

**AGREEMENT SUMMARY
BROKEN ARROW MUNICIPAL AUTHORITY
TASTE AND ODOR MITIGATION STUDY
AT THE VERDIGRIS RIVER WATER TREATMENT PLANT
PROFESSIONAL CONSULTANT AGREEMENT**

1.0 Professional Consulting Firm:

- 1.1 Name: HDR Engineering, Inc.
- 1.2 Telephone No.: 972-960-4400
- 1.3 Address: 17111 Preston Road, Suite 300, Dallas, Texas 75248

2.0 Project Name/Location: Taste and Odor Mitigation Study at the Verdigris River Water Treatment Plant

3.0 Statement of Purpose: This project involves bench-scale evaluation of treatment technologies capable of reducing the impacts of MIB and geosmin on treated water taste and odor. Additionally, a pilot-scale evaluation will be conducted to determine if biofiltration can successfully reduce MIB and geosmin.

4.0 Agreement Summary:

- 4.1 Agreement Amount: \$333,405.00
- 4.2 Agreement Time: 360 calendar days
- 4.3 Estimated Construction Cost: Not Applicable

5.0 Contract Documents and Priority: The Broken Arrow Municipal Authority (OWNER), represented by the City Manager, and the Professional Consulting firm, (CONSULTANT), identified in paragraph 1.0 agree to perform this AGREEMENT in strict accordance with the clauses, provisions, and the documents identified as below, all of which are made part of this Contract. In the event of conflict, these documents shall be interpreted in the following order:

- 5.1 AGREEMENT with corresponding Attachments;
- 5.2 Duly authorized Amendments to the AGREEMENT;
- 5.3 AGREEMENT Summary;
- 5.4 Specific project written correspondence mutually recognized; and
- 5.5 Specific project verbal instructions mutually recognized.

6.0 Agreement Approved by the Owner on: _____

**AGREEMENT
FOR
PROFESSIONAL CONSULTANT SERVICES
BETWEEN
BROKEN ARROW MUNICIPAL AUTHORITY
AND
HDR ENGINEERING, INC.
FOR
TASTE AND ODOR MITIGATION STUDY
AT THE VERDIGRIS RIVER WATER TREATMENT PLANT
PROFESSIONAL CONSULTANT AGREEMENT**

This AGREEMENT, including Attachment A through Attachment E, between the Broken Arrow Municipal Authority (OWNER) and HDR Engineering, Inc., (CONSULTANT);

W I T N E S S E T H:

WHEREAS, OWNER intends to have a Taste and Odor Mitigation Study prepared for the Verdigris River Water Treatment Plant, Project No. _____ (Project) for which, OWNER has requested that CONSULTANT provide certain professional services as required and,

WHEREAS, CONSULTANT is qualified and capable to provide the professional services required;

NOW, therefore, in consideration of the promises contained in this AGREEMENT, OWNER and CONSULTANT agree as follows:

ARTICLE 1 - EFFECTIVE DATE

The effective date of this AGREEMENT shall be the 7 day of may, 2019.

ARTICLE 2 - GOVERNING LAW

This AGREEMENT shall be governed by the laws of the State of Oklahoma and venue for any action concerning this Agreement shall be in the District Court of Tulsa County, Oklahoma.

ARTICLE 3 - SERVICES TO BE PERFORMED BY CONSULTANT

CONSULTANT shall perform the SERVICES described in Attachment A, Scope of Services. If construction phase services are included, the CONSULTANT shall be the OWNER'S agent and representative to observe, record and report with respect to all services that are required or authorized by the construction documents.

ARTICLE 4 – ORGANIZATION OF SUBMITAL DOCUMENTS

CONSULTANT shall prepare the documents as described in Attachment B as part of this Agreement.

ARTICLE 5 - COMPENSATION

OWNER shall pay CONSULTANT in accordance with Attachment D, Compensation.

ARTICLE 6 - OWNER'S RESPONSIBILITIES

OWNER shall be responsible for all matters described in Attachment C, OWNER'S Responsibilities and Special Conditions.

ARTICLE 7 - STANDARD OF CARE

CONSULTANT shall perform the SERVICES undertaken in a manner consistent with the prevailing accepted standard for similar services with respect to projects of comparable function

and complexity, and with the applicable state laws, as well as the specific codes, regulations, design criteria and construction specifications adopted by the owner and other governing policies published and generally considered authoritative by CONSULTANT'S profession that are in effect at the time of performance of these SERVICES. CONSULTANT is obligated to perform professional services in accordance with the foregoing standard with respect to the laws, codes, regulations, design criteria and construction specifications that are applicable pursuant to this AGREEMENT.

ARTICLE 8 - LIABILITY

8.1 General. Having considered the potential liabilities that may exist during the performance of these SERVICES, the benefits of the PROJECT, and CONSULTANT'S fee for the SERVICES; and in consideration of the promises contained in this AGREEMENT, OWNER and CONSULTANT agree to allocate and limit such liabilities in accordance with Article 10.

8.2 Indemnification. CONSULTANT agrees to defend, indemnify, and hold harmless OWNER, and its agents and employees, from and against legal liability for all claims, losses, damages, and expenses to the extent such claims, losses, damages, or expenses are caused by the negligent or intentional acts, errors, or omissions of CONSULTANT, its agents or employees. In the event claims, losses, damages, or expenses are caused by the joint or concurrent negligence of OWNER and CONSULTANT, or their agents or employees, then they shall be borne by each party in proportion to each entity's own negligence.

8.3 Consequential Damages. OWNER shall not be liable to CONSULTANT for any special, indirect, or consequential damages resulting in any way from the performance of the SERVICES such as, but not limited to, loss of use, loss of revenue, or loss of anticipated profits.

8.4 Survival. Upon completion of all SERVICES, obligations, and duties provided for in this AGREEMENT, or if this AGREEMENT is terminated for any reason, the terms and conditions of this Article 8 shall survive.

ARTICLE 9 - INSURANCE

During the performance of the SERVICES under this AGREEMENT, CONSULTANT shall maintain the following insurance:

- (1) General Liability Insurance, with a combined single limit of \$1,000,000 for each occurrence and \$1,000,000 in the aggregate;
- (2) Automobile Liability Insurance, with a combined single limit of not less than \$1,000,000 for each person, not less than \$1,000,000 for each accident and not less than \$1,000,000 for property damage; and
- (3) Professional Liability Insurance, with a limit of \$1,000,000 annual aggregate.

CONSULTANT shall furnish OWNER certificates of insurance, which shall include a provision that such insurance shall not be canceled without at least thirty (30) days written notice to OWNER. All PROJECT sub-consultants shall be required to name OWNER and CONSULTANT as certificate holders on their certificate of insurance for the PROJECT, and shall be required to indemnify OWNER and CONSULTANT to the same extent. CONSULTANT shall be held responsible to submit certificates of insurance for sub-consultants to OWNER prior to the sub-consultant's release to commence work.

ARTICLE 10 - LIMITATIONS OF RESPONSIBILITY

CONSULTANT shall not be responsible for: (1) construction means, methods, techniques, sequences, procedures, or safety precautions and programs in connection with the construction of the PROJECT; or (2) procuring permits, certificates, and licenses required for any construction unless such responsibilities are specifically assigned to CONSULTANT in Attachment A, Scope of Services.

ARTICLE 11 - LIMITATIONS OF RESPONSIBILITIES FOR ACTS OF OTHERS

CONSULTANT shall not at any time supervise, direct, control or have authority over any work performed by any employee, contractor or other agent of OWNER. CONSULTANT shall not be responsible for the acts or omissions of any employee, contractor or other agent associated with the PROJECT except for its own employees, subcontractors and other agents.

ARTICLE 12 - OPINIONS OF COST AND SCHEDULE

Since CONSULTANT has no control over the cost of labor, materials, or equipment furnished by others, or over the resources provided by others to meet PROJECT schedules, CONSULTANT'S opinion of probable costs and of PROJECT schedules shall be made on the basis of experience and qualifications as a professional. CONSULTANT does not guarantee that proposals, bids, or actual PROJECT costs will conform to OWNER'S cost estimates or that actual schedules will conform to OWNER'S projected schedules.

ARTICLE 13 - REUSE OF DOCUMENTS

All documents, including, but not limited to, drawings, specifications, and details, reports, etc. prepared by CONSULTANT pursuant to this AGREEMENT are instruments of service in respect to the PROJECT. They are not intended or represented to be suitable for reuse by CONSULTANT or others on extensions of the PROJECT or on any other project. Any reuse or adaptation without prior written verification by the OWNER for the specific purpose intended will be at CONSULTANT'S sole risk and without liability or legal exposure to the OWNER. CONSULTANT shall defend, indemnify, and hold harmless the OWNER against all claims, losses, damages, injuries, and expenses, including attorney's fees, arising out of or resulting from such reuse.

ARTICLE 14 - OWNERSHIP OF DOCUMENTS AND INTELLECTUAL PROPERTY

Except as otherwise provided herein, engineering documents, drawings, and specifications prepared by CONSULTANT as part of the SERVICES shall become the property of OWNER. CONSULTANT shall retain its rights in its standard drawing details, specifications, data bases, computer software, and other proprietary property. Rights to intellectual property developed, utilized, or modified in the performance of the SERVICES shall remain the property of CONSULTANT, but shall be provided to the OWNER, at no additional expense to the OWNER.

ARTICLE 15 - TERMINATION

This AGREEMENT may be terminated by either party upon written notice in the event of substantial failure by the either party to perform in accordance with the terms of this AGREEMENT. The non-performing party shall have fifteen (15) calendar days from the date of the termination notice to cure or to submit a plan for cure acceptable to the other party.

OWNER may suspend performance of this AGREEMENT for OWNER'S convenience upon written notice to CONSULTANT. Upon restart, an equitable adjustment may be made to CONSULTANT'S compensation, if the period of suspension has created an economic hardship for the CONSULTANT.

ARTICLE 16 - DELAY IN PERFORMANCE

Neither OWNER nor CONSULTANT shall be considered in default of this AGREEMENT for delays in performance caused by circumstances beyond the reasonable control of the non-performing party. For purposes of this AGREEMENT, such circumstances include, but are not limited to, abnormal weather conditions such as floods, earthquakes, fire; civil disturbances such as war, riots, or other civil epidemic; power outages, strikes, lockouts, work slowdowns, or other labor disturbances; sabotage; judicial restraint, and inability to procure permits, licenses, or authorizations from any local, state, or federal agency for any of the supplies, materials, accesses, or services required to be provided by either OWNER or CONSULTANT under this AGREEMENT.

Should such circumstances occur, the non-performing party shall, within a reasonable time of being prevented from performing, give written notice to the other party describing the circumstances preventing continued performance and the efforts being made to resume performance of this AGREEMENT.

ARTICLE 17 - COMMUNICATIONS

Any communication required by this AGREEMENT shall be made in writing to the address specified below:

OWNER: Broken Arrow Municipal Authority
485 N. Poplar Street
Broken Arrow, OK 74012

Contact: Stacy White, P.E.
Assistant Utilities Director

CONSULTANT: HDR Engineering, Inc.
17111 Preston Road, Suite 300
Dallas, Texas 75248
(972) 960-4400

Contact: Joel R. Cantwell, P.E.
Project Manager

Nothing contained in this Article shall be construed to restrict the transmission of routine communications between representatives of OWNER and CONSULTANT.

ARTICLE 18 - WAIVER

A waiver by either OWNER or CONSULTANT of any breach of this AGREEMENT shall be in writing. Such a waiver shall not affect the waiving party's rights with respect to any other or further breach.

ARTICLE 19 - SEVERABILITY

The invalidity, illegality, or unenforceability of any provision of this AGREEMENT or the occurrence of any event rendering any portion or provision of this AGREEMENT void shall in no way affect the validity or enforceability of any other portion or provision of this AGREEMENT. Any void provision shall be deemed severed from this AGREEMENT, and the balance of this AGREEMENT shall be construed and enforced as if this AGREEMENT did not contain the particular portion or provision held to be void. The parties further agree to amend this AGREEMENT to replace any stricken provision with a valid provision that comes as close as possible to the intent of the stricken provision. The provisions of this Article shall not prevent this entire AGREEMENT from being void should a provision which is of the essence of this AGREEMENT be determined void.

ARTICLE 20 - INTEGRATION

This AGREEMENT represents the entire and integrated AGREEMENT between OWNER and CONSULTANT. It supersedes all prior and contemporaneous communications, representations, and agreements, whether oral or written, relating to the subject matter of this AGREEMENT.

ARTICLE 21 - SUCCESSORS AND ASSIGNS

To the extent permitted by Article 22, OWNER and CONSULTANT each binds itself and its successors and assigns to the other party to this AGREEMENT.

ARTICLE 22 - ASSIGNMENT

Neither OWNER nor CONSULTANT shall assign its duties under this AGREEMENT without the prior written consent of the other party. Unless otherwise stated in the written consent to an assignment, no assignment will release or discharge the assignor from any obligation under this AGREEMENT. Nothing contained in this Article shall prevent CONSULTANT from employing independent sub-consultants, associates, and sub-contractors to assist in the performance of the SERVICES. However, third party entities must comply with Article 9.

ARTICLE 23 - THIRD PARTY RIGHTS

Nothing in this AGREEMENT shall be construed to give any rights or benefits to anyone other than OWNER and CONSULTANT.

ARTICLE 24 - COMPLETION

CONSULTANT shall complete the services within the time frame outlined on Attachment E, Schedule, subject to conditions which are beyond the control of the CONSULTANT.

ARTICLE 25 - IMMIGRATION COMPLIANCE

25.1 Consultant shall demonstrate that he:

25.1.1 Has complied, and shall at all times during the term of this Contract, comply in all respects with all immigration-related laws, statutes, ordinances and regulations including without limitation, the Immigration and Nationality Act, as amended, the Immigration Reform and Control Act of 1986, as amended, and the Oklahoma Taxpayer and Citizen Protection Act of 2007 (Oklahoma HB 1804) and any successor laws, ordinances or regulations (collectively, the Immigration Laws"); and

25.1.2 Has properly maintained, and shall at all times during the term of this Contract, maintain any and all employee records required by the U.S. Department of Homeland Security ("DHS"), including, without limitation, properly completed and maintained Form I-9s for each of the Consultants employees; and

25.1.3 Has verified the employment eligibility for all employees hired on or after July 1, 2008 through DHS's E-Verify system, and shall at all times continue to verify the employment eligibility of all employees hired during the term of this Contract; and

25.1.4 Has required, and will at all times during the term of this Contract, require any sub-contractor utilized, hired or sub-contracted for by Consultant for the completion or undertaking of any duties, tasks or responsibilities under this Contract, to comply the requirements and obligations imposed by the Immigration Laws and set forth in Paragraph (I), parts (a), (b) and (c), above, with regards to each of the sub-contractor's employees.

25.2 Consultant will indemnify, defend and hold harmless City against any loss, cost, liability, expense (including, without limitation, costs and expenses of litigation and reasonable attorney's fees) demands, claims, actions, causes of action, liabilities, suits, damages, including special and consequential damages that arise from or in connection with, directly or indirectly, Consultants failure, deliberate or negligent, to fulfill its obligations and representations regarding verifying the employment eligibility of its employees and the employees of any subcontractor utilized by Contractor as set forth more fully in Paragraph 25.1 above. IN WITNESS WHEREOF, the City Manager has hereunto set his hand, for and on behalf of the Broken Arrow Municipal Authority and the CONSULTANT has signed, or caused his name to be signed, and seal affixed by proper authority, the day and year first above written and these presents have been executed in triplicate counterparts.

OWNER:
Broken Arrow Municipal Authority

CONSULTANT:
HDR Engineering, Inc.

Approved as to form:

By [Signature]
Assistant City Attorney

By [Signature]
Ramon F. Miguez, Vice President

Date 4-18-2019

By _____
Michael L. Spurgeon, City Manager

(CORPORATE SEAL) If applicable

Date _____

Attest:

Attest:

By _____
Curtis Green, City Clerk

By [Signature]
Jenifer Rayshell, Secretary

Date _____

Date 4-18-2019

VERIFICATION

State of Texas)
County of Dallas) §

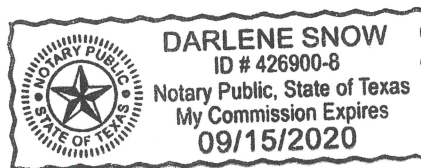
Before me, a Notary Public, on this 18th day of April, 2019, personally appeared Ramon Miguez, known to be a Vice President of HDR Engineering, Inc., and to be the identical person who executed the within and foregoing instrument, and acknowledged to me that he executed the same as his free and voluntary act and deed for the uses and purposes therein set forth.

My Commission Expires:

9/15/2020

[Signature]

Notary Public



**ATTACHMENT A
TO
AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES
BETWEEN
BROKEN ARROW MUNICIPAL AUTHORITY
AND
HDR ENGINEERING, INC.
FOR
TASTE AND ODOR MITIGATION STUDY
AT THE VERDIGRIS RIVER WATER TREATMENT PLANT
PROFESSIONAL CONSULTANT AGREEMENT**

SCOPE OF SERVICES

The following scope of services shall be made a part of the AGREEMENT dated the 7 day of May, 2019.

1.0 PROJECT UNDERSTANDING

CONSULTANT understands that the OWNER, the Broken Arrow Municipal Authority ("BAMA"), owns and operates the Verdigris River Water Treatment Plant to provide potable water for its citizens. Over the past several years, the plant has experienced seasonal algal growth issues in the raw water supply (both the Verdigris River oxbow at the intake and the presedimentation basins on the plant site). The highest concentrations of algae have been observed in the presedimentation basin effluent. As a result, taste and odor concentrations contributed by methylisoborneol (MIB) and geosmin have periodically increased and exceeded the taste and odor threshold (8 to 10 ng/L) by up to ten times, leading to customer complaints.

CONSULTANT has been asked to assist the BAMA with validation of viable technologies capable of reducing the impacts of MIB and geosmin and maintaining concentrations below the taste and odor threshold. Three treatment alternatives are recommended for bench-scale evaluation: ozonation, powdered activated carbon (PAC), and granular activated carbon (GAC).

Additionally, the feasibility of biological filtration (biofiltration) using pilot-scale GAC columns is recommended for both raw and filtrate water to determine if biological treatment can successfully reduce MIB and geosmin. Biofiltration can treat a wide range of organic and inorganic contaminants (e.g., natural organic matter, trace organic compounds, and inorganic compounds) in both surface water and groundwater. Coupling biofiltration with pre-oxidation can improve removal of organic compounds.

The objectives of this study are to:

1. Rapidly evaluate the efficacy of three treatment methods for MIB and geosmin removal with bench-scale tests,
2. Characterize the performance of a pilot-scale biofiltration system for both raw water and filtrate water for MIB and geosmin removal,
3. Compare performance between the bench-scale and pilot-scale systems and evaluate representativeness of pilot system performance.

2.0 PROJECT SCOPE

This document presents the proposed scope of work for the CONSULTANT to complete this project. These five major tasks are described in detail in the following sections:

1. Project Management and Administration
2. Existing Data Collection and Review
3. Bench-Scale Validation of Three Treatment Alternatives
4. Biofiltration Pilot-Scale Testing
5. Coordination with ODEQ

3.0 SCOPE OF SERVICES

3.1 PROJECT MANAGEMENT AND ADMINISTRATION: CONSULTANT shall be responsible to perform the following tasks throughout the course of the PROJECT:

- 3.1.1 Oversee and coordinate all work activities;
- 3.1.2 Review all project deliverables for quality;
- 3.1.3 Maintain project schedule and submit monthly as an attachment to the invoice;
- 3.1.4 Monitor budget and expenditures

CONSULTANT will submit a schedule to be reviewed and approved by the BAMA Project Manager. CONSULTANT shall notify the Project Manager if there are anticipated variances to budget and shall report on them on a monthly basis.

Deliverables:

- Monthly Invoices with Progress Report

3.2 EXISTING DATA COLLECTION AND REVIEW: This task includes review of water quality data provided by the BAMA to analyze and establish water quality trends for parameters of interest in developing a bench-scale and pilot-scale test plan (Task 3 and 4). The following elements will be included in this task:

- 3.2.1 Development of a formal data request submitted to the BAMA for raw and filtrate water to supplement previous data provided to the CONSULTANT.
- 3.2.2 Review of data submitted to the CONSULTANT by the BAMA in electronic format.
- 3.2.3 A brief PowerPoint summary with data plots and potential implications during bench-scale testing.

Deliverables:

- Water Quality Data Summary (PPT format)

3.3 BENCH-SCALE VALIDATION OF THREE TREATMENT ALTERNATIVES: This task includes bench-scale studies to evaluate the efficacy of three treatment alternatives for removal of MIB and geosmin.

Based on the mutual understanding of the Project, the major bench-scale validation elements of this task include:

- 3.3.1 Development of a bench-scale test plan based on the results from Task 2 to evaluate ozone, PAC, and GAC for removal of MIB and geosmin. A test plan summary is proposed in Table 1.
- 3.3.2 Coordination with the BAMA to collect and ship representative water samples, at the BAMA's cost, to CONSULTANT's bench-scale testing laboratory (Applied Research and Engineering Center [AREC]).
- 3.3.3 Administration of bench-scale ozonation tests that determine the ozone demand, ozone decay, bromate formation, MIB/geosmin removal, and assimilable organic carbon (AOC) and/or biodegradable organic carbon (BDOC) formation.
 - 3.3.3.1 Tests will be conducted at the laboratory at up to three water temperatures and three ozone doses with spiking of bromide, geosmin, and MIB at ambient pH. Additional bench-scale ozonation tests will be conducted to test the efficacy of peroxide addition to form peroxone, an advanced oxidation process.
- 3.3.4 Administration of bench-scale PAC tests that consider the PAC dose, MIB/geosmin removal, and TOC removal.
 - 3.3.4.1 Tests will be conducted on at the laboratory at up to three water temperatures for and three PAC doses for two types of PAC with spiking of geosmin and MIB at ambient pH.
- 3.3.5 Administration of bench-scale GAC tests (rapid small scale column test [RSSCT]) to select a GAC media type that successfully reduces MIB and geosmin.
 - 3.3.5.1 Tests will be conducted at the laboratory at up to two water temperatures and three types of GAC with spiking of geosmin and MIB at ambient pH. Media characteristics will be selected for each water type for application in Task 4.
- 3.3.6 Review of bench-scale test results and preparation of a PowerPoint summary that includes a recommended basis for design criteria or considerations for pilot-scale testing if further investigation is needed. The PowerPoint will be presented at Workshop No. 1.
- 3.3.7 Under this task, the results from Tasks 2 and 3 will be summarized in the form of a report with analysis of existing water quality data and bench-scale test results. Feedback from Workshop No. 1 will be included with final recommendations for Task 4 (pilot-testing).

Table 1: Bench-Scale Test Plan

Test	Water(s) Tested	Temperatures Tested	Parameters Tested
Ozonation	Raw (Pre-sedimentation Basin Effluent) and Filtrate	Low, Mid, High	3 Ozone Doses 2 Peroxone Doses
PAC	Raw	Low, Mid, High	3 PAC Doses for 2 types of PAC
GAC (RSSCT)	Filtrate	Low, High	3 GAC Media Types

Deliverables:

- Bench-scale Test Plan
- Test Results Summary with Recommended Basis for Pilot-Testing or Design (PPT format)
- Workshop No. 1 – Review Bench-Scale Test Results Summary
- Draft (before Workshop No. 1) and Final Bench-Scale Testing Report

3.4 BIOFILTRATION PILOT-SCALE TESTING: Task 4 will include an 8-month pilot study at the Verdigris River Water Treatment Plant under typical biofiltration operating conditions (i.e., source water, average loading rate, and backwashing protocol). Based on the mutual understanding of the Project, the major pilot-scale validation elements of this task include:

- 3.4.1 Development of a pilot-scale test plan based on the results from the Task 3 GAC RSSCT testing. The pilot-scale test plan will include an overview of the pilot design, operational parameters, sampling plan, proposed schedule of testing, communications plan, and quality management plan.
- 3.4.2 Development of an Excel database for pilot operations and water quality tracking for BAMA operations staff to use during pilot-scale testing.
- 3.4.3 Assistance with coordination and procurement of a pilot-scale filtration unit for pilot testing.
- 3.4.4 Assistance with start-up and sampling from the pilot-scale filtration unit.
- 3.4.5 Weekly coordination calls and monthly site visits to track pilot-scale operation during the 8-month pilot-testing.
- 3.4.6 Daily operation of the pilot units will be conducted by BAMA staff, including all sampling. Samples will be delivered by BAMA staff to the BAMA's contracted external laboratory for analysis. The laboratory analysis fees will be paid directly by the BAMA and are not included in this scope of work.
- 3.4.7 Development of enhancement strategy dosing protocol for Phase 2 (Table 2). The BAMA will be responsible for providing and installing onsite chemical feeds to the pilot unit.
- 3.4.8 Review of pilot-scale test results and preparation of a PowerPoint summary that includes a recommended basis for design criteria,

estimated AACE Class 5 Cost Estimate ranges for capital and O&M costs, and considerations for additional pilot-scale testing if further investigation is needed. The PowerPoint will be presented at Workshop No. 2.

- 3.4.9 Under this task, the results from Task 4 will be summarized in the form of a report with analysis of pilot-scale test results. Feedback from Workshop No. 2 will be included with final recommendations.

One pilot-scale biofilter skid with four columns will be used exclusively during the entire 8-month testing period and monitored for hydraulic and contaminant removal parameters. Pilot columns will be fed both raw water from the Verdigris River and filtrate water from the microfiltration membranes. A pilot layout schematic is shown in Figure 1. For each water source, one filter will be maintained as a control filter (no optimization strategies tested during entire study), while a second filter will be dedicated to optimization testing.

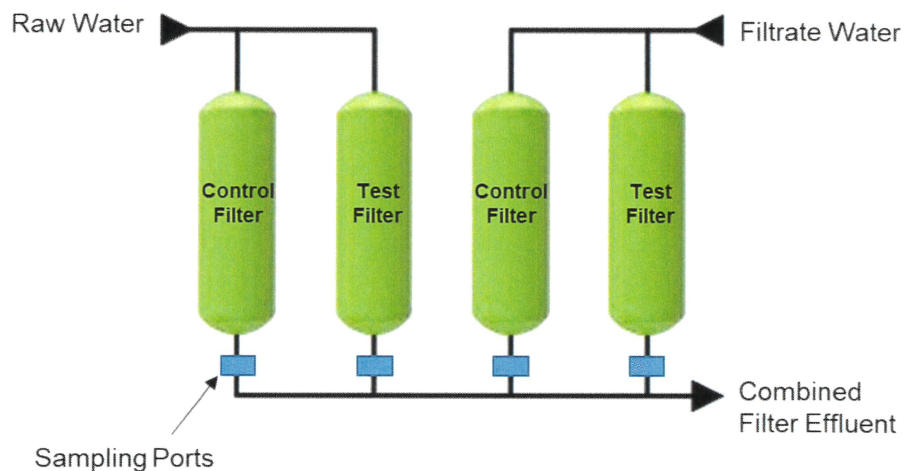


Figure 1: Pilot-scale Biofiltration Skid Schematic

Three phases of testing will be associated with Task 4, as summarized in Table 2.

Table 2: Biofiltration Pilot Test Plan

Phase 1 Baseline Operating and Source Water Conditions (2 months)	Examine pilot-scale performance and removal of MIB/geosmin from the existing source water. Reach steady state hydraulic performance and turbidity removal. Establish a successful loading rate and empty bed contact time for existing water treatment. All pilot columns will be operated with no optimization strategies or MIB and geosmin spiking.
Phase 2 Spiked MIB and Geosmin in Pilot Feed (2 months)	Examine pilot-scale filter performance with spiked concentrations of MIB and geosmin. Spiked dosages will vary by compound; however, initial target concentration will equal or exceed annual peaks (e.g. MIB > 100 ng/L). Establish a successful loading rate and empty bed contact time for MIB and geosmin removal. All pilot columns will be operated with no optimization strategies.
Phase 3 Enhancement Testing with Spiked MIB and Geosmin in Pilot Feed (4 months)	Examine pilot-scale filter performance with spiked concentrations of MIB and geosmin and test optimization strategies in test filters. Spiked dosages will vary by compound; however, initial target concentration will equal or exceed annual peaks (e.g. MIB > 100 ng/L). Optimization strategies include peroxide addition or nutrient augmentation (ammonia-nitrogen and ortho-phosphate). The initial peroxide target dose will be 1 mg/L; however, the dose will be optimized during the study. Biofilter nutrient augmentation will target a 100:10:1 carbon:nitrogen:phosphorus stoichiometric ratio.

Deliverables:

- Pilot-Scale Test Plan
- Excel Database for Pilot Operations and Water Quality Tracking
- Site Visit During Pilot Startup
- Monthly Site Visits During Piloting
- Test Results Summary (PPT Format)
- Workshop No. 2 – Review Pilot-Scale Test Results Summary
- Draft (before Workshop No. 2) and Final Taste and Odor Mitigation Report

- 3.5 COORDINATION WITH ODEQ: Task 5 will include coordinating and attending one meeting with the Oklahoma Department of Environmental Quality (ODEQ) to discuss bench-scale and pilot-scale testing results and future piloting requirements or development of a preliminary engineering report (PER) for conditional approval of taste and odor treatment implementation:

Deliverables:

- Documentation of ODEQ Communications

ADDITIONAL SERVICES NOT INCLUDED IN THE SCOPE OF WORK:
CONSULTANT is available to assist or provide services that may become beneficial for further development of taste and odor mitigation approaches if deemed necessary. These items include, but are not limited to, the following:

1. Bromate mitigation strategy testing for implementation of ozone.
2. Development of a PER for implementation of the selected treatment technology that includes treatment process design criteria and associated life-

cycle costs. The PER would include review of system manufacturers, when applicable, and a proposed basis of design for site implementation.

3. Final design, bidding, and construction phase services

**ATTACHMENT B
TO
AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES
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BROKEN ARROW MUNICIPAL AUTHORITY
AND
HDR ENGINEERING, INC.
FOR
TASTE AND ODOR MITIGATION STUDY
AT THE VERDIGRIS RIVER WATER TREATMENT PLANT
PROFESSIONAL CONSULTANT AGREEMENT**

ORGANIZATION OF SUBMITTAL DOCUMENTS

The following constitutes a list of project deliverables, as required, and shall be made a part of the AGREEMENT dated the 7 day of May, 2019.

- Monthly Invoices with Progress Report
- Water Quality Data Summary (PPT format)
- Bench-scale Test Plan
- Bench-scale Test Results Summary (PPT format);
- Draft and Final Bench-scale Testing Report
- Pilot-scale Test Plan
- Excel Database for Pilot Operations and Water Quality Tracking
- Pilot-scale Test Results Summary (PPT Format)
- Draft and Final Taste and Odor Mitigation Report

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**ATTACHMENT C
TO
AGREEMENT FOR CONSULTING SERVICES
BETWEEN
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TASTE AND ODOR MITIGATION STUDY
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PROFESSIONAL CONSULTANT AGREEMENT**

OWNER'S RESPONSIBILITIES AND SPECIAL CONDITIONS

The following list of special OWNER'S responsibilities and contract special conditions shall be made a part of this AGREEMENT dated the 7 day of may, 2019.

1.0 OWNER'S RESPONSIBILITIES

- 1.1 OWNER shall furnish to CONSULTANT all available information pertinent to the PROJECT including previous reports and any other data relative to the PROJECT;
- 1.2 OWNER shall furnish to CONSULTANT all public utility information available relative to the PROJECT. Consultant topographical survey shall locate all utilities above and below ground for exact location;
- 1.3 OWNER shall furnish to CONSULTANT list of codes adopted by the municipality as well as subdivision regulations, design criteria and construction standards and specifications that may be pertinent to the PROJECT;
- 1.4 OWNER shall examine all studies, reports, sketches, estimates, specifications, plan drawings, proposals, and other documents presented by the CONSULTANT and render in writing decisions pertaining thereto within a reasonable time so as not to delay the SERVICES of the CONSULTANT.

2.0 SPECIAL CONDITIONS

- 2.1 None

**ATTACHMENT D
TO
AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES
BETWEEN
BROKEN ARROW MUNICIPAL AUTHORITY
AND
HDR ENGINEERING, INC.
FOR
TASTE AND ODOR MITIGATION STUDY
AT THE VERDIGRIS RIVER WATER TREATMENT PLANT
PROFESSIONAL CONSULTANT AGREEMENT**

COMPENSATION AND ADDITIONAL SERVICES

The following compensation and hourly rates shall apply as described in Attachment D and shall be made a part of the AGREEMENT dated the 7 day of May, 2019.

1.0 BASIC COMPENSATION

The basic compensation for the Professional Consultant to perform all duties and responsibilities associated with the Scope of Services as described in Attachment A shall be in accordance with the following payment breakdown. See **Exhibits D-1, D-2, and D-3** for the basis of compensation. The amounts shown include all labor, material, overhead and profit associated with the Scope of Services.

- 1.1 Task 1 - Project Management and Administration: The OWNER shall pay the CONSULTANT a lump sum amount of **\$8,118.00**.
- 1.2 Task 2 - Existing Data Collection and Review: The OWNER shall pay the CONSULTANT a lump sum amount of **\$ 10,829.00**.
- 1.3 Task 3 - Bench-Scale Validation of Three Treatment Technologies: The OWNER shall pay the CONSULTANT a lump sum amount of **\$ 88,352.00**.
- 1.4 Task 4 - Biofiltration Pilot-Scale Testing: The OWNER shall pay the CONSULTANT a lump sum amount of **\$ 99,820.00**.
- 1.5 Task 5 - Coordination with ODEQ: The OWNER shall pay the CONSULTANT a lump sum amount of **\$ 5,473.00**.
- 1.6 OTHER DIRECT COSTS: OWNER shall pay the CONSULTANT on a Time and Materials basis with a not to exceed amount of **\$45,684.00**. CONSULTANT shall be paid an amount equal to Reimbursable Expenses times a factor of 1.0 and CONSULTANT's subconsultant charges times a factor of 1.1. These costs include the following:

- Travel Expenses
- Printing and Copying Costs

- Lab Analytical Fees for Bench-scale Testing

1.7 PILOTING EQUIPMENT COST: OWNER shall pay the CONSULTANT on a Time and Materials basis with a not to exceed amount of **\$75,129.00**. CONSULTANT shall be paid an amount equal to Reimbursable Expenses times a factor of 1.0, and CONSULTANT's subconsultant charges times a factor of 1.1. These costs include the following:

- Pilot Rental Equipment (Subcontracted as a Subconsultant)
- Miscellaneous Plumbing Supplies
- Miscellaneous Disposal Costs

3.0 REPRODUCTION

All charges for reproduction shall be included in Basic Compensation Fee of the Professional Consultant. No separate payment will be made for these expenses.

4.0 MILEAGE

All direct costs shall be included in the Basic Compensation of the Professional Consultant. No separate payment will be made for these expenses.

5.0 DIRECT COSTS

All direct costs shall be included in the Basic Compensation of the Professional Consultant. No separate payment will be made for these expenses.

6.0 ADJUSTMENT CLAUSE

The rates and costs described in this AGREEMENT shall not be revised annually, unless mutually agreed upon by both parties.

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EXHIBIT D-1 - TOTAL BASIS OF COMPENSATION
City of Broken Arrow, OK
Taste and Odor Mitigation Study

Item	Cost Range Basis and Description	Total Estimated Cost
HDR Engineering Fee		
Scope and Fee	HDR Bench-Scale and Pilot-Scale Testing Engineering	\$258,276
Piloting Equipment Cost - Contracted Through HDR		
Pilot Rental Equipment	Pilot Equipment Cost per Process = \$2,200 per week Shipping = \$5,000 per unit Onsite Commissioning and Training = \$5000 per unit Remote Access = \$65/week 25% Discount for >31 week Rental	\$73,129
Miscellaneous Plumbing	Break tanks, PVC piping, valves, pumps, etc.	\$1,000
Miscellaneous Disposals	Chemicals, safety equipment, reagents, spare parts	\$1,000
	Subtotal Equipment Cost	\$75,129
	Total HDR Fee	\$333,405
Costs Paid Directly by the City - Not Contracted Through HDR		
Piloting Sample Analysis	All WQ samples go to external lab, including select emerging contaminants (cost given is an estimate--see breakdown)	TBD
Student or Intern	Student worker or intern from local college to assist plant staff in everyday piloting operation and sampling (if desired)	TBD (if desired)

Bench-Scale Testing for Taste and Odor Mitigation

Total Fee	
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EXHIBIT D-3 - HDR Water Quality Laboratory Basis of Compensation

	Task Description	Totals	Lab	Consumables	External Lab
	Task 3: Bench-scale Testing	189			
	a) Ozone Testing				
2	- Waters tested (Raw & Settled)		90	\$450	
5	- 3 Ozone doses tested + 2 peroxide ratios				
3	- Temperatures tested				
4	- MIB/Geosmin timepoints				
	- Ozone decay curves (8 timepoints)				\$15,000
	- Beginning water characterization (list in Column I)		1		\$760
	- Final water measurements: Bromate, AOC or BDOC				\$7,500
	b) PAC Testing				
1	- Waters tested (Raw)		14	\$150	
6	- PAC doses tested (2 types, 3 doses each)				
3	- Temperatures tested				
	- Beginning water characterization (list in Column I)		1		\$160
	- Final water measurements: TOC, UV254, MIB, Geosmin				\$2,880
	c) GAC, RSSCT Testing				
1	- Waters tested (Filtrate)		70	\$300	
3	- Types of Carbon Tested				
2	- Temperatures tested				
	- Equipment set-up		10		
	- Daily sampling and laboratory analyses (up to 30 days)				
	- 2xday: flow, temp, pH				
	- 1xday: UV254, TOC, turbidity				
	- Beginning water characterization (list in Column I)				\$160
	- Final water measurements: TOC, UV254, MIB, Geosmin				\$960
	- Data Processing & Analysis		4		
	Materials (chemicals and laboratory consumables)	\$900		\$900	
	External laboratory	\$27,420			
	Shipping costs/Driving to external lab	\$1,514			
	TOTAL	\$29,834			

Initial Water characterization:

Bromide	Geosmin & MIB
Geosmin	TOC
MIB	AOC
pH	BDOC
Alkalinity	Bromate
DO	Bromide
TOC	
UV254	
SUVA	
AOC (or BDOC)	

TOC
UV254
MIB
Geosmin

TOC
UV254
MIB
Geosmin
Turbidity

External lab

Geosmin & MIB
TOC
AOC
BDOC
Bromate
Bromide

\$125
\$35
\$200
\$200
\$50
\$20

**ATTACHMENT E
TO
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PROFESSIONAL CONSULTANT AGREEMENT**

PROJECT SCHEDULE

The following schedule shall be made a part of the AGREEMENT dated the 7 day of May, 2019. On issuance of notice proceed by the OWNER, the CONSULTANT shall provide the OWNER a Gantt chart schedule, utilizing the tasks described in Attachment A.

Total Contract Time: 360 Calendar Days

See **Exhibit E-1** for detailed Project Schedule

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BAMA - Taste & Odor Mitigation Study at the Verdigris River WTP

ID	Task Name	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	1. Project Management & Admin														
2	2. Existing Data Collection & Review														
3	2.1. Data Request		◆ 5/13												
4	2.2. Data Review														
5	2.3 Water Quality Data Summary		◆ 5/17												
6	3. Bench-Scale Alternatives Evaluation														
7	3.1. Bench-scale Test Plan		◆ 5/24												
8	3.2. Sampling Coordination														
9	3.3. Ozonation Testing														
10	3.4. PAC Testing														
11	3.5. GAC Testing														
12	3.6. Workshop No. 1				◆ 7/8										
13	3.7. Bench-scale Testing Report				◆ 7/18										
14	4. Biofiltration Pilot-scale Testing														
15	4.1. Pilot-scale Test Plan				◆ 7/3										
16	4.2. Development of Excel Database														
17	4.3. Pilot-scale Unit Procurement														
18	4.4. Start-up Assistance														
19	4.5. Weekly Calls & Monthly Site Visits														
20	4.6. Daily Operation & Sampling by Plant Staff														
21	Phase 1 - Baseline with Existing Source Water														
22	Phase 2 - Spiked MIB/Geosmin														
23	Phase 3 - Enhancement Testing														
24	4.7. Enhanced Dosing Protocol Development														
25	4.8. Workshop No. 2													◆ 4/10	
26	4.9. Taste & Odor Mitigation Report													◆ 4/24	
27	5. Coordination with ODEQ														