative Water Supply Options.

Activity 2.5.1.2 The second type of alternative water supply options focus on increasing supply to the CAGWCC distribution system. TWI will evaluate the following alternative water supply options as a preliminary feasibility level evaluation to develop a good understanding of the volume available for each water supply option, the feasibility of

developing the supply, the infrastructure required to connect the supply to the CAGWCC distribution system and the cost associated with developing the water supply option:

- Evaluate use of surface water treatment from the Mississippi River for a variety of plant capacities;
- Evaluate use of shallow, alluvial groundwater alongside the Mississippi River;
- Evaluate reclamation of municipal effluent for non-potable and potable uses;
- Evaluate industrial water reclamation as a source of supply;
- Evaluate brackish groundwater desalination from the SHAS;
- Evaluate potential for Aquifer Storage and Recovery;
- Develop an approach for screening and selecting preferred alternative water supply options; and
- Consider options to combine multiple strategies into supply portfolios to meet identified needs.

Activity 2.5.1.3 Develop a costing tool specific to the study to use a standard approach for costing out all the alternative water supply options. The costing model will be used in Subtask 2.5.2 to estimate illustrative capital and life cycle costs associated with developing the alternative water supply options. The assumptions considered for the costing model will be reviewed with CAGWCC. The costing model will be used to develop cost estimates for alternative water supply options, compare the alternatives' costs to the baseline cost of using current supplies to meet future demand.

Subtask 2.5.2 Estimating costs associated with providing supplementary water supplies.

Activity 2.5.2.1 Use information from the industrial water users survey to determine the current cost of industrial water supply alternatives. This includes obtaining a thorough understanding of their current water sources, the methodology and source used for delivering those sources and the cost incurred in ensuring the availability of the current sources. Develop a baseline estimate for the current water sources, and their viability to meet the projected demand.

Activity 2.5.2.2 Using data from Subtask 2.3 concerning water consumption by type of use and water purity (water quality), determine costs associated with meeting demand with the water supply options considered in Subtask 2.5.1. Comparative data, useful for assessing economic parity within the industrial community, can be generated from other industrial users in the greater Baton Rouge area. This information also supports the industrial supply metric.

Subtask 2.5.3 Identifying potential financial instruments to address supplementary water supply costs. Propose potential approaches for structuring a Public-Private Partnership (P3) for developing water supply options. Document examples of P3s in other metropolitan areas faced

with water management challenges; identify potential partnerships and viable financial structures for a P3 in the District. Examine funding opportunities for making alternatives more affordable, the cost of each alternative, and how that could be reflected in the fees to extractors from the SHAS.

TASK 2A.6: EVALUATE EXISTING AQUIFER MONITORING FRAMEWORK
COST: $166,041

The Commission needs to be able to assess progress toward meeting specified management objectives, as well as adapt its management approach to changing conditions and needs. This includes monitoring water levels and concentrations in the SHAS. A comprehensive and robust framework can also provide the learning necessary to refine and update GAM models, the primary tool for predicting the potential impacts of management.

Subtask 2.6.1 Evaluate the adequacy of the existing network of wells for determining: a) the spatial distribution and concentrations of salt throughout the SHAS; b) the spatial extent of and changes to water levels/cones of depression, ensuring a current and synoptic view of all sands within the SHAS. Assess whether additional data collection should be initiated to meet long-term fundamental objectives.

Subtask 2.6.2 Review current subsidence data collection activities. Collate and update data as possible, and assess whether additional data collection should be initiated in other areas of the District, outside of the central cone of depression.

Subtask 2.6.3 For the Commission to be able to assess the potential for management of saltwater intrusion along the fault, they must monitor water levels and concentrations near the "leaky windows" along the fault. These are areas where saltwater is coming through the fault. Therefore, updating the stratigraphic model along the fault and identification of potential location of observation wells is necessary. Analyze existing well logs after 2016 in both East and West Baton Rouge Parishes to update the Baton Rouge stratigraphy model. This will be utilized to determine the location of the "leaky windows" of the Baton Rouge fault where saltwater is coming across. Utilize this updated stratigraphy to determine potential locations of observation wells along the fault. This investment is necessary to identify and evaluate the potential efficacy of injection wells along the fault zone.

TASK 2A.9: FACILITATED DISCUSSION FORUM AND INFORMATION EXCHANGE
COST: $38,723

Subtask 2.9.1. Facilitated Forum for Discussion and Information Exchange. Over the course of 8 months, conduct a series of seminars (4), coincident with regularly scheduled Commission meetings, to discuss technical aspects of the evaluation process, and provide learning content on select topics related to aquifer management, modeling, decision making analyses, and other technical tasks outlined herein. Topical areas to be determined in consultation with the Commission. This activity will continue as part of Phase 2B.

Activity 2.9.1.1 Develop the definition of "detailed research, considering both recharge and withdrawal data."

Activity 2.9.1.2 Develop the minimum "research data" necessary "to establish ground water use priorities."

Phase 2A1 Tasks with Flexible Start Dates

Phase 2A1 are necessary tasks with flexible start dates and can go ahead and start in Phase 2A, but they can be pushed to start in Phase 2B if necessary.

TASK 2A1.3: FORECASTING WATER DEMAND ACROSS THE CAPITAL REGION
COST: $64,807

Subtask 2.3.1 Understanding Historical and Current Domestic Demand.

Activity 2.3.1.2 Forecast District wide population growth. This includes not only total population growth, but spatial variation in that growth. Examine data available from Population Projections of Louisiana Parishes through 2030 to develop an estimate of the future forecasts as reported by existing sources. Develop trends based on the historic county population data and currently available population projections. Forecast district-wide population growth through 2070.

Activity 2.3.1.3 Partition population data based on the public use and domestic use types using the trends developed by the USGS. Apply per-capita water demands for public supply and domestic water use based on the most recently available water use data. Develop projections for public supply and domestic water use based on the estimated per-capita demands and computed population projections.

Subtask 2.3.2 Understanding Historical and Current Industrial Demand.

Activity 2.3.2.3. Compare the water use trends developed for the industry users with the census data and the ACS employment data. Use a correlation of historic employment and industrial water use data to forecast industrial demands over the 50-year planning horizon. Also use the survey information collected from the industrial users and other studies conducted in the region that capture the future growth patterns for the industries. Use information from economic bureau and trends in cities in similar conditions, as available, to develop estimates for the future growth patterns.

Activity 2.3.2.4 Work with CAGWCC and industrial customers to develop a spatial distribution of demands and divide between groundwater use and other alternative sources.

Phase 2B

TASK 2B.0: COORDINATION AND PROJECT MANAGEMENT
COST: $122,347

Phase Two information needs are complex, and will require the identification and sourcing of expertise and data from across a range of technical areas. To deliver products capable of facilitating the evaluation of alternative strategies, TWI will ensure the requisite level communication and coordination between the technical teams and partners (including USGS, LSU, Freese and Nichols, Commission staff and all Commissioners), as well as provide oversight to both the process and final products. Further, TWI will regularly engage with the CAGWCC and ensure that the interests and needs of the District are fully represented throughout Phase 2.

Subtask 2.0.1 Participate in project status calls, internal team meetings, and continued oversight of technical work and teams. This includes bi-weekly project status calls of the technical team, as well as regular internal team meetings, to keep the project team updated on the progress and coordinate technical information exchange across technical tasks and subtasks.

Subtask 2.0.2 Attend CAGWCC board meetings (in-person) including board and various other meetings with Commissioners to ensure the Commissioners and sub-committees are up to date on progress and able to provide feedback on progress.

Subtask 2.0.3 Documentation and progress report updates.

TASK 2B.2: QUANTIFYING GROUNDWATER SUPPLY FOR THE CAPITAL REGION: DEVELOPMENT OF GROUNDWATER AVAILABILITY MODEL
COST: $550,120

Subtask 2.2.3 Development of the GAM.

Activity 2.2.3.1 Fund the modeling team to develop a District scale, screening-level transient groundwater flow and transport numerical model capable of assessing key performance measures, water availability, water quality (e.g., salt concentration) and potentially the risk of subsidence. Fund the comprehensive GAM model development that builds upon existing GACWCC investments in modeling. The GAM will estimate

water budgets at sand level for each sand in the SHAS, calculate the cone of depression at scale for each sand, predict the spatial extent and rate of salt transport within the SHAS, and potentially simulate subsidence under variable groundwater conditions (depending on the results and recommendations from the MAC). Model output can inform: the establishment of zones or sensitive areas; the future placement of wells and well operations (well closure, pumping levels, vertical placement of pumps, etc.); the efficacy of scavenger well performance; and evaluate sustainable levels of groundwater withdrawal at a sand level. The proposed GAM will be flexible enough that should the District wish to explore additional management options not identified early on, for example the efficacy of injection wells along the fault zone, they can do so. The GAM will allow for adaptive management over the long term. The model can be extended to gain insights into aquifer resilience, by evaluating low probability, high consequence scenarios to estimate limits on groundwater recovery.

Activity 2.2.3.2 Ensure model aligns with CAGWCC performance metrics. Oversee and interact with modeling team to ensure that the model is developed to be capable of informing decisions by the CAGWCC based on the performance metrics detailed in the Framework for a Long-Term Strategic Plan for the CAGWCC. Guide model development to ensure model selection, input data, resolution, and capabilities are appropriate for answering the questions necessary for decision support for the CAGWCC.

Activity 2.2.3.3 Calibration/validation oversight. Interact with the modeling team to review the calibration and validation of the model. Ensure that the model is calibrated sufficiently to forecast groundwater responses to perturbations in scenarios required for decision support, and validated to ensure appropriate model response against historical data.

Activity 2.2.3.4 Production oversight/QA/QC. Interact with the modeling team to ensure production simulations are performed appropriately and in accordance with the project schedule. Review model outputs for quality assurance and quality control.

Subtask 2.2.4 Oversee use of the GAM model to help evaluate the effects of the alternatives (i.e. consequences) decided and portfolio of actions on the groundwater system which is measured by the performance metrics identified through the fundamental objectives. Coordination with other tasks herein will be needed such that it can be incorporated into the modeling. The draft performance metrics are:

- Spatial extent and water levels of the cone of depression in each sand;
- Volume of water per year that is available for public supply at an acceptable cost, and that meets quality standards relating to salt, hardness, taste, impurities, and health risk;
- The volume of water available for commercial and industrial use at an acceptable cost;

- Mass of salt in each sand and the horizontal area of each sand for which the chloride concentration is measured against some threshold; and
- The probability of subsidence of greater than x inches per year in any part of the District.

TASK 2B.3: FORECASTING WATER DEMAND ACROSS THE CAPITAL REGION
COST: $76,152

Water demand is dynamic, with factors such as population and economic growth, technology, weather and consumer behavior affecting patterns of use. Long term planning requires an appreciation of its dynamic nature, and the appropriate means for forecasting demand would consider such factors. For use in strategic decision making and modeling, factors will need to be quantified and estimated through a range of possible outcomes. Quantify the uncertainty of the demand forecasts in a way that can be reflected in the decision analysis.

Subtask 2.3.1 Understanding Future Domestic Demand

Activity 2.3.1.4 Collate and synthesize the best available information on locally predicted future precipitation patterns, to understand mediated changes to water consumption based on changes in precipitation.

Activity 2.3.1.5 Forecast future water consumption need, which incorporates both historical data, population growth, weather input and anticipated changes in consumer behavior. Multiple scenarios may be developed to capture a business-as-usual approach (i.e., no change in household or per capita consumption), as well as potential impacts of regulation, water pricing policies, and conservation education/incentives. Assuming available data, including detailed historic records of population and public water use, prepare an analysis of uncertainty related to population and demand projections and influences from outside factors, including economic and climate impact. Prepare alternative future projections with this sensitivity in mind.

Activity 2.3.1.6 Coordinate with the CAGWCC to develop final spatial distribution of demands.

Subtask 2.3.3 Understanding Agricultural and Non-District Regulated Demand.
Coordinate with Louisiana Rural Water Authority, Louisiana DNR, NASS, USGS and select agricultural associations to determine best estimates of current consumption by agricultural community, where that community draws from the relevant sands, and by permitted wells producing under 50,000 gallons per day. This subtask may draw upon the USGS 5-year projections, as well as other best practices for projecting demand.

TASK 2B.4: PUBLIC ATTITUDES EVALUATION TO SUPPORT ALTERNATIVES

COST: $52,448

Subtask 2.4.1: Evaluating Public Attitudes and Uses Related to Groundwater Management.

Activity 2.4.1.3 Conduct a series of one-on-one interviews and targeted focus group meetings with major groundwater producers, public stakeholders and interested parties to gather input on the development and implementation of the CAGWCC long-term strategic plan. These meetings will be coordinated through community organizations, trade and business associations, and other local entities to assure that all potentially impacted stakeholder groups are adequately represented. This wide-ranging assessment will result in a deeper understanding of public attitudes about groundwater and groundwater management and assure that the CAGWCC long-term strategic planning process effectively addresses local concerns. This deeper level of public engagement will also help ensure community buy-in and acceptance of the final strategic plan.

Activity 2.4.1.4 Compile and analyze information from activities 2.4.1.1, 2.4.1.2, (in TASK 2A.4) and 2.4.1.3 to identify potential groundwater management outcomes and inform Tasks 2.5 and 2.7.

TASK 2B.5: ECONOMIC ANALYSES

COST: $47,576

Subtask 2.5.1 Evaluate Alternative Water Supply Options.

Activity 2.5.1.1 Two different types of alternative water supply options are considered in this study. The first type of alternatives analysis focuses on using demand reduction as a means to address future needs. TWI will adapt the Alliance for Water Efficiency (AWE) conservation tracking tool for use in Louisiana. TWI will use the tool to evaluate the potential for water conservation measures for both public supply and domestic water use. TWI will prepare at least two scenarios for low- and high-efficacy outcomes.

Subtask 2.5.2 Estimating costs associated with providing supplementary water supplies.

Activity 2.5.2.3 Analyze efficacy of conservation-oriented fee schedules. Synthesize lessons learned from other water management authorities and water resource economics literature on the structure and efficacy of different fee schedules to identify potential impacts to water demand in the District. This information is useful background for crafting a rationale to take to the Louisiana Public Service Commission to secure permission to alter existing rate structure.

TASK 2B.7: DEVELOPING OUTREACH AND CONSERVATION EDUCATION MATERIALS

COST: $39,216

Subtask 2.7.1 Develop a synthesis report that will be informed by and report on the results of Task 2.4. This will be a graphics-heavy product developed for general educational purposes that will build public awareness of the status and threats to local water resources and make the public aware of water management in the Capital Area. This synthesis report will provide public messaging for ongoing activities undertaken by the CAGWCC and other entities. This report will be presented at a public meeting and will be provided to all stakeholder groups engaged in activity 2.4.1.3.

TASK 2B.8: LEGAL AND POLICY ANALYSIS

COST: $28,862

Select proposed management actions will require a legal and policy analysis to assess authorities, means or sequencing prior to assessment or implementation. The legal and policy engagement will occur once alternatives are fully crafted. Legal and policy expertise will be needed in a) developing a legal analysis and exploring potential legal bases to support the assignment of zones, caps, priorities per existing CAGWCC legislation, and/or b) developing financial instruments, such as a public-private partnership or bond issue.

TASK 2B.9: FACILITATED DISCUSSION FORUM AND INFORMATION EXCHANGE

COST: $147,267

Subtask 2.9.1. Facilitated Forum for Discussion and Information Exchange. Over the course of 16 months, conduct a series of seminars with regularly scheduled Commission meetings, to discuss technical aspects of the evaluation process, and provide learning content on select topics related to aquifer management, modeling, decision making analyses, and other technical tasks outlined herein. Topical areas to be determined in consultation with the Commission.

Subtask 2.9.2 Develop a summary of the consequences for alternative actions, based on modeling output of the alternative simulations. The tasks outlined in this SOW will be used to evaluate the effects of the alternatives and portfolio of actions on the groundwater system. This will include metrics related to conservation, water demand forecasting, supply quantification, well pumping, population growth, commercial and industrial water usage, water supply costs, and subsidence will all be taken into consideration to forecast the consequence on the groundwater system.

Subtask 2.9.3 Presentation of Consequence Analysis. The final meeting will be a summary of results of phase 2 work, presentation of the consequences, and discussion SOW for phase 3 (which will include formal decision analysis, tradeoffs, and selection of alternatives).

TASK 2B.10: SUPPORTING ACTIVITIES AND DATA NEEDS

COST: $77,926

Subtask 2.10.1 A variety of data streams will be necessary to either complete the GAM model, or to improve management efficacy overtime and support the tasks herein. These include:

> Activity 2.10.1.3 For Subtask 2.3.2, TWI can lead and coordinate the process of communicating with industrial/commercial producers to obtain demand estimates, however the Commission will need to identify/define which producers should be included in this subtask.

Subtask 2.10.2 Outline of CAGWCC Strategic Plan: Analyze 8-10 other strategic water plans to begin outlining what the CAGWCC long-term plan will look like. Craft a template for a general strategic plan, based on major common elements of existing plans and best alignment with CAGWCC goals.

Subtask 2.10.4 The reduction in pumpage at the Georgia Pacific facility enables a study of aquifer recovery in each of the affected sands. This is in part due to the advance knowledge of the decreased pumping and the water level data collection efforts of the USGS. A brief literature review will be performed, and aquifer recovery test will be performed on each sand based on Willmann et al. (2007), Meier (1998), and Theis (1935). Results will be utilized to improve management, the Darcy flow analysis, and the GAM.

TASK 2.11: DELIVERABLES

Deliverables for Phase 2A will include:

- Monthly invoices and progress updates;
- Regular meetings with the CAGWCC for in-person updates; and
- Phase 2A report which includes the assessment of existing investments by the GAGWCC (data, monitoring, and modeling) as well as recommendations for filling gaps and evaluation of alternatives of Phase 2B.

Deliverables for Phase 2B will include:

- Monthly invoices and progress updates;

- Regular meetings with the CAGWCC for in-person updates;
- Synthesis report on status of local water resources for public outreach and general educational purposes;
- Outline of the CAGWCC draft strategic plan, based on major common elements of existing plans and alignment with CAGWCC goals; and
- Phase 2B report and recommended approach for Phase 3 of the long-term strategic planning process.

PERIOD OF PERFORMANCE

The activities are proposed to be carried out over 49 months from the Notice to Proceed, with Phase 2A envisioned to be 10 months from 12/1/2020 to 9/30/2021, and Phase 2A1 and 2B lasting 39 months from 10/01/2021 to 12/31/2024.

PROPOSED COST

The proposed budget for these activities is $1,951,890 to be delivered on a fixed-price basis.

TASK	2A	2A1	2B	TOTAL
TASK 2.0: COORDINATION AND PROJECT MANAGEMENT	$61,173		$122,347	$183,520
TASK 2.1: EVALUATION OF EXISTING DATA/ INFORMATION AND FINALIZING ALTERNATIVES	$218,496			$218,496
TASK 2.2: MODEL INVESTMENTS/QUANTIFYING GROUNDWATER SUPPLY			$550,120	$550,120
TASK 2.3: EVALUATING/FORECASTING WATER DEMAND ACROSS THE CAPITAL REGION	$59,280	$64,807	$76,152	$200,239
TASK 2.4: PUBLIC UNDERSTANDING OF GROUNDWATER RESOURCES	$54,934		$52,448	$107,382
TASK 2.5: ECONOMIC ANALYSES	$146,522		$47,576	$194,098
TASK 2.6: EVALUATE AND UPDATE AQUIFER MONITORING FRAMEWORK	$166,041			$166,041

TASK 2.7: DEVELOPING OUTREACH AND CONSERVATION EDUCATION MATERIALS			$39,216	$39,216
TASK 2.8: LEGAL AND POLICY ANALYSIS			$28,862	$28,862
TASK 2.9: FACILITATED DISCUSSION FORUM AND INFORMATION EXCHANGE	$38,723		$147,267	$185,990
TASK 2.10: SUPPORTING ACTIVITIES AND DATA NEEDS			$77,926	$77,926
TOTAL:	***$745,169***	***$64,807***	***$1,141,914***	**$1,951,890**