LEGGETTE, BRASHEARS & GRAHAM, INC.

PROFESSIONAL GROUNDWATER AND ENVIRONMENTAL ENGINEERING SERVICES

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February 11, 2016

City of Clinton
415 W. Gary Blvd.
Clinton, OK 73601

RE: Geophysical Survey Proposal
Washita River Paleo Channel
Clinton, Oklahoma

Dear Sir or Madam,

As discussed with Mr. Daniel Clement of Burns & McDonnell, Leggette, Brashears & Graham, Inc. (LBG) is pleased to provide the City of Clinton, Oklahoma (the City) with this proposal to conduct geophysical well siting exploration activities. The exploration activities will be conducted in Custer County, R17W, T12N, in portions of sections 19, 20, 29 and 30. The objective of the surveys is to further define the shape, depth and stratigraphy of a paleo channel that has been identified in an area adjacent to the Washita River. The proposed exploration program will consist of electrical resistivity and seismic refraction surveys that will be designed to meet the physical conditions of the alluvial aquifer in the exploration area such that the most favorable formation depth and material, suitable for construction of the planned new wells, can be identified.

Resistivity surveys use electrical currents to measure the electrical resistivity (the inverse of conductivity) of the subsurface. The resistivity of the subsurface material is related to the composition and grain size of the geologic material present beneath each survey line and can be used to distinguish favorable sand and gravel units from clay units or bedrock. Resistivity surveys are well suited to map the thickness and relative permeability of buried sand and gravel units found in alluvial depositional environments such as those that occur at this site.

Seismic refraction surveys use sound waves to measure the depth to geologic units with different velocities for the conduction of sound waves, such as an interface between sand and gravel and dense till or bedrock. Adding the refraction survey to the resistivity survey adds independent confirmation of the depth to bedrock and the thickness of the sand and gravel aquifer using a different physical property and increases the sensitivity and reliability of the geophysical survey.

The proposed geophysical survey will consist of 10 high-resolution electrical resistivity lines, or profiles, and one seismic refraction line per each resistivity line completed. Each of the proposed

lines will be approximately 900 feet long. The resistivity surveys will be conducted using an Advanced Geosciences Inc. (AGI) R1 Sting/Swift resistivity system with up to 56 electrodes. The general locations of the proposed resistivity lines are shown on the attached figure. The actual locations of the lines may vary from those shown due to field conditions and access limitations, as encountered.

We will also collect one seismic refraction line per each resistivity line completed. The seismic data will assist in mapping the base of the sand and gravel units and in identifying the deepest portions of the aquifer where thicker sand and gravel deposits are likely located. Each seismic line will be approximately 460 feet long and oriented parallel to a resistivity line. The refraction data will be collected with a 24-channel Seistronix seismograph utilizing a Betsy Seisgun as the seismic source. Each seismic line will be collected simultaneously while collecting the resistivity data.

For the purpose of this proposal we have assumed the geophysical surveys will be completed in four days of field work utilizing a two person crew. Following data collection, the crew will mobilize back to the office where the data will undergo reduction (cleaned-up as necessary), modeling, analysis and interpretation. Based on this analysis, we will then identify the most favorable areas for completion of confirmation test borings, which can be utilized to collect preliminary water quality and aquifer hydraulic properties. The proposed test boring sites will be based on the interpreted thickness and depth of sand and gravel deposits detected beneath the survey lines. Within four weeks of completing the field work we will submit a draft letter report to the City that provides the results of the geophysical surveys and recommended test boring locations.

The work described above should provide the City with the information needed to find the most favorable well locations and ultimately maximize the yield of the new City wells. We assume that the City will obtain safe access to the exploration areas for completion of the geophysical surveys. It appears that the majority of the geophysical surveys will be conducted on land that has been identified as floodplain. It is important to note that the survey equipment is not suited for use in wet or muddy field conditions. It also appears that some of the exploration area may be located on cropland. Conducting the geophysical surveys in a planted field will add time to the data collection process due to extra precautions taken to minimize crop damage (i.e., carrying the equipment through the field as opposed to driving). LBG will attempt to locate the geophysical lines as near to the proposed locations as possible, but will attempt to remain outside of the crop land as necessary to avoid damage to crops while still meeting the exploration goals of the project. In the event some of the surveys are completed where crops have been planted, the farmer will typically require reimbursement for damaged crops resulting in lost yield. In densely planted fields our field time could increase by up to 25%, which would result in a reduction of the data acquired or an increase in field costs. It is important to note that the survey locations will be laid out not to cross metallic objects or buried utilities, both as a safety hazard to the field crew and to negative impacts to the data.

The total estimated cost to complete the activities discussed in the proposal is $24,500. If additional exploration work is requested by the City, it will be billed at our normal hourly rates including lodging and meals, estimated at an additional $3,200 per day. These costs are intended as reasonable estimates based on similar projects for other clients but are subject to change, depending on site conditions and changes in the project scope.

We trust this information meets your needs and look forward to working with the City in locating the most favorable locations for siting new municipal wells. If this proposal is acceptable,

please sign and return the attached professional services agreement. Please let us know if we can answer any questions or provide more information.

Very truly yours,

LEGGETTE, BRASHEARS & GRAHAM, INC.

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Leggette, Brashears, and Graham
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Email: ted.powell@lbgmn.com

TLP:tlp

Attachments

cc: Kevin Powers, LBG
File

QUICK START CONTRACT

This agreement for the performance of services is entered into this 3rd day of February, 2016, by and between Leggette, Brashears & Graham, Inc. (LBG) and City of Clinton (Client). Subject to the contract terms printed on the reverse side of this form, LBG's standard fee schedule and the annexed proposal or scope of work. In the event of a conflict between the standard contract terms or fee schedule and any attached proposal or scope of work, terms of the proposal or scope shall govern.

CLIENT

Name:
Company: City of Clinton
Address: 415 W. Gary Blvd
City/State/Zip: Clinton, OK 73601

CLIENT CONTACTS

Reporting: Same as client
Site Conditions:

BILLING INFORMATION

Name: Same as client
Company:
Address:
City/State/Zip:

Project Location: **Street:** **City:** Clinton **State:** OK **Zip:** 73601
Proposal/Scope Date and Reference No.: February 3, 2016 **#Pages Attached:** 3

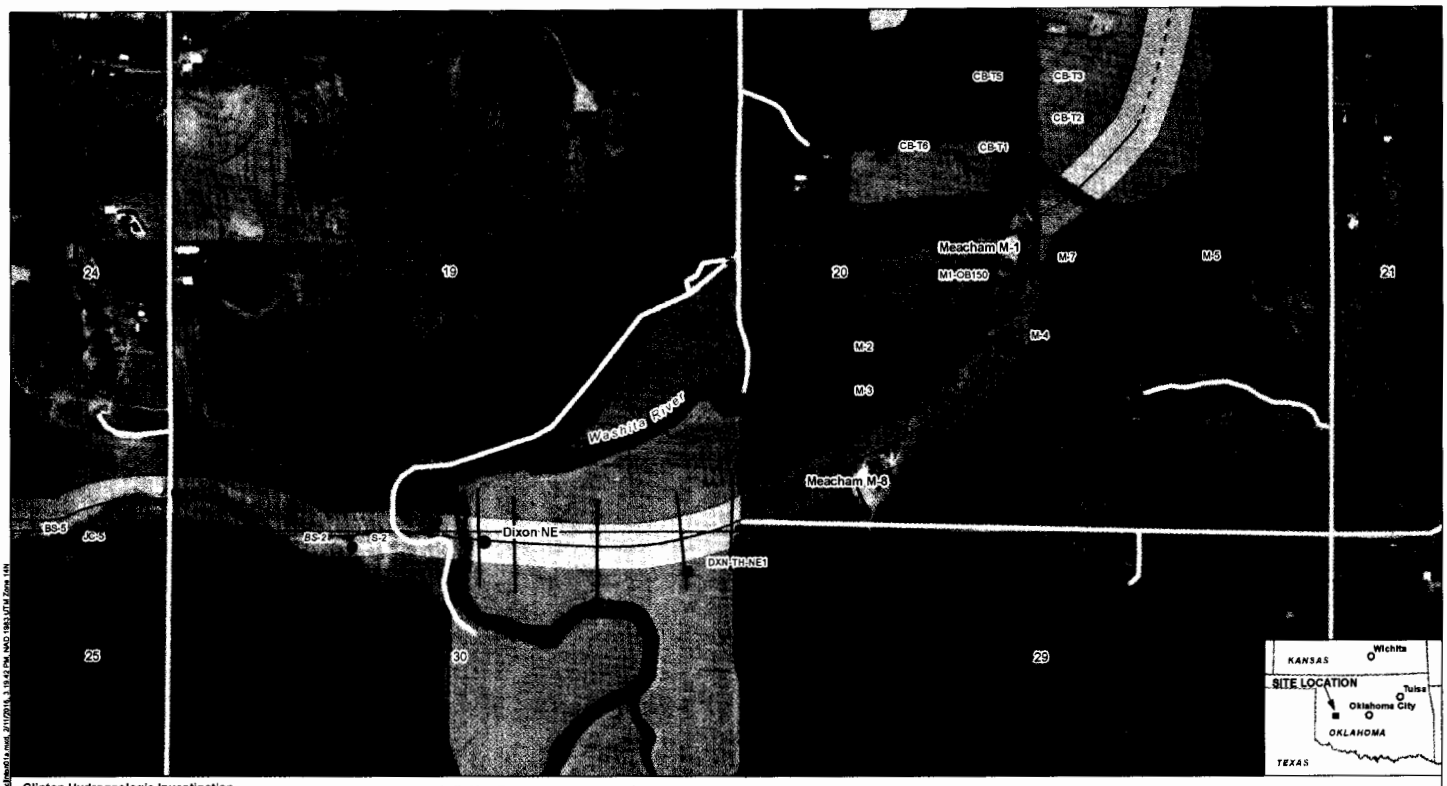
Brief Statement of Services: Geophysical surveys for well siting activities

Anticipated Start Date: **Anticipated Completion Date:**
Preliminary Cost Estimate: $24,500

LBG Office Location: St. Paul, Minnesota **Project Representative:** Ted Powell
Principal-in-Charge: J. Kevin Powers
Retainer: $

Client hereby engages LBG to perform the services described and referred to herein and agrees to pay LBG for such services, and acknowledges that the terms of this agreement are subject to LBG's standard contract terms and all attached and referenced material and documents. Unless otherwise provided in the attached proposal or scope: (1) inclusion of anticipated "start" and "completion" dates shall not be construed to impose a "time is of the essence" requirement; and (2) any preliminary cost estimate shall not be construed as a "flat-fee" or "not-to-exceed" amount. In consideration of the foregoing, LBG agrees to perform the services described and referenced herein.

CITY OF CLINTON CLIENT		LEGGETTE, BRASHEARS & GRAHAM, INC.	
By: (signature)		**By: (signature)**	
(printed)		**(printed)**	J. Kevin Powers
Title:		**Title:**	Senior Vice President
Date:		**Date:**	
Witness:		**Witness:**	



Clinton Hydrogeologic Investigation

- Proposed Well Site
- Test Holes
- Delineated Paleo Channel (Dashed Where Approx.)
- Proposed Resistivity Lines
- Deep Paleo Channel Average Bounds ~400ft
- PLSS Sections

Note: Modified from Burns & McDonnell figure titled:
"Figure ES-9 - Conceptual Wellfield Hydrogeologic Investigation - Clinton, OK"

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Prepared By:
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CITY OF CLINTON, OKLAHOMA

PROPOSED RESISTIVITY LINES

FILE:	g3bmclinton01a.MXD	DATE:	2/11/2016	FIGURE:	1

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