Upper Occoquan Service Authority

Leader in Water Reclamation and Reuse

14631 COMPTON ROAD, CENTREVILLE, VIRGINIA 20121-2506
(703) 830-2200

March 15, 2022

TO ALL RFP RECIPIENTS:

For UOSA RFP 22-11 Landfill Engineering Services

SUBJECT: Addendum # 1

The above numbered solicitation is amended as set forth below. The hour and date specified for receipt of offers:

☑ is not extended

☐ is extended

OFFERORS MUST ACKNOWLEDGE receipt of this Addendum by one of the following methods:

a. By acknowledgement of this Addendum on Submission Form submitted with the proposal;
b. By referencing its receipt in your Transmittal Letter

If by virtue of this Addendum you desire to change a proposal already submitted, such change may be made by letter, provided it includes reference to the solicitation and this Addendum and is received prior to the due hour and date specified.

DESCRIPTION OF ADDENDUM:

The purpose of this addendum is to answer questions received by the deadline. The single question received is addressed below:

Q: Is it OK for us to use UOSA personnel as a reference

A: Yes - it is fine to use UOSA personnel as a reference.

All other Terms, Conditions, Tables, Charts and Specifications, and Drawings not otherwise changed remain as originally stated or as shown.

ISSUED BY:

Upper Occoquan Service Authority

Kristen Hylton Digitally signed by Kristen Hylton Date: 2022.03.15 07:59:28 -04'00'

Kristen Hylton, Purchasing Manag

03/15/2022
Date

UPPER OCCOQUAN SERVICE AUTHORITY

REQUEST FOR PROPOSALS #22-11

FOR

LANDFILL ENGINEERING SERVICES

Issued By:

Purchasing Department
Administration Building
14631 Compton Road
Centreville, Virginia 20121-2506
Tel. 703-830-2200
Fax. 703-830-5934
E-mail: Purchasing@uosa.org

Date Issued:	**Monday, February 28, 2022**
Optional Pre-proposal Conference:	**Wednesday, March 9, 2022, Virtual**
Deadline For Questions:	**Friday, March 11, 2022, 5:00 p.m.**
Proposals Must be Received On Or Before:	**Wednesday, March 30, 2022, 2:00 p.m.**

NOTICE: Firms who have received this solicitation package from a source other than UOSA's Purchasing Office should immediately contact UOSA's Purchasing Department and provide their name and mailing address in order that amendments to this solicitation or other communications can be sent to them. Firms who fail to notify the Purchasing Office with this information assume complete responsibility in the event that they do not receive communications prior to the closing date.

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Upper Occoquan Service Authority **Purchasing Department**
14631 Compton Rd, Centreville, VA 20121 • (703) 830-2200 • Purchasing@uosa.org

Solicitation Response Form

IFB/RFP Number: [ ] Title: [ ]

Company Identification

Name _____ Contact Name _____

Mailing Address _____ Title _____

Phone _____

Remit Address _____ Fax _____

Email _____

FEIN # _____ VA SCC ID # _____

**Pursuant to VA Code § 2.2-4311.2, an offeror organized or authorized to transact business in the Commonwealth must include its VA SCC provided ID# or proof of pending application for SCC authorization. If offeror is exempt from SCC authorization requirement they shall include, as a separate attachment, a statement accurately and completely reflecting why the offeror does not need to be so authorized. See Section 2.2 in the Standard Terms and Conditions.*

Company Classification

Principal place of business located in (state) _____ State of incorporation_____

Check one: Sole Prop. ☐ Partnership ☐ Limited Partnership ☐ Corporation ☐ Limited Liability Corporation ☐

Check all that apply: Small ☐ Women Owned ☐ Minority Owned ☐ Service Disabled Veteran Owned ☐

Addenda Receipt Confirmation:

Addendum # _____☐, Addendum # _____☐, Addendum # _____☐, Addendum # _____☐, Addendum # _____☐

Confirmation of Compliance to Solicitation Requirements, Terms and Conditions

The undersigned offers and agrees to furnish the goods, and/or services requested in solicitation [ ] in accordance with the attached offer. The undersigned certifies that they have read and understand all standard and supplemental terms and conditions provided in the aforementioned solicitation including but not limited to Standard Terms and Conditions Section 2.1 - Collusion, Section 2.2 - Compliance with Laws and Section 2.9 - Ethics in Public Contracting.

The attached offer is in accordance with all specifications and offeror accepts all terms and conditions contained in and incorporated by reference into the solicitation,

☐ with no exceptions.

☐ with the following exceptions/modifications (provided as separate attachment).

☐ Offeror has reviewed all specifications and terms and conditions, however under Virginia Code § 2.2-4302.2.4, Offeror is not required to provide any exceptions unless or until requested to do so as part of formal negotiations.

Note (n/a for RFP 22-11: Any material exceptions to solicitation specifications, terms or conditions will render an offer non-responsive. UOSA, in its sole discretion, will determine what constitutes a material exception.

Authorized Signature _____ Date _____

(must be original, ink signature)

Printed Name _____ Title _____

Submission Checklist – The following documents and forms are required as part of your submission. See Section 2.[***]

Solicitation Response Form (this form)	☐		☐
Attachment A Client List/ References	☐		☐
All Addenda issued	☐		☐
	☐		☐

SECTION 1

1. SUMMARY INFORMATION

1.1 Background

The Upper Occoquan Sewage Authority (UOSA) is a public body politic and corporate organized under the Virginia Water and Waste Authorities Act. UOSA was created by the concurrent actions of its member jurisdictions and chartered by the State Corporation Commission of Virginia on April 1, 1971. The member jurisdictions include the Counties of Fairfax and Prince William and the Cities of Manassas and Manassas Park. UOSA is located in Fairfax County and currently employs approximately 180 individuals. UOSA currently owns and operates an advanced water reclamation plant with a capacity of 54 million gallons per day ("mgd") a regional system of interceptor sewer lines, pump stations and force mains that deliver sewage from the four member jurisdictions to the treatment plant and an onsite captive industrial landfill.

This RFP covers the active industrial landfill which is owned and operated by UOSA. The landfill is located in western Fairfax County, near Centreville, Virginia. The landfill is situated on the north side of the main UOSA water reclamation plant, on the west side of Compton Road, just south of Interstate 66. The facility is currently monitoring groundwater semi-annually under a modified Phase I Monitoring Program as per 9 Virginia Administrative Code 20-80-300 C 3 and the April 2006 Variance Petition utilizing a network of six groundwater monitoring wells. The facility is also monitoring leachate and lime solids annually.

1.2 Objective

This Request For Proposal (RFP) invites written proposals to provide reoccurring annual and on-call/as needed, professional engineering services necessary for compliance with the Virginia Solid Waste Management Regulation (VSWMR) and other landfill-related engineering services.

Professional engineering services projects may include, but are not limited to groundwater monitoring and reporting in accordance with the VSWMR as well as the facility's Solid Waste Permit, Groundwater Monitoring Plan, and the March 2013 Variance Petition, lime solids analyses reporting in accordance with the facility's Solid Waste Permit and Operations Manual, leachate monitoring and reporting in accordance with the facility's Solid Waste Permit and Operations Manual, and the development of operations plans and fill / grading plans.

Offeror shall be qualified to provide such services and include proof of such qualifications in its proposal.

The form of the Contract will be a Basic Ordering Agreement (BOA) that includes labor rates, multipliers, and terms and conditions, coupled with Task Orders (TO) that specify the scope of the engineering services.

Landfill area surveys and other technical assistance may be authorized by separate Task Orders resulting from this procurement. Any additional Task Order assignments shall be at the sole discretion of UOSA.

END SECTION 1

2. SPECIFICATIONS

2.1 Scope of Work

The selected Firm shall be capable of providing the following services:

A. All services must comply with the VSWMR as well as the facility's Solid Waste Permit, Groundwater Monitoring Plan (Attachment B), and the Variance Petition (Attachment C), Lime solids and leachate analyses and reporting shall be in accordance with the facility's Solid Waste Permit and Operations Manual. Due to the size of the latter two (2) documents they will be made available upon request.

B. Semi-annual groundwater sample collection. Sampling is required for three (3) upgradient and three (3) downgradient monitoring wells.

C. In addition to wells listed in A above, one (1) unpermitted well must be monitored for water elevation to help describe groundwater flow.

D. Semi-annual analysis of monitoring well samples referred to in Item B above for required field parameters and for nineteen (19) metals listed on Table 3.1 Column A of VAC 20-81-250. Laboratory analysis shall be conducted using EPA SW-846 methods.

E. Conduct appropriate inter-well statistics.

F. Semi-annual groundwater report preparation and submittal to DEQ on UOSA's behalf, after approval of the draft report by UOSA.

G. Annual groundwater report preparation and submittal to DEQ on UOSA's behalf, after approval of the draft report by UOSA. The annual report shall present details regarding the groundwater sampling activities, chemical analyses, and statistical analysis performed for the first and second semi-annual monitoring periods.

H. Annual lime solids data validation and evaluation, in accordance with the toxicity concentration limits listed in 40 CFR 261 to access the hazardous waste characteristic potential of the lime solids.

I. Annual lime solids report preparation and submittal to DEQ on UOSA's behalf after approval of the draft report by UOSA. Monitoring results shall be provided by UOSA.

J. Annual leachate sample collection, analyses and report preparation and submittal to DEQ on UOSA's behalf after approval of the draft report by UOSA. The leachate sample shall be analyzed for the same parameters as the groundwater samples.

K. If requested, other separate tasks performed under this BOA to assist UOSA in meeting compliance with DEQ Waste Management Regulations. This could include aerial surveys, waste load replacement verification, calculations to verify the basis for financial assurance requirements and landfill life expectancy calculations. In addition and if so tasked, recommendations to modify the current O & M manual to meet DEQ regulations and reflect current UOSA practices. Additional tasks may include performing the update of the existing manual, audit actual practices and site conditions and incorporate data and CAD drawings from existing air survey work.

L. Facilitate compliance with current VSWMR. Keep current with amendments to the VSWMR such that compliance is assured.

M. If requested, perform other functions related to the groundwater monitoring and the safe, efficient, and compliant operation of the solid waste management facility.

N. If requested, evaluate the existing data sources, data records, existing permits and plans; or formulate proposal(s) for additional data sources or procedures for obtaining monitoring or test data if existing records are assessed to be deficient.

O. If requested, landfill design changes or permit amendments may also be negotiated as separate task orders.

2.2 Client List/References

Using Attachment A, provide a list of at least five (5) Clients for which you have provided similar or equivalent services. UOSA reserves the right to require additional references from the Offeror, or to obtain additional references from other sources not provided by the Offeror.

END SECTION 2

3. SUBMISSION OF PROPOSALS AND METHOD OF EVALUATION

3.1 General

The following general information is provided and shall be carefully followed by all Offerors to insure that proposals are properly prepared:

This procurement shall be conducted in accordance with the competitive negotiation procedures of the Virginia Public Procurement Act.

A. Each Offeror must furnish all information required by the RFP. The person signing the proposal must initial erasures or other changes. Proposals signed by an agent of the corporation must be accompanied by evidence of his or her authority to bind the corporation to the terms and conditions of this solicitation.

B. UOSA reserves the right to conduct discussions with qualified Offerors in any manner necessary to serve the best interest of UOSA.

3.2 Questions and Communications

A. All contact between Offerors and UOSA with respect to this solicitation will be formally held at scheduled meetings or in writing through the Purchasing Department. Questions concerning this solicitation are due by the deadline for questions shown on the cover page. Misinterpretation of specifications shall not relieve the Contractor(s) of responsibility to perform. Substantive questions must be submitted in writing via mail, express mail, e-mail, fax, etc., to the attention of the Purchasing Agent listed on the cover page, by the deadline also specified on the cover page. Questions submitted after the deadline will not be answered. All properly submitted substantive questions will be responded to in writing, in the form of an Addendum to the solicitation. Failure to submit questions or to otherwise seek clarification(s) by the deadline for submitting questions shall constitute a waiver of any potential claim by the Offeror/contractor.

B. Communications between prospective Offerors, their agents and/or representatives and any member of UOSA other than as authorized herein, concerning this solicitation are prohibited. In any event and in all circumstances, unauthorized communications cannot be relied upon.

3.3 Optional Pre-Proposal Conference

UOSA will conduct an Optional Pre-Proposal Conference to give all potential Offerors an opportunity to collect necessary data and to seek answers to any questions which they may have concerning this service. UOSA will issue an addendum resulting from any clarification noted at the Pre-Proposal Conference; no oral changes will be considered. Attendance at this Conference is **OPTIONAL**. Failure to attend the Pre-Proposal Conference will not prohibit Offerors from submitting Proposals. However, it is recommended that potential Offerors attend the Pre-Proposal Conference, as no claims for misunderstandings or lack of information pertaining to these requirements will be considered by UOSA.

The Conference schedule is shown on the cover sheet of this Request for Proposal (RFP). The meeting will be held virtually. While attendance at the Pre-Proposal Conference is not mandatory, information presented may be very informative; therefore, all interested Offerors are encouraged to attend to increase their chances of preparing acceptable Proposals.

3.4 Addenda to the RFP

UOSA reserves the right to amend this RFP at any time prior to the deadline for submitting proposals. If it becomes necessary to revise any part of this RFP, notice of the revision will be

given in the form of an Addendum that will be provided to all prospective Offerors who are on record with the Purchasing Agent as having received this RFP. Addenda will be distributed within a reasonable time to allow Offerors to consider them in preparing their proposals. If in the opinion of the Purchasing Agent, the deadline for receipt of proposals does not provide sufficient preparation time; the deadline shall be extended. Acknowledgment of the receipt of all Addenda is required from all Offerors receiving the RFP. Acknowledgement must be submitted by the final deadline for submission of proposals. Failure to acknowledge receipt of an Addendum may result in rejection of the proposal.

3.5 Duration of Proposals

Proposals shall be valid for a minimum of 90 days following the deadline for submitting offers. If an award is not made during that period, all offers shall be automatically extended for another 90 days. Offers will be automatically renewed until such time as either an award is made or proper notice is given to UOSA of Offeror's intent to withdraw its offer. Offers may only be canceled by submitting Notice at least 15 days before the expiration of the then current 90-day period.

3.6 Contractor Identification

All Offerors must include the following in their transmittal letter:

A. Individual Contractors must provide their social security numbers.

B. Proprietorships, partnerships, and corporations must provide their Federal Employer Identification Numbers.

3.7 Proposal Organization

A. Technical Proposal:

Offerors shall submit one original and five (5) sets of a written Technical Proposal plus one electronic copy. One original set with an original signature must be identified as "original" on the cover of the volume. In order to enhance this process and provide each firm with an equal opportunity for consideration, adherence to a standardized proposal format is required. Failure to adhere to the prescribed format may result in finding the proposal non-responsive. Proposals shall be limited to thirty (30) total pages, excluding required RFP documents, resumes and exhibits. The format of each proposal must contain the following elements organized into separate chapters and sections, as the Offeror may deem appropriate.

All proposal elements except price shall be included in the Technical Proposal and shall include at a minimum the following:

i. Solicitation Response Form
ii. Company history and qualifications: The Offeror will briefly describe its company history, sales history, and history of performing work as described herein.
iii. Written Narrative: Each Offeror must provide a written narrative that discusses the Offeror's experience and the experience of the proposed project team members in providing the services described in Section 2. Include any special qualifications, experience, awards, etc.
iv. Confirmation of Compliance with the Specification(s): The Offeror shall describe how the proposal meets UOSA's Specification. If any portion of the Specification cannot be met, the Offeror must identify the discrepancy in detail and describe an alternative solution.
v. Description of any proposed use of subcontractors.

vi. Client List/References (Attachment "A" – or separate sheet in identical format to Attachment "A")

vii. Technical Proposals shall be limited in length to 30 (thirty) single sided pages excluding required forms, resumes and exhibits.

B. Cost Proposal (this will be submitted at the discussion stage and is not required to be submitted with the Technical Proposals at the date/time due shown on the cover page of this solicitation)

At the discussion stage the Offerors with the highest ranked technical proposals may be requested to submit a written non-binding cost proposal. UOSA will provide detailed information regarding what will be required in the non-binding cost proposal at the time this information is requested.

3.8 Instructions for Submitting Proposals

A. The deadline for submitting Proposals is shown on the cover sheet. Offerors mailing proposals should allow sufficient mail delivery time to insure timely receipt by the Purchasing Department. Proposals will be opened in accordance with the provisions of the Virginia Public Procurement Act. There will be no public proposal opening. The list of prospective Offerors shall be available for public inspection only after Contract Award or upon cancellation of the solicitation.

B. The attached Solicitation Response Form must accompany the proposal. The purpose of this form is to formally submit the proposal and bind the Offeror to the terms, conditions and specifications contained in the solicitation. The Form must be signed by an individual who is authorized to bind the Offeror's firm to all items in the proposal including products, services, etc., and prices, contained in the proposal. *(*Notice – please be sure to complete fully the section of the Response Form which addresses SCC ID. This ID number is NOT your Federal ID or Tax ID number. Offerors will be disqualified if this section is not completed and either a valid number, valid Certificate of Authority, or letter of valid exception from Offeror's legal counsel is provided*)*

C. Submit one (1) original and five (5) hard copy sets and 1 electronic copy of your Technical Proposal. The set of originally signed documents must be uniquely identified on the cover of each volume. Costs are not to be included in the Technical Proposal.

All proposals must be submitted in a sealed package(s). The proposal should be submitted in sealed envelopes or packages, and identified as follows:

From: _____ _____

Name of Offeror Due Date

_____ _____

Street RFP No.

_____ _____

City, State, Zip Code RFP Title

3.9 Late Proposals

Proposals or unsolicited amendments to proposals arriving after the closing date and time will not be considered. Proposals received after the proposal submission deadline will be returned to the Offeror unopened providing that sufficient proposal identification information is shown on the outside of the proposal envelope.

3.10 Evaluation Process

A. Evaluation Committee: UOSA will establish an Evaluation Committee (the "Committee") to review and rank each proposal. The Committee will be composed of any individuals designated by UOSA. The Committee may request additional technical assistance from other sources.

B. Qualifying and Evaluating Proposals: Each proposal will first be reviewed for compliance with the requirements to transact business in the Commonwealth of Virginia. Any Offeror who does not comply with this requirement will be disqualified. Thereafter, each proposal will be reviewed for compliance with the remaining requirements of the RFP. The Offeror assumes responsibility for addressing all necessary technical and operational issues in order to meet the objectives of the RFP. Each proposal will be evaluated according to the criteria listed below:

   i. Past performance – 20%
   ii. Project team qualifications and experience – 25%
   iii. Company history, qualifications and capabilities – 20%
   iv. Responsiveness and completeness of the proposal – 10%
   v. Local presence in the metropolitan Washington, D.C. area. – 10%
   vi. Client List/References – 15%

UOSA reserves the right to reject any or all proposals received. Proposals must meet or exceed the mandatory requirements of the Specifications Section. If an Offeror does not meet a mandatory requirement, UOSA may classify the proposal as "not responsive." The Evaluation Committee may determine that an Offeror is "not responsible," i.e., does not have the capabilities in all respects to perform the Work required. The Committee may determine that a proposal meets the Specifications but does not raise itself to the competitive level of some or all of the other Offerors. In such instances, the Committee shall issue a determination that any and all such proposals are "not reasonably susceptible of being selected." Proposals deemed by the Committee to be not responsive, not responsible, or not reasonably susceptible of being selected will be excluded from further consideration and the Offeror so notified.

3.12 Award

UOSA shall engage in individual discussions with two or more offerors deemed fully qualified, responsible and suitable on the basis of initial responses and with emphasis on professional competence, to provide the required services. Repetitive informal interviews shall be permissible. The offerors shall be encouraged to elaborate on their qualifications and performance data or staff expertise pertinent to the proposed project, as well as alternative concepts. Ranking of Offerors shall be performed using evaluation criteria listed in Section 3.10.

As stated in Section 3.7, offerors are not required to furnish estimates of man-hours or cost for services. At the discussion stage, the public body may discuss nonbinding estimates of total project costs, including, but not limited to, life-cycle costing, and where appropriate, nonbinding estimates of price for services. Proprietary information from competing offerors shall not be disclosed to the public or to competitors.

At the conclusion of discussion, outlined in this subdivision, on the basis of evaluation factors published in Section 3.10 and all information developed in the selection process to this point,

UOSA shall select in the order of preference two or more offerors whose professional qualifications and proposed services are deemed most meritorious.

PLEASE NOTE: Offerors are not requested or required to list any exceptions to proposed contractual terms and conditions until AFTER the qualified offerors are ranked for negotiations.

Final negotiations with top ranked Offerors will begin with terms and conditions. The final Contract with a successful Offeror will contain the Terms and Conditions from this RFP. If the top ranked Offeror(s) intend(s) to take exception to any Terms and Conditions or proposal additional or alternative language they must:

(1) Identify clearly the Terms and Conditions to which they take exception and provide additional or alternate terms within three (3) days of being notified of being a top Ranked Offeror.
(2) Failure to identify clearly the terms and conditions for exception or alternate language may result in termination of negotiations.

If a contract satisfactory and advantageous to the public body can be negotiated with acceptable terms and conditions and rates considered fair and reasonable by UOSA, then an award shall be made to that Offeror. If a contract containing both terms and conditions acceptable to UOSA and rates considered fair and reasonable by UOSA cannot be negotiated, negotiations will be terminated and conducted with the next ranked Offeror, and so on.

Should UOSA determine in writing and in its sole discretion that only one offeror is fully qualified, or that one offeror is clearly more highly qualified and suitable than the others under consideration, a contract may be negotiated and awarded to that offeror.

3.13 Contract Award (Multiple Contracts)

UOSA reserves the right to award Contracts for Professional Engineering Services to one or more of the ranked Offerors. The UOSA Evaluation Committee may select one or more Contract awardees deemed to be the most advantageous to UOSA to perform the efforts anticipated. Subsequently, UOSA will select a Contract awardee most advantageous to UOSA to draft and perform task orders for engineering service projects under the Contract.

3.14 Term of Contract

The initial Contract will be for three (3) years, with options to extend annually thereafter for up to four (4) additional one-year periods. Renewal will be at the sole option and discretion of UOSA. Renewal will be at the rates, terms and conditions contained within the executed Contract Documents, or as agreed to between the parties prior to Contract renewal.

UOSA expects to award a contract before June 30, 2022.

3.15 Key Personnel

The Contractor shall assign to this contract, key personnel as listed in their proposal. During the period of performance, the Contractor shall make no substitutions of key personnel unless the substitution is necessitated by leave of absence, illness, death or termination of employment. The Contractor shall notify UOSA within five (5) calendar days after the occurrence of any of these events and provide the information required by the paragraph below.

The Contractor shall provide a detailed explanation of the circumstances necessitating the proposed substitutions, complete resumes for the proposed substitutes and any additional

information requested by UOSA. Proposed substitutes should have comparable qualifications to those of the personnel being replaced. UOSA will notify the Contractor within fifteen (15) calendar days after receipt of all required information whether or not UOSA has approved the Contractor's proposed key personnel substitutions. This clause will be modified to reflect any approved changes of personnel.

END SECTION 3

STANDARD TERMS AND CONDITIONS

[Non-Construction]

The following Terms and Conditions establish requirements and conditions governing responsibility, policy, and procedures und the Contract Documents that apply during the performance of the Contract and Warranty Period. Additional requirements and conditions appear in other Contract Documents. The Contract Documents may be modified only in writing, signed by the Owner.

ARTICLE I
DEFINITIONS

Whenever used in this solicitation or in the Contract Documents, the following terms have the following meanings, which are applicable to both the singular and plural and the male and female gender thereof:

1.0 **Acceptance:** UOSA's acceptance of any Phase or of the Project as a whole from the Contractor upon confirmation from the Contract Manager and the Contractor that the Phase or the Project as a whole is totally complete in accordance with the Contract requirements and that all defects have been eliminated. Final Acceptance is UOSA's written determination that the Work (excluding Warranties) is complete. Final Acceptance is confirmed by the making of Final Payment of the Contract Price for the affected Phase or for the Project as a whole including any Change Orders or other modification thereto. Contractor is responsible for all Work until Final Acceptance.

1.1 **Bidder:** The individual or business entity who or which submits a Bid or a Proposal to the RFP or IFB (see also, Offeror).

1.2 **Change Order:** A written modification to the Contract affecting Contract Price or Contract Time, or both, signed by both parties. A Unilateral Change Order is a Change Order issued by UOSA establishing a modification when the parties cannot agree on a Change Order, with the right reserved to the Contractor to initiate a claim if the parties are unable to agree on the disputed terms. Any modification to the Contract affecting Contract Price or Contract Time shall be made only by Change Order or Unilateral Change Order.

1.3 **Contract:**

A. "The Contract" is the written agreement of the parties, and shall be deemed to incorporate the Contract Documents covering the performance of the Work and the furnishing of services, labor, materials, Equipment, incidental services, tools, and equipment for the performance of the Work. It shall be deemed to include Supplemental Agreements amending or extending the scope of the Work contemplated and which may be required to achieve Acceptance and Final Acceptance or both. The Contract, as so defined, represents the entire and integrated agreement between the Owner and the Contractor, and supersedes all prior negotiations, representations, or agreements, both written and oral.

B. References to the "executed Contract" or the "signed Contract" refers to that portion of the Contract signed by parties. For Projects under $50,000 and where specifically noted therein, a Purchase Order may take the place of the executed Contract.

C. The Contract may be modified only in writing signed by the Owner. The Contractor recognizes that no representative or agent of Owner has any authority to modify the Contract Documents in any other manner, express or implied. The Contractor agrees that it shall not rely upon or in any way assert the occurrence of any modification of any Contract Document other than in writing signed by the Owner and waives any right or ground to do so.

1.4 **Contract Documents:** The Contract Documents consist of the Invitation for Bid ("IFB") OR the Request for Proposal ("RFP"), a signed copy of the Bid Form OR Proposal (including drawings and submittals and excluding any terms and conditions contrary or in addition to those in the RFP unless specifically agreed to in writing as a Supplemental Condition), the signed Contract, the Payment Bond (if any), the Performance Bond (if any), the Terms and Conditions, the Supplemental Conditions, and shall include all modifications of any of the foregoing incorporated by Addenda into the Contract Documents prior to execution of the Contract, and all Supplemental Agreements or Changes to the Contract Documents made subsequent to execution of the Contract.

1.5 **Contract Manager**: The UOSA employee designated for purposes of oversight of the Contract and the Work. The Contract Manager is the Owner's authorized representative for all aspects of the Contract after Contract Award. UOSA may also designate a Technical Representative for routine coordination with the Contractor. The Contract Manager and the Technical Representative, if any, should be identified in the executed Contract. However, any change to the Contract affecting the Contract Price or the Contract Time is not effective and has no force and effect unless and until signed by the UOSA Executive Director or, in the absence of the Executive Director, UOSA Deputy Executive Director, or designee.

1.6 **Contract Price:** The total compensation to be paid the Contractor for performance of all requirements of the Contract Documents. Any provision of the Contract Documents which imposes any responsibility or performance obligation upon the Contractor shall be deemed to include the phrase "within the Contract Price." Any claim or request by the Contractor for additional compensation for any reason shall be deemed to be a claim for modification of the Contract Price and must be submitted in strict accordance with the Disputes clause.

1.7 **Contract Time:** The time within which the Contractor is required to achieve Acceptance, and thereafter to achieve Final Acceptance, of the Work. The Contract Time is of the essence of the Contract.

1.8 **Contractor:** The person or persons, partnership, firm, join venture, or corporation submitting a Bid or Proposal for the Work contemplated.

1.9 **Notice:** The term "Notice" or the requirement to notify, as used in the Contract Documents or applicable state or federal statutes, shall mean a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to the party who gives the Notice. Notice to the Owner shall be given at the office of the Owner's Contract Manager. Notice is effective upon receipt. Communications by email shall not satisfy any Notice requirements of the Contract Documents except as may be provided specifically.

1.10 **Notice to Proceed:** A written Notice given by the Owner to the Contractor establishing the date on which the Contract Time will commence and on which the Contractor shall be authorized to begin the Work. The execution of a Task Order or the issuance of a Purchase Order shall operate as a Notice to Proceed for the Work included in that document.

1.11 **Offeror:** The individual or business entity who or which submits a Bid or a Proposal to the RFP or IFB. (see also, Bidder)

1.12 **Owner:**

A. Owner means the Upper Occoquan Sewage Authority, also known as Upper Occoquan Service Authority, and referred to by the acronym "UOSA", whose address is 14631 Compton Road, Centreville, Virginia, 20121-2506 (telephone number 703-830-2200). The Executive Director of the Upper Occoquan Sewage Authority shall have the authority to act on behalf of the Upper Occoquan Sewage Authority for all purposes under this Contract, and in the absence or incapacity of the Executive Director, the Deputy Executive Director shall have all powers and authority of the Executive Director. The Executive Director may designate a Contract Manager for purposes of over-sight of the Contract and the Work.

B. UOSA is a public body politic and corporate organized under the Virginia Water and Waste Authorities Act and subject to the Occoquan Policy. UOSA was created by the concurrent actions of the governing bodies of Fairfax County, Prince William County, the Town of Manassas (now the City of Manassas), and the Town of Manassas Park (now the City of Manassas Park) and was chartered by the State Corporation Commission of Virginia on April 1, 1971. UOSA was formed to acquire, finance, construct, operate and maintain facilities for the abatement of pollution resulting from sewage in its service areas in order to protect water quality in the Occoquan Watershed.

C. UOSA currently owns and operates an advanced water reclamation plant and a regional system of interceptor sewer lines, pump stations and force mains that deliver sewage from the four member jurisdictions to the treatment plant.

1.13 **Partial Utilization:** The terms "or a defined portion thereof," "Partial Utilization," "Owner's Partial Utilization," "defined portion of the Work," "Owner's use of portions of the Work," or words of similar import when used in the Contract Documents shall be deemed to mean such portion of the Work as may be designated by the Owner in its sole discretion as having achieved that degree of completion which will permit the Owner to take over and commence the use and operation thereof prior to Acceptance of all Work. Such determination as to a defined portion of the Work so as to permit Owner's Partial Utilization shall not affect the determination of either Acceptance or Final Acceptance of the Work as a whole, which is understood to be indivisible, nor shall such determination have any impact on the obligation of the Owner to assess and deduct Liquidated Damages for failure to achieve Acceptance of the Work.

1.14 **Project:** The term "Project" shall be synonymous with the term "the Work."

1.15 **Proposal:** The response by an Offeror to the RFP.

1.16 **SubContractor:** Any party, entity, or enterprise of any sort other than the Contract providing labor or services to the Project pursuant to any agreement or arrangement with the Contractor.

1.17 **Supplemental Agreements:** Written agreements covering alterations, amendments, or extensions to the Contract and include Change Orders and Unilateral Change Orders.

1.18 **UOSA:** Upper Occoquan Service Authority, interchangeable with "Owner."

1.19 **Work**: The word "Work" within the Contract Documents shall include all services, material, labor, equipment and tools, Equipment, appliances, machinery, transportation, appurtenances, bonds, insurance, and all related costs necessary to perform and complete the Contract, and any such additional items and costs not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated or as required by industry practice, custom or usage to provide a complete and satisfactory deliverable system, structure or product in strict compliance with all requirements of the Contract Documents. Work means the same as "Project".

ARTICLE II
THE CONTRACTOR REPRESENTATIONS AND OBLIGATIONS

2.0 **Arrearage:** By submitting a Bid or Proposal in response to this IFB or RFP, the Offeror shall be deemed to represent that it is not in arrears in the payment of any obligation due and owing UOSA, the Commonwealth of Virginia, or any public body within Virginia. Said representation shall include the payment of taxes and employee benefits. Offeror further agrees that it shall make diligent effort to avoid becoming in arrears during the term of the Contract.

2.1 **Collusion:** By submitting a bid or a proposal, Offeror represents that such bid or proposal is submitted without prior understanding, agreement, or connection with any corporation, partnership, firm, or person submitting a proposal for the same requirements, without improper collusion or fraud. Collusive bidding is a violation of State and Federal law and can result in fines, prison sentences, and civil damage awards. All Bidders are required to sign the included UOSA Solicitation Response Form that is included at the beginning of the Solicitation document. (Response form must be filled out in its entirety.)

2.2 Compliance with Laws: The Offeror/Contractor hereby represents and warrants that:
It is qualified to do business in the Commonwealth of Virginia and that it will take such action as, from time to time hereafter, may be necessary to remain so qualified;
It shall comply with all federal, State and local laws, regulations, and ordinances applicable to its activities and obligations under the Contract including, but not limited to the Virginia Procurement Act;
It shall obtain at its expense, all regulatory and professional licenses, business licenses, permits, insurance, and governmental approvals, if any, necessary to the performance of its obligations under the Contract; and
The Offeror *shall include in its bid or Proposal the identification number issued to it by the Virginia State Corporation Commission. Any bidder that is not required to be authorized to transact business in the Commonwealth of Virginia as a foreign business entity under Title 13.1 or Title 50 of the Virginia Code or as otherwise required by law shall include in its bid a statement describing why the bidder is not required to be so authorized. Any Offeror that fails to provide this required information shall not be entitled to a Contract Award.*

2.3 Contractor's Responsibilities: The Contractor shall be responsible for all Work required by this solicitation. The use of SubContractors is prohibited, without prior written consent from UOSA. Any consent to use SubContractors, shall not relieve the Contractor of liability under the Contract.

2.4 Debarment Status: By submitting a Bid or a Proposal, Offeror certifies that it is not currently debarred by the Commonwealth of Virginia (or any other Virginia public body) from submitting Offers or proposals on Contracts for the type of goods and/or services covered by this solicitation, nor is it an agent of any person or entity that is currently so debarred.

2.5 Drug-free Workplace: During the performance of this Contract, the Contractor agrees to (i) provide a drug-free workplace for the Contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every SubContract or purchase order of over $10,000, so that the provisions will be binding upon each SubContractor or vendor.

2.6 Duration of Bids/Proposals: Bids/Proposals shall be valid for a minimum of 90 days following the deadline for submitting bids. If an award is not made during that period, all offers shall be automatically extended for another 90 days. Bids/Proposals will be automatically renewed until such time as either an award is made or proper notice is given to UOSA of Bidder's/Offeror's intent to withdraw its bid/proposal. Bids/Proposals may only be canceled by submitting written notice at least 15 days before the expiration of the then current 90-day period.

2.7 Employment Discrimination:

A. By submitting their bids or proposals, Offerors certify to UOSA that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, and where applicable, the Virginians With Disabilities Act, the Americans With Disabilities Act and § 2.2-4310 of the Virginia Public Procurement Act.

B. During the performance of this Contract, the Contractor agrees as follows:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

2. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

3. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

4. The Contractor will include the provisions of the foregoing paragraphs 1, 2 and 3 in every SubContract or purchase order over $10,000.00, so that the provision will be binding upon each SubContractor or vendor.

2.8 Employment of Aliens: It shall be the responsibility of the Contractor to comply and to require compliance by others on the Project with all federal, state and local laws dealing with employment of aliens, including, but not limited to, the requirements and prohibitions provided in the Immigration and Nationality Act (INA) of 1952, as amended, and the Immigration Reform and Control Act (IRCA) of 1986, as amended, which control employment of unauthorized aliens. By entering into a Contract with UOSA, Contractor represents that it does not, and shall not during the performance of the Contract, knowingly employ an unauthorized alien.

2.9 Ethics in Public Contracting: Contractor hereby certifies that it has familiarized itself with the following provisions of the Virginia Code, and that all amounts received by it pursuant to any Contract or Task Order Awarded to it are proper and in compliance therewith: Section 2.2-3100 et. seq., the State and Local Government Conflict of Interests Act; Section 2.2-4367 et seq., Ethics in Public Contracting; Section 18.2-498.1 et seq., Virginia Governmental Frauds Act; and Articles 2 (Section 18.2-438 et seq.) and 3 (Section 18.2-446 et seq.) of Chapter 10 of Title 18.2.

2.10 Examination of Records: The Offeror agrees that in any resulting Contract, either UOSA or its duly authorized representative shall have access to and the right to examine and copy any directly pertinent books, documents, papers, and records of the Contractor involving transactions related to any resulting Contract. This obligation shall expire five years after the final payment for the final service performed as a result of any and all Contract(s), Task Order(s) or Purchase Orders awarded pursuant to this solicitation, or until audited by UOSA, whichever is sooner. Contractor will provide reasonable access to any and all necessary documents and upon demand provide copies of documents if so required by UOSA or its representative(s). UOSA will reimburse the Contractor for any reasonable expenses it incurs as a result of such a request.

2.11 Independent Contractor: The Contractor shall perform or cause to be performed all Work under the Contract as an independent Contractor and shall not be considered either an agent or employee of the Owner or of the Engineer.

2.12 Permits and Inspections (where applicable):

A. The Contractor shall obtain and provide any and all required permits from the appropriate local authority.

B. The Contractor shall be responsible for scheduling all inspections and performing all work necessary for testing and inspections as required by any and all authorities having jurisdiction during the course of Work.

2.13 Safety Program and Contractor's Compliance (where applicable): If applicable to this Contract:

A. The Contractor shall comply with all applicable Federal, State, and local safety programs, regulations, standards, and codes, to include though not limited to:

1. The Virginia Uniform Statewide Building Code;
2. Building Officials & Code Administrators (BOCA) codes (together with adopted International Codes);
3. Virginia Department of Health (VDH) regulations;
4. Virginia Department of Environmental Quality (DEQ) regulations;
5. Virginia-OSH (VOSH) regulations, and
6. National Electric Code (NEC).

B. The Contractor shall have a current written safety program, that complies with all applicable OSHA and VOSH standards for General Industry regulations, and if required, a written Permit Required Confined Space Entry Program that complies with VOSH Standard Confined Space Entry Standard 1910.146. A copy of these programs shall be provided to the Purchasing Manager with the Contractor's general safety program not later than seven days after Contract award and before beginning Work.

C. If the Work requires working in a confined space, the Contractor shall utilize only personnel trained for confined space entry and shall provide all entry equipment including atmospheric test equipment.

D. Contractor's employees shall wear hard hats and steel toe shoes while working in all applicable areas.

2.14 Superintendence by Contractor (where applicable):

A. The Contractor shall have a competent Superintendent, satisfactory to UOSA, to oversee the progress of the Work. The Contractor shall be responsible for coordinating all portions of the Work except where otherwise specified in the Contract Documents, and for all safety and worker health programs and practices. The Contractor shall notify the Contract Manager, in writing, of any proposed change in Superintendent including the reason therefore prior to making such change.

B. The Contractor shall at all times enforce strict discipline and good order among the workers on the project. The Contractor shall not employ on the Project any unfit person, anyone not skilled in the work assigned to him, or anyone who will not work in harmony with those employed by the Contractor, subContractors, UOSA or UOSA's separate Contractors and their subContractors.

C. UOSA may, in writing, require the Contractor to remove from UOSA property, any employee UOSA deems to be incompetent, careless, not working in harmony with others on the site, or otherwise objectionable.

2.15 UOSA Drug and Alcohol Policy: The Contractor shall be subject to follow this UOSA Policy at all times while on UOSA premises.

A. Drugs or Alcohol and the Job:

The nature of the Work of UOSA requires that the highest standards of safety be maintained for the public, employees and Contractors working at UOSA. The use of drugs, i.e., controlled substances or alcohol while on the job or working while under their influence poses a threat to that health and safety.

B. Guidelines for Drugs and Alcohol:

All employees and Contractors are required to work with faculties unimpaired. Therefore, the use or possession of drugs or alcohol while on UOSA premises is strictly prohibited. Working or reporting to work in a condition that would prevent the employee or Contractor from performing his duties in a safe or effective manner for any reason also is prohibited. Any illegal substances will be turned over to the appropriate law enforcement agency and may result in criminal prosecution.

Employees or Contractors undergoing prescribed medical treatment with a controlled substance are required to advise their supervisor, Contract administrator and/or the UOSA safety officer of such treatment. Prescribed use of controlled substances as a part of a medical treatment is not necessarily grounds for disciplinary action. However, where such use adversely affects an employee or Contractor's ability to perform his or her job safely and effectively, alternative work assignment or other appropriate action will be employed.

C. Detection of Drugs or Alcohol:

As a part of its program to prevent the use of controlled substances and alcohol that affect the workplace and in the event of an accident or any incident where safety rules have been or appear to have been violated, employees or Contractors involved or responsible may be required to undergo a urine test or other method for the purpose of detecting the use or presence of controlled substances or alcohol. In addition, where a supervisor, Contract administrator or safety officer has reason to believe that an employee or Contractor may be drug or alcohol impaired, he or she may require the employee or Contractor to submit to such testing. The cost of any such testing required for a Contractor will be charged to that Contractor or deducted from payments to the Contractor. An employee's or Contractor's refusal to submit to a urine or other test or to cooperate with UOSA's effort to eliminate drugs or alcohol in the workplace may be grounds for disciplinary action, including termination of employment or Contract.

2.16 UOSA Smoking Policy: The Contractor shall be subject to follow this UOSA Policy at all times while on UOSA premises.

Purpose:
The purpose of the UOSA smoking policy is to maintain UOSA as a safe and smoke-free environment for everyone.

Policy:
Because of the numerous potentially flammable solids, liquids, and gases encountered in UOSA operations. With limited exceptions smoking must be prohibited in the UOSA workplace.

Smoking is prohibited inside the security fence of the Plant and all Pump Stations except in the following Plant locations:

patio area on the east side of the Laboratory Building;
patio area north of Building H/1;
the immediate area at the south entrance to Building S/2;
the east side of X/1;
the north side of D/2; and
the east balcony off the 2nd floor of Building U.
Employees may smoke in the patio area on the east side of Building F.
The public will be allowed to smoke on the west side of Building F.

The users must keep all smoking areas clean. Failure to do so may result in the loss of the smoking privileges. Trash receptacles and cigarette disposal receptacles will be provided at each approved location. The responsibility of emptying the receptacles rests with the users.

Other Non-UOSA Sites:
Contractor shall obey all nonsmoking rules and regulations when performing work for UOSA on non-UOSA premises. It is the responsibility of the Contractor to identify these prohibited areas and inform its employees that smoking is not allowed in specified restricted areas.

2.17 Vehicle Operation Compliance: Vehicles being driven on UOSA property must comply with the posted speed limit, stop and yield signs. Operators found in non-compliance will be asked to leave UOSA property. The Contractor may be required to replace the offenders with new personnel if deemed to be in the best interest of the Authority by UOSA's Safety Officer.

ARTICLE III
CONTRACT TERMS

3.0 Contract Changes / Change Orders: No verbal agreement or conversation with any officer, agent or employee of UOSA either before or after the execution of any Contract resulting from this solicitation or follow-on negotiations, shall affect or modify any of the terms, conditions, specifications, or obligations contained in the solicitation, or resulting Contract. No alterations to the Terms and Conditions or any other change affecting Contract Price or Contract Time, or both, shall be valid or binding upon UOSA unless made in writing in the form of a Change Order and signed by UOSA's Executive Director or Deputy Executive Director, or designee.

In any event and in all circumstances, the Contractor shall be solely liable and responsible for, and UOSA shall be under no obligation to pay for, any Contract changes or deviations made without first receiving a Written Change Order to deviate from the Contract. Changes can be made to the Contract in any of the following ways:

1. By mutual agreement between the parties in a written Change Order.
2. By UOSA issuing a Unilateral Change Order ordering the Contractor to proceed with the work. Any claim for an adjustment in Contract Price under this provision must be asserted by Notice to the UOSA Contract Manager. Neither the existence of a claim nor a dispute resolution process, litigation or any other provision of this Contract shall excuse the Contractor from promptly complying with the changes ordered by the Unilateral Change Order or with the performance of the Contract generally.

3.1 Contract Documents Precedence: The Contract to be entered into as a result of this solicitation shall be by and between the Offeror as Contractor and UOSA. The Contract Documents shall include the following items, which are listed in order of precedence:

1. Supplemental Agreements, with the most recent having precedence,
2. Fully executed Task Orders, (if applicable)
3. The fully executed Contract
4. The Terms and Conditions
5. The RFP or IFB and any Addenda to the IFB or RFP,
6. The Offeror's Bid or Proposal (including any drawings and submittals), and excluding terms and conditions that are not expressly agreed to in writing by UOSA in a Supplemental Agreement.

Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called for by all, except that a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect.

The intent of the Contract Documents is to describe a functionally complete Project to be performed in accordance with the Contract Documents. Any services, material, labor, equipment, tools, Equipment, appliances, machinery, transportation, appurtenances, bonds, insurance, and all related costs that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be deemed to be part of the Work whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe any portion of the Work, such words shall be interpreted in accordance with that meaning. The words "will" or "shall" are used interchangeably and denote mandatory, non-discretionary conduct or intent.

By submitting an Offer or Bid in response to this solicitation, the Offeror agrees to all Terms and Conditions and to the Specifications contained in the RFP or IFB, unless and except as otherwise noted as an exception in the Offeror's Bid or Proposal. Any terms and conditions that the Offeror proposes to use must be submitted as part of the Bid or Proposal (unless otherwise specifically noted in this solicitation or otherwise required in accordance with Virginia law) but shall not be deemed accepted terms agreed to by the Owner unless and until those terms are incorporated expressly into the Contract by Supplemental Agreement or by Change Order signed by both parties. Terms and conditions submitted by an Offeror after the required submission date will not be considered for incorporation into the terms of the awarded Contract.

Terms and conditions submitted by an Offeror after the required submission date will not be considered for incorporation into the terms of the awarded Contract.

All time limits stated in the Contract Documents, including but not limited to the time for completion of the Work, are of the essence.

3.2 Default: The Contractor may be deemed by the Owner to be in default of the Contract if the Contractor:

1. abandons the Work or a defined portion thereof; or
2. persistently or repeatedly fails or refuses to perform the Work or a defined portion thereof; or
3. persistently or repeatedly fails to make prompt payment to SubContractors for material or labor; or
4. persistently or repeatedly disregards laws, ordinances, or regulations; or
5. fails to prosecute the Work either in a timely manner or in conformance with the Contract Documents; or
6. neglects or refuses to remove and replace at its own cost Work rejected by the ; or
7. is otherwise in breach of the Contract.

3.3 Delays:

A. The Contractor shall not be responsible for delays caused by UOSA, its agents, or other Contractors under Contract with UOSA. To the extent that the Contractor is unable to proceed with timely performance due solely to the actions or inactions of UOSA, its agents, employees or such other Contractors, the Contractor shall be granted an extension to the performance schedule equal to the documented amount of time the Contractor was prevented from performing work, so long as the Contractor submits a Notice of Claim to UOSA at the time the delay begins or within seven (7) days thereafter if the resulting delay was not reasonably foreseeable. This Notice is condition precedent to the assertion of any claim for additional time or compensation.

B. Any claim for an extension of time for a delay for any cause, shall be made by filing a Notice of claim with the Owner at the time the delay begins or within seven (7) days thereafter if the resulting delay was not reasonably foreseeable. The Notice of claim for any delay shall be submitted in duplicate, in writing, and shall state the circumstances of the occurrence, the justification for the delay and for the extension of time, and provide the estimated duration of the delay and of the time extension requested.

C. Within seven (7) days after the delay has ceased, the Contractor shall give written Notice to the Owner of the actual date of the cessation of the delay and the anticipated time extension. Within twenty (20) days after the delay has ceased, the Contractor shall submit a written statement of the actual time extension requested as a result of the claimed delay which shall include all documentation and supporting information for such claimed delay required by the Contract Documents.

D. The Contractor shall be entitled to an extension of time for delay caused by any act or any neglect of the Owner, the Engineer or by any separate Contractor employed by the Owner; or by strikes, lockouts, fire, insurrection, war, acts of public authorities, lightning, hurricane, tornado, flood, abnormal and unusually severe weather as defined above, or for any delays arising as a result of the occurrence of any physical conditions, subsurface conditions or soil conditions which may be encountered in the prosecution of the Work and which, in the exercise of reasonable care and due diligence in the investigation and analysis of all information available, should not have been foreseeable, anticipated, or indicated; or by any other cause which in the opinion of the Owner is entirely beyond the expectation and control of and arises without the fault or negligence of the Contractor. Entitlement to such extension of time shall, however, be subject to all limitations on claims for delay set forth in the Contract, and shall be conditioned upon strict compliance with all Notice and submission requirements imposed by therein. The Contractor shall be entitled to an extension of time for such causes only for the number of days of delay which the Owner may determine to be due solely to such causes and then only to the extent that such occurrences actually delay the Acceptance of the Project or defined portions thereof. ***If the delay is not due solely to such causes but also is due concurrently to causes for which the Contractor is not entitled to an extension of time, the Contractor shall not be entitled to an extension of time for such period of concurrent delay.*** Any request for extension of time shall, to the extent that such information has not been included in any previously submitted Time Impact Analysis, as may be required by the Specifications, be accompanied by detailed documentation of what specific schedule activities were affected, when they were affected and for what duration, as well as what actions the Contractor took to eliminate or mitigate the extent of the delay. Provided, however, compliance with this requirement shall not be in lieu of, nor result in any extension of, the submittal requirements for a Time Impact Analysis as required by Specifications.

3.4 Disputes:

A. In any case where the Contractor deems it is due additional compensation beyond the Contract Price, the Contractor shall give written Notice of such claim to the Owner at the time of the discovery of the occurrence of the event giving rise to the claim and before beginning any Work on which the claim is based. Such Notice shall identify itself as a Notice of claim, shall state the circumstances of the occurrence, shall specify the additional work contemplated as being required, shall state why such work is not already included within the scope of the Contract Documents, and to the extent reasonably foreseeable shall estimate the anticipated amount of the claim. If the Owner declines to consent to a Change Order and directs the Contractor to proceed with such Work, then the Contractor shall so proceed and within ten (10) days after completion of the Work for which additional compensation is claimed shall submit in writing to the Owner an itemization of the actual additional compensation claimed. Strict compliance with these provisions shall be a condition precedent to the assertion of any claim, and any claim for additional compensation not presented as required in this provision shall be barred. Compliance with such requirements, however, shall not create any presumption of the validity of such claim.

B. The Owner will make the final decision on all requests for additional compensation or an extension of Contract Time. Within ninety (90) days after the Contractor files its itemization of the actual amount of additional compensation claimed, the Owner shall present the Owner’s final written decision to the Contractor as to whether any additional compensation should be paid. A written decision by the Owner within the stated time shall be a condition precedent to the institution of any judicial claim for relief by the Contractor. The Owner's written decision shall be final and conclusive unless the Contractor institutes appropriate judicial appeal within six (6) months of the date of the decision by the Owner. In the event the Owner has not rendered a decision on a claim for additional compensation or extension of Contract Time within the specified time frame after submission of such claim as provided herein, the claim shall be deemed denied and the Owner’s final decision shall be deemed to have been issued on the last day of the specified time frame after submission of the claim. In the interest of compromise, the Owner may, but is not required to, consider further submissions by the Contractor related to a claim after a final decision on a claim, but no such actions by the Owner shall in any way affect or extend the effective date of the Owner’s final decision on the claim.

C. If the Owner agrees to pay additional compensation in response to such claim, payment shall be made in accordance with or pursuant to such Supplemental Agreement as may be reached between the Owner and the Contractor.

D. The Contractor shall comply with all directions and decisions of the Owner or Owner’s agent (if applicable) and shall proceed diligently with performance of the Contract and with any disputed work pending final resolution of any claim or dispute, whether for additional compensation or extension of time. "Final resolution" as used throughout the Contract Documents shall mean the conclusion or exhaustion of all judicial proceedings.

E. If the Contractor at any time determines the Owner to be in material breach of the Contract, the Contractor shall provide Notice of claim thereof to the Owner within seven (7) days of the occurrence the Contractor deems to constitute such material breach. Such Notice shall specify the precise occurrence(s) of such material breach. The Contractor’s continuing performance under the Contract, after giving such Notice of claim, including but not limited to receiving moneys thereunder, shall constitute an election to waive such material breach and to confirm the continued existence of the Contract.

F. No payment or partial payment on any claim shall be made prior to final resolution of such claim.

G. All matters of dispute must be resolved either to the mutual satisfaction of the Owner and the Contractor or by final resolution as a condition precedent to the Owner's obligation to make final payment for the Work to the Contractor.

H. The Contractor shall make no claim against any officer, agent, or employee of the Owner for, or on account of, any act or omission to act in connection with the Contract, and hereby waives any and all rights to make any such claim or claims.

I. If additional compensation and/or extension of time is granted as to any claim, the same shall be incorporated in a Change Order to the Contract. The Contractor shall not be entitled to recover interest on any amounts claimed to be due from the

Owner which are the subject of a good faith dispute by the Owner which are paid by the Owner within thirty (30) days following the final resolution of such dispute.

J. The terms "claim" and "dispute" are used interchangeably in the Contract Documents and either shall mean any request by the Contractor for compensation in excess of that to which the Owner agrees, for a time extension in excess of that to which the Owner agrees, or for any other relief beyond that to which the Owner agrees.

K. For any judicial proceedings arising from or related to the Contract Documents, the Contractor and the Owner hereby consent to exclusive venue and jurisdiction in the Circuit Court of Fairfax County, Virginia, or the United States District Court for the Eastern District of Virginia (Alexandria Division).

L. Failure of the Owner to require compliance with any term or condition of this Contract shall not be deemed a waiver of such term or condition, or a waiver of the subsequent enforcement thereof, including but not limited to the Owner's claim for a subsequent material breach of Contract.

M. Failure by the Contractor to comply with any condition precedent to a claim provided by the Contract Documents shall be an absolute bar to such claim.

3.5 Examination and Verification of Contract Documents: By executing the Contract, the Contractor confirms that it has thoroughly examined and become familiar with all of the Contract Documents; that it has determined the nature and location of the Work; the general and local conditions; the availability and competence of labor; the availability of equipment, materials, supplies, and Equipment, and all other matters which can in any way affect the Work under the Contract. Failure to have made any examination necessary for these determinations shall not release the Contractor from any of the obligations of the Contract nor be grounds for any claim based upon unforeseen conditions. No verbal agreement or conversation with any officer, agent, or employee of the Owner, either before or after the execution of the Contract, shall affect or modify any of the terms or obligations of the Contract Documents.

3.6 Indemnity:

A. To the maximum extent permitted by law, the Contractor shall indemnify, save harmless and defend UOSA, or any employee of UOSA, against liability for any suits, actions, or claims of any character whatsoever, whether in tort, Contract or other remedy, arising from or relating to the performance of the Contractor or its SubContractors under this Contract. This indemnification obligation shall include but not be limited to attorneys' fees and other costs or fees commonly associated with litigation.

B. UOSA does not agree to indemnify the Contractor for any reason, or to "hold harmless" the Contractor or others for any matters relating to this Contract or for performance or non-performance of work hereunder.

C. The Contractor shall be responsible for its Work and every part thereof, and for all materials, equipment, and property of any and all description used in connection therewith. The Contractor assumes all risks of direct and indirect damage or injury to any person or property wherever located, resulting from any action, omission, commission, or operation under the Contract, or in connection in any way whatsoever with the Contracted work.

D. The Contractor shall immediately notify the Contract Manager of any claim or suit made or filed against the Contractor or its SubContractors regarding any matter resulting from or related to the Contractor's obligations under the Contract, and shall keep UOSA reasonably informed of the status of such claim. The Contractor will cooperate, assist, and consult with UOSA in the defense or investigation of any suit or action made or filed against UOSA as a result of or relating to the Contractor's performance under this Contract.

3.7 Insurance: The Contractor shall, during the continuance of all work under the Contract provide and agree to maintain the following:

A. General Insurance Requirements: Before commencing work, the Contractor shall procure and maintain at its own expense, minimum insurance in forms and with insurance companies acceptable to UOSA to cover loss or liability arising out of the Work. All insurance policies must be from insurers authorized to conduct business within Commonwealth of Virginia and must have a Best's rating of at least A- and a financial size of class VIII or better in the latest edition of Best's Insurance Reports.

B. Workers' Compensation and Employers' Liability Insurance: The Contractor shall obtain Statutory Workers' Compensation Insurance covering injury to employees of the Contractor while performing work within the scope of their employment and Employers' Liability Insurance with limits of at least $100,000/$500,000/$100,000.

C. Required Commercial General Liability Insurance: This insurance must be written on an "occurrence" basis and shall be endorsed to include UOSA as an additional insured and shall provide at a minimum the following:

General Aggregate Limit	$1,000,000
(Other than Products-Completed Operations)	
Products-Completed Operations Aggregate Limit	$ 500,000
Personal & Advertising Injury Limit	$ 500,000
Each Occurrence Limit	$ 500,000

D. Business Automobile Liability Insurance: This insurance shall apply to any auto, including all owned, hired and non-owned vehicles, covering Bodily Injury and Property Damage with a combined single limit of at least $500,000 each accident.

E. Professional Liability Insurance, Errors & Omissions: This insurance shall be written on a "claims made" basis, and shall be provided to UOSA during the course of the Project and continuing for at least three (3) years after completion of construction. Minimum coverage amount $1,000,000.

F. Certificates of Insurance: The Contractor shall provide UOSA with a certificate of insurance evidencing the required coverage before commencing with the work. Insurance certificates shall provide that UOSA be notified at least 30 days prior to any change or cancellation of the said insurance policies.

3.8 Latent Defects: No failure on the part of either the Owner to discover and either to condemn or reject Work which does not comply with the intent and requirements of the Contract Documents shall be construed to imply acceptance thereof. The Owner reserves and retains all of its rights and remedies at law or in equity against the Contractor for correction of any and all defective or nonconforming Work whenever discovered, whether before, during or after the Warranty Period.

No tests or inspections conducted by the Owner or others shall relieve the Contractor of its obligations to execute the Work in strict compliance with the requirements of the Contract Documents and to correct defective or nonconforming Work not initially identified by the Owner or others at the time of tests or inspections but discovered subsequently.

3.9 Liquidated Damages: Should the Contractor fail to achieve Acceptance or Final Acceptance of the Work within the periods of time required by the Contract Documents, the Contractor shall reimburse the Owner for the additional expense and damage incurred by the Owner as a result thereof for each calendar day that the Work, or any defined portion thereof, remains uncompleted. The parties hereby agree that the damages to the Owner for the continued expense of completion of the Work and on account of the value of the operation of the facilities which are dependent upon such completion are anticipated to be substantial but are not readily ascertainable. It therefore is agreed that the amount of such additional expense and damage incurred by the Owner by reason of a failure to complete the Work within the required times shall be the per diem rates stipulated in the Contract Documents. It is expressly understood and agreed that these amounts are not to be considered in the nature of a penalty, but as Liquidated Damages. The Contractor hereby waives any defense as to the validity of any Liquidated Damages under the Contract as they may appear on the grounds that such Liquidated Damages are void as penalties or are not reasonably related to actual damage. The Owner shall deduct from funds otherwise due the Contractor Liquidated Damages which have been assessed. In the event more than one ground for assessment of Liquidated Damages as provided by the Contract Documents exists concurrently, such grounds shall be deemed to be independent and all applicable Liquidated Damages shall be deducted cumulatively.

3.10 Ownership of the Work: Upon Final Acceptance, UOSA shall own all the Work, including, but not limited to, all technologies, materials, software and processes provided under this Contract, except as specifically agreed to by the parties in a Supplemental Agreement prior to the performance of that portion of the Work that the Contractor does not intend to turn over ownership to UOSA. The presumption is that all Work will become UOSA's property with UOSA's ability to exercise control and access to all portions of the Work.

The Contractor, shall indemnify and hold harmless UOSA, its employees and officers from liability of any nature or kind, including cost and expenses for or on account of any copyrighted, patented, or un-patented invention, process or article provided by the Contractor. If the Contractor uses any design, device, or materials covered by letters, patent, copyright, or licenses, all royalties and/or costs arising from the use of such design, device or materials in any way involved in the work are included in the Contract Price.

3.11 Right to Accept Defective or Nonconforming Performance: If any part or portion of the Work shall prove defective or nonconforming or otherwise not in accordance with the intent and requirements of the Contract Documents, the Owner, at its sole discretion, shall have the right and authority to accept such Work and make such deductions in the payment therefore as may be just and reasonable. The Owner shall be under no obligation to accept any defective or nonconforming Work.

3.12 Site Safety and Access:

A. UOSA shall have the right to deny access to the Site, or require the Contractor to remove from the Site, any individual who has exhibited violent, abusive, threatening, negligent, careless, or dangerous behavior or conduct.

B. UOSA may limit, restrict, or prohibit access to areas of the Site on a permanent or temporary basis. When access to such restricted areas is required by the Contractor to perform the Work, the Contractor shall obtain permission from the UOSA Contract Manager and shall comply with such conditions or limitations to access as may be imposed by the UOSA Contract Manager.

C. UOSA may restrict parking or require parking permits for vehicles to be brought onto the plant. The Contractor shall be responsible for arranging transportation for its personnel to reach the job sites from whatever parking area is provided by UOSA.

3.13 Termination:

<u>For Convenience:</u>

The Owner may terminate performance of the Work under the Contract for its convenience in whole, or from time to time in part, whenever the Owner determines that such termination is in the best interest of the Owner.

Upon receipt of such Notice of Termination, the Contractor shall immediately, to the extent of the termination:
stop Work;
place no further subContracts or orders for materials or services;

transfer title and deliver to the Owner all materials and Equipment for which the Owner has made payment or will make payment pursuant to this Article, and turn over to the Owner all complete or partial Drawings, releases, information, manuals and other such documentation related to such materials and Equipment;
assign to Owner all SubContracts as designated by Owner to be assigned and terminate all other subContracts; and
commence demobilization and removal of operations from the Site (if applicable).
The Owner will pay all reasonable costs associated with the Contract that the Contractor had incurred up to the date of Termination and reasonable demobilization costs. However, the Contractor shall not be reimbursed for any profit and/or overhead that had not been earned up to the date of termination.

For Cause:

If the Contractor is in default, written Notice of such default shall be given to the Contractor. If the Contractor does not cure such default within ten (10) days following such Notice, the Owner may:

1. terminate the Contract by written Notice;
2. withhold further payment to the Contractor until satisfactory performance has resumed;
3. transfer the obligation to perform the Contract from the Contractor to the Surety (if any);
4. take over the Work as a whole or that portion of the Work which has been improperly performed or not timely executed, and make good the deficiencies and deduct the cost thereof from the payments then or thereafter due the Contractor. Any such action by the Owner shall not prejudice any warranty rights of the Owner nor any rights of the Owner under the Contractor's Payment Bond or Performance Bond (if any) or general Virginia law. Provided, however, the Owner may so proceed without such Notice if an emergency or danger to the Work or the public exists; and/or
5. all finished or unfinished Work provided by the Contractor shall, at the Owner's option, become the Owner's property.

Upon determination of the damages resulting to the Owner as a result of Contractor's default, if the amount due Contractor for Work properly performed prior to Contractor's receipt of Notice of Termination exceeds the Owner's damages, the Owner shall pay such excess to the Contractor. If the damages to the Owner exceed the amount due Contractor for Work properly performed prior to Contractor's receipt of Notice of Termination, the Contractor shall pay such excess to the Owner.

The Owner may avail itself of any other legal remedy to protect its interests and recoup its damages.

If the Contractor is sold, bought, goes bankrupt, or goes into receivership, the Owner reserves the right to terminate for cause.

The Owner may cancel this solicitation at any time and for any reason prior to execution of the Contract

3.14 Time is of the Essence: All time limits stated in the Contract Documents, including but not limited to the time for completion of the Work, are of the essence.

3.15 Virginia Freedom of Information Act- Disclosure of Information: As a public body, the Owner is subject to the Virginia Freedom of Information Act and its records are public records except as defined in that statute. Any information which the Contractor deems to be confidential or proprietary shall be marked by the Contractor in accordance with the Virginia Freedom of Information Act. No separate non-disclosure agreement will be provided.

3.16 Warranty: The Contractor shall warrant that, unless otherwise specified, all Materials and Equipment incorporated in the Work under the Contract shall be new, in first class condition, and in strict accordance with the Contract Documents. The Contractor further shall warrant that all Workmanship shall be of the highest quality and in strict accordance with Contract Documents and shall be performed by persons qualified at their respective trades.

Warranty Period. All warranties and guarantees against any defect in the Work, including materials, equipment and parts, shall apply from the date of Acceptance of the Work and shall continue for a period of one (1) year thereafter.
All warranties set forth in the IFB or RFP or in any other Contract Document are separate and independent from and in addition to any of the Contractor's other guarantees or obligations in any Contract awarded as a result of this solicitation.
In addition to the foregoing warranties, Contractor shall warrant that (1) the Work performed and materials to be supplied are fit and sufficient for the purpose intended; (2) the Work performed and the materials supplied are merchantable, of good quality and free from defects, whether patent or latent, in material or workmanship; and (3) the Work performed and the materials provided conform to the Specifications of the solicitation. To the extent that Contractor engages SubContractors or Vendors, Contractor shall ensure that all SubContractors and Vendors provide these same warranties to the Owner. Such SubContractor or Vendor warranties shall not be in lieu of or otherwise relieve Contractor of its warranty obligations as stated in this solicitation or in any Contract Document.
Any implied warranties, including but not limited to the warranty for "Merchantability and Fitness for A Particular Purpose" are not waived and are a mandatory part of this solicitation and any ensuing Contract.
Work not conforming to any warranty shall be considered defective.
The Contractor hereby agrees to make at its expense, all repairs or replacements necessitated by defects or non-conformities in the Work, including Materials, Equipment and Parts, and to pay for any damage to other work resulting from such defects or non-conformities which become evident at any time prior to the expiration of any applicable Warranty Period or such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or otherwise provided. Defects or non-conformities which are remedied as a result of obligations of the warranty shall subject the remedied portion of the Work to an extended Warranty Period of one (1) year from the date upon which such defect or

nonconformity was fully remedied or from the date of Final Acceptance, whichever is later. The Contractor must submit to the Owner a written certification that the item of defective or nonconforming Work has been corrected. Un-remedied defects or non-conformities identified for correction during the Warranty Period but remaining after its expiration shall be considered as part of the obligations of the warranty.
No tests or inspections conducted by the Owner, its Engineer or others shall relieve the Contractor of its obligations to execute the Work in strict compliance with the requirements of the Contract Documents and to correct defective or nonconforming Work not initially identified by the Owner, the Engineer or others at the time of tests or inspections, but discovered subsequently.
The Contractor further shall assume responsibility for a similar warranty for all Work provided by SubContractors, Manufacturers or Manufacturers/Suppliers.
The Contractor shall agree to hold the Owner harmless from liability of any kind arising from damage due to said defects or non-conformities.
The Contractor shall make all repairs and replacements promptly upon receipt of written order for same from the Owner. If the Contractor after receipt of written demand for repair from Owner fails to make or complete the repairs and replacements within fourteen (14) days, or within such lesser time as in the opinion of the Owner may be necessary to avoid serious impairment to the operation of the facilities or to prevent a threat to health or safety, or if the Owner otherwise has a reasonable grounds to determine that the Contractor will not perform the Work in question, the Owner may perform such repairs or replacements and the Contractor shall be liable for the cost thereof. Any condition of such urgency that in the opinion of the Owner immediate corrective action is required may be remedied by the Owner without prior Notice to the Contractor, and the Contractor shall be liable for the cost thereof. Any such corrective action taken by the Owner shall be without prejudice to the Contractor's warranty obligations as set forth herein, which shall remain in full force and effect as if such corrective measures had been taken by the Contractor. In addition to the extension of the Warranty Period otherwise provided in this Article, the Warranty Period of any Work item requiring repair shall be extended by the number of days in excess of fourteen (14) days following written demand for correction required to accomplish the repairs to the satisfaction of the Owner. Any repetitive Equipment malfunction identified within the Warranty Period shall remain under warranty until it has been fully corrected and has performed without malfunction for one full year.

ARTICLE IV
PAYMENT

4.0 Acceptance of Final Payment Constitutes Release: The acceptance by the Contractor of final payment shall release the Owner and the Engineer, as representative of the Owner, from all claims and all liability to the Contractor for all things done or furnished in connection with the Work, and from every act of the Owner and others relating to or arising out of the Work. No payment, however, final or otherwise, shall operate to release the Contractor or its Sureties from obligations under the Contract Documents.

4.1 Payment:

A. Invoices:
Invoices for completed Work shall be submitted by the Contractor directly to the payment address shown on the Purchase Order/Contract. Invoices shall show the Owner's Purchase Order or Contract number and either the social security number (for individual Contractors) or the federal employer identification number (for proprietorships, partnerships, and corporations) and are subject to review and approval by the Owner's Contract Manager.

B. Partial Payments:
Requests for partial payments or advance payments must be submitted as part of the Bid or Proposal along with a justification. The Owner reserves the right to accept, reject or negotiate requests for partial payments. If the request is rejected, the Bidder/Offeror must waive the requirement in order to remain in consideration.

C. Refunds:
If the Contractor is declared to be in default, the Owner will be eligible for a full and immediate refund for payments made to the Contractor.

4.2 Price Firm Period and Cost Increases (if applicable):

A. Bid/Proposal Prices:
Pricing shall be firm and fixed as originally bid/proposed and accepted. Contract pricing for additional materials, options, accessories, labor (including subContractors), etc., will be firm and fixed for the initial 12-month Contract period. Surcharges (i.e. fuel surcharges) shall NOT be allowed to be added to invoices as an additional line item. All charges shall be included in the price bid on the Bid Summary Sheet or provided as a Cost Proposal in response to an RFP. Any provision of the Contract Documents which imposes any responsibility or performance obligation upon the Contractor shall be deemed to include the phrase 'within the Contract price'.

B. Annual Increases for Labor, Materials and Maintenance:
1. After the first year (and any year thereafter), Contract prices may not be increased by more than the Cost of Living as indicated in the Consumer Price Index – Urban (i.e., "CPI-U") for the calendar month ending two months before the expiration month of the then current Contract year.

2. Increases based upon factors other than the CPI (e.g., Force Majeure, etc.) may be submitted when and, as they occur providing that sufficient detailed supporting documentation is included with the request. The Owner reserves the right to reject any such request or negotiate a mutually agreeable price.

3. The Owner reserves the right to periodically check market pricing for similar services. Based upon those findings the Owner reserves the right to require the Contractor to enter into negotiations to arrive at pricing consistent the competitive marketplace. Failure to arrive at acceptable Contract pricing may result in cancellation and rebid the Contract.

4.3 Prompt Payment:

A. The Contractor shall take one of the two following actions within seven days after receipt of amounts paid to the Contractor by the Owner for work performed by any SubContractor(s) under the Contract:

1. The Contractor shall pay its SubContractor(s) or for the proportionate share of the total payment received from the Owner attributable to the work performed by the SubContractor under that Contract; or

2. Notify the Owner and any SubContractor(s), in writing, of his intention to withhold all or a part of the SubContractor's payment with the reason for nonpayment.

B. Bidders shall include in their bid submissions either: (i) if an individual Contractor, their social security numbers; and (ii) proprietorships, partnerships, and corporations to provide their federal employer identification numbers.

C. The Contractor shall pay interest to the SubContractor(s), on all amounts owed by the Contractor that remain unpaid after seven days following receipt by the Contractor of payment from the Owner for work performed by the SubContractor under the Contract, except for amounts withheld as allowed under A above.

D. Unless otherwise provided under the terms of this Contract, interest shall accrue at the rate of .10% percent per month.

E. The Contractor shall include in each of its SubContracts a provision requiring each SubContractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier SubContractor.

F. A Contractor's obligation to pay an interest charge to a SubContractor pursuant to the payment clause in this section shall not be construed to be an obligation of the Owner. A Contract modification shall not be made for the purpose of providing reimbursement for the interest charge. A cost reimbursement claim shall not include any amount for reimbursement for the interest charge.

4.4 Release of Liens and Claims (where applicable): The Contractor hereby acknowledges and agrees that the Owner is an agency of the Government and as such its property is immune from mechanic's liens. The Contractor hereby waives any and all mechanics' rights it may purport to have, and agrees that it shall neither file nor assert any such lien claim.

As a condition precedent to final payment for the Work, the Contractor shall sign and deliver to the Owner a release of liens and claims sworn to under oath and duly notarized. The release shall state that the Contractor has satisfied all claims and indebtedness of every nature in any way connected with the Work, including, but not limiting the generality of the foregoing, all payrolls, amounts due to subContractors, accounts for labor performed and materials and equipment furnished, incidental services liens, and judgments.

ARTICLE V
DELIVERY

5.0 Default: In case of default by the Contractor, or failure to deliver the supplies or services ordered by the time specified, the Owner, after due notice (oral or in writing), will cure the failure by procuring the items ordered from other sources and hold Contractor responsible for any excess cost occasioned thereby.

5.1 Discounts: If discount for prompt payment is allowed, the discount period will begin on the date of receipt of proper invoice, or material/service, whichever is later.

5.2 Strict Adherence to Contract Documents:

A. Goods or Services delivered must be strictly in accordance with the Contract Documents and shall not deviate in any way therefrom. Equipment, materials and/or supplies delivered on this order shall be subject to inspection and test upon receipt. If rejected, they shall remain the property of the vendor and the order shall be considered as not received.

B. Contractor shall provide the exact quantities specified on this order. The Owner will not pay for overages and if delivered the Owner will – at its sole option and discretion – either return the additional quantities to the seller, at the seller's risk and expense, or accept the additional quantities at no additional cost to the Owner.

5.3 Taxes and Freight:

A. Deliveries against this order must be free of excise or transportation taxes.

B. All prices unless otherwise specified are F.O.B. Destination, Freight Prepaid and Allowed.

ARTICLE VI
MISCELLANEOUS TERMS

6.0 Assignment of Interest: The Contractor shall not assign any interest in the Contract and shall not transfer any interest in the same.

6.1 Cooperative Procurement: Subject to the mutual agreement between the parties, any Contract awarded on the basis of this solicitation may be used by any public entity to enter into a Contract for the services described and defined herein, with the successful Bidder/Offeror.

Except for Contracts for professional services, a public body may purchase from another public body's Contract even if it did not participate in the procurement process if the procurement was designated as a cooperative procurement to which other public bodies may participate. This is such a cooperative procurement. However, the Contractor is under no obligation to participate with other public bodies.

6.2 **Equal Opportunity:** The Upper Occoquan Service Authority does not discriminate against any bidder or Offeror in the solicitation or awarding of Contracts because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment

6.3 **Governing Law:** Notwithstanding Offeror's submitted terms and conditions to the contrary and without regard to conflicts of law principles, the solicitation and any resulting Contract shall be governed in all respects by the laws of the Commonwealth of Virginia.

6.4 **Hard Hat Area:** Contractor's employees shall wear hard hats while working in areas designated as hard hat areas by the Owner's Safety Officer.

6.5 **Hours of Operation and Holidays:** The Owner's typical work schedule is 8:00 a.m. through 4:30 p.m. Monday through Friday excluding the Owner's holidays. Contractor's access to work sites and work areas shall be limited to these same days and hours, but may be modified with the prior written approval of the Owner's Contract Manager. In any event and under all circumstances, the unilateral decision of the Owner's Contract Manager regarding access to the Owner's facilities shall be final. The following list identifies the twelve (12) Owner's Holidays that are normally taken and should be included by the Contractor in its planned Work schedule as non-Work days:

New Year's Day
Martin Luther King Day
President's Day
Memorial Day
Independence Day
Labor Day
Veterans Day
Thanksgiving Day
Friday after Thanksgiving Day
Christmas Day
Christmas Eve or Day after Christmas
New Year's Eve

6.6 **Partial Invalidity/Waiver:** Neither any payment for, nor acceptance of, the whole or any part of the services by the Owner, nor any extension of time, shall operate as a waiver of any provision of any Contract resulting from this IFB/RFP, nor of any power herein reserved to the Owner, or any right to damages herein provided, nor shall any waiver of any breach of any Contract be held to be a waiver of any other or subsequent breach. Failure of the Owner to require compliance with any term or condition of any Contract shall not be deemed a waiver of such term or condition or a waiver of the subsequent enforcement thereof.

6.7 **Taxes:** The Owner is exempt from Federal Excise Taxes, Virginia State Sales and Use Taxes, and the District of Columbia Sales Taxes and Transportation Taxes. The Owner's federal tax identification number is 54-0902952.

ATTACHMENT B: REFERENCES

Reference 1:

Company Name:	
Address:	
Contact Person:	
Telephone:	
Fax:	
Email:	
Description and years of Work:	

Reference 2:

Company Name:	
Address:	
Contact Person:	
Telephone:	
Fax:	
Email:	
Description and years of Work:	

Reference 3:

Company Name:	
Address:	
Contact Person:	
Telephone:	
Fax:	
Email:	
Description and years of Work:	

Reference 4:

Company Name:	
Address:	
Contact Person:	
Telephone:	
Fax:	
Email:	
Description and years of Work:	

Reference 5:

Company Name:	
Address:	
Contact Person:	
Telephone:	
Fax:	
Email:	
Description and years of Work:	

This form must be included with your submission.

End of Attachment B

ATTACHMENT B - UOSA SOLID WASTE PERMIT, GROUNDWATER MONITORING PLAN

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
NORTHERN REGIONAL OFFICE
13901 Crown Court, Woodbridge, Virginia 22193
(703) 583-3800 Fax (703) 583-3821
www.deq.virginia.gov

L. Preston Bryant, Jr.
Secretary of Natural Resources

David K. Paylor
Director

June 3, 2009

Dr. Evelyn Mahieu
Upper Occoquan Sewage Authority
Department of Regulatory Affairs
14631 Compton Road
Centreville, Virginia 20121-2506

RE: UOSA Lime Solids Landfill, Permit No. 542
Approval of Minor Permit Amendment
Revised Operation and Maintenance Manual, Chapter V

Dear Dr. Mahieu:

This letter is in response to the facility's minor permit amendment dated May 19, 2009, prepared on your behalf by SCS Engineers. The amendment outlined a change in operating hours of the landfill and the use of a storage pad for the deposit of lime solids during evenings, weekends, and holidays. A revised Chapter V of the Operation and Maintenance Manual was included with the amendment request. In accordance with 9 VAC 20-80-620 F.1.a and Table 7.2. of the Virginia Solid Waste Management Regulations (VSWMR, 9 VAC 20-80-10 et seq.), this request is classified as minor permit amendment. This amendment is hereby approved.

In order to document this approval, please incorporate a copy of this letter, its attachments, and the revised Chapter V of the Operation and Maintenance Manual and the lime solids storage pad design drawings submitted with the permit application into each copy of Permit No. 542.

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have 30 days from the date of service of this decision to initiate an appeal of this decision, by filing notice with:

David K. Paylor, Director
Virginia Department of Environmental Quality
ATTN: Waste Division
P.O. Box 1105
Richmond, Virginia 23218

In the event that this decision is served to you by mail, three days are added to that period. Please refer to Part Two of the rules of the Supreme Court of Virginia, which describes the required content of the Notice of Appeal, including specification of the Circuit Court to which an appeal is taken, and additional requirements governing appeals from decisions of administrative agencies.

Please be advised that, in accordance with 9 VAC 20-80-620.F.1.b.(2), the permittee shall send a notice of this modification to the local governing body (Fairfax County) within 90 days of the date of approval of this change. It is also the responsibility of the applicant to obtain any other permits or authorizations that may be necessary. If there are any questions, please contact Kathryn Perszyk at (703) 583-3856 or Kathryn.Perszyk@deq.virginia.gov.

Respectfully,

Richard C. Doucette

Richard C. Doucette
Waste Program Manager

Enc: Permit Intro and Modules I and II

cc: James H. Johnston, P.E., SCS Engineers, Project Manager
Paul A. Mandeville, P.E., SCS Engineers, Vice President/Project Director
Kathryn Perszyk, DEQ-NRO Solid Waste Permit Writer
Jason Williams, DEQ-TRO Waste Permit Coordinator
Becky Dietrich, DEQ-BRRO Waste Permit Coordinator
DEQ-NRO Administrative File

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Secretary of Natural Resources

David K. Paylor
Director

SOLID WASTE FACILITY PERMIT
PERMIT NUMBER 542

Facility Name: Upper Occoquan Sewage Authority

Facility Type: Industrial Landfill **Latitude:** 38° 48' 55" N

Site Location: Fairfax, Virginia **Longitude:** 77° 27' 40" W

Location Description: The facility occupies approximately 50 acres of the northeast section of property owned by the Upper Occoquan Sewage Authority (UOSA) located at 14631 Compton Road in Centreville, Virginia. The site is bounded by Compton Road (State Route 658) and the wastewater treatment plant and is approximately 2,200 feet west of the intersection of Compton Road and State Route 28.

Background: The facility serves as an industrial waste landfill for disposal of lime solids generated at the UOSA wastewater treatment plant. The landfill is owned and operated by UOSA and will accommodate a total capacity of 2.0 million cubic yards of waste during the facility life. The landfill incorporates a single synthetic liner system, which is not provided for in the regulations but which was petitioned for by the permittee pursuant to the requirements of Part IX of the regulations, a leachate collection and removal system, and a groundwater monitoring system.

Permit Amendments: This is the sixth amendment to Solid Waste Permit No. 542, which was originally permitted on August 5, 1992. This amendment allows the use of a lime solids storage pad to be constructed adjacent to the landfill for the storage of lime solids during evening, weekends, and holidays as a result of a change in operating hours of the landfill. Previous permit amendments are outlined in Section I.G. of Module I.

THIS IS TO CERTIFY THAT:

Upper Occoquan Sewage Authority
14631 Compton Road
Centreville, Virginia 20121-2506

is hereby granted a permit to construct, operate, and maintain the facility as described in the attached Permit Modules I, II, III, IV, V and VI. These Permit Modules and Permit Attachments are as referenced hereinafter and are incorporated into and become a part of this permit.

The herein described activity is to be established, modified, constructed, installed, operated, used, maintained, and closed in accordance with the terms and conditions of this permit and the plans, specifications, and reports submitted and cited in the permit. The facility shall comply with all regulations of the Virginia Waste Management Board. In accordance with Chapter 14, § 10.1 - 1408.1(D) of the Code of Virginia, prior to issuing this permit, any comments by the local government and general public have been investigated and evaluated and it has been determined that the facility poses no substantial present or potential danger to human health or the environment. The permit contains such conditions and requirements as are deemed necessary to comply with the requirements of the Virginia Code, the regulations of the Board, and to prevent substantial or present danger to human health or the environment.

Failure to comply with the terms and conditions of this permit shall constitute grounds for the revocation or suspension of this permit and for the initiation of necessary enforcement actions.

The permit is issued in accordance with the provisions of § 10.1-1408.1.A, Chapter 14, Title 10.1, Code of Virginia (1950) as amended.

Part A Approval: November 9, 1989
Part B Issued: August 5, 1992
Amendment 1: August 23, 1993
Amendment 2: October 22, 1999
Amendment 3: October 19, 2001
Amendment 4: February 2, 2006
Amendment 5: March 31, 2008

APPROVED:

Thomas A. Faha
Regional Director

06 - 03 - 09
Date Amended

PERMIT MODULES AND PERMIT ATTACHMENTS[1]

REFERENCE LIST

PERMIT MODULE I – GENERAL PERMIT CONDITIONS

PERMIT MODULE II[2] – CONDITIONS OF OPERATION
- PERMIT ATTACHMENT II-1 – OPERATIONS MANUAL
- PERMIT ATTACHMENT II-1A – SAFETY PLAN
- PERMIT ATTACHMENT II-1B – CONTINGENCY PLAN
- PERMIT ATTACHMENT II-2 – WASTE ANALYSIS PLAN
- PERMIT ATTACHMENT II-3 – LOCATIONAL LIMITATIONS
- PERMIT ATTACHMENT II-4 – UNAUTHORIZED WASTE PLAN

PERMIT MODULE III– INDUSTRIAL LANDFILL
- PERMIT ATTACHMENT III-1A – DESIGN PLANS
- PERMIT ATTACHMENT III-1B – APPROVED VARIANCES
- PERMIT ATTACHMENT III-2 – CONSTRUCTION QUALITY ASSURANCE PLAN
- PERMIT ATTACHMENT III-3 – DESIGN REPORT & SPECIFICATIONS

PERMIT MODULE IV -- PHASE I GROUNDWATER MONITORING
- PERMIT ATTACHMENT IV-1 – GROUNDWATER MONITORING PLAN

PERMIT MODULES V[2] **AND VI**[2]—CLOSURE AND POST-CLOSURE CARE
- PERMIT ATTACHMENT V-1 – CLOSURE AND POST-CLOSURE PLAN
- PERMIT ATTACHMENT V-2 – COST ESTIMATES

NOTES:

1. Should information contained in any Permit Module that consists of documents submitted by the permittee, conflict with any requirement or condition contained in Permit Modules I, II, III, IV, V, VI, or 9 VAC 20-80 et seq., the regulatory/Permit Module requirement or condition shall prevail (unless an appropriate variance has been granted). The Department is not responsible for spelling, typographical, or syntax errors in modules based on information submitted by the permittee.

2. The Emergency/Contingency Plan (Permit Attachment II-1b), or the Closure and Post-Closure Plan (Permit Attachment V-1) emergency contact lists, may be revised with Department approval.

PERMIT MODULE I

GENERAL PERMIT CONDITIONS

I.A. EFFECT OF PERMIT

The permittee is allowed to dispose solid waste on-site in accordance with the conditions of this permit. Any disposal of solid waste not authorized by this permit is prohibited. Compliance with the terms of this permit does not constitute a defense to any order issued or any action brought under Sections 10.1-1402(18), 10.1-1402(19), or 10.1-1402(21) of the Virginia Waste Management Act (Chapter 14, Title 10.1, Code of Virginia (1950), as amended); or any other law or regulation for protection of public health or the environment. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby. For purposes of this permit, terms used herein shall have the same meaning as those in the Virginia Waste Management Act, and Part I and other pertinent parts of the Virginia Solid Waste Management Regulations (VSWMR, 9 VAC 20-80, *et seq.*), unless this permit specifically provides otherwise; where terms are not defined in the regulations or the permit, the meaning associated with such terms shall be defined by the generally accepted scientific or industrial meaning of the term or a standard dictionary reference. "Director" means the Director of the Department of Environmental Quality, or his designated or authorized representative.

I.B. DUTIES AND REQUIREMENTS

The permittee shall comply with all conditions of this permit and 9 VAC 20-80-10, et seq. The effect of this permit is detailed in 9 VAC 20-80-550, and it shall be the duty of the permittee to insure the applicable requirements are met. Additionally, the permittee is subject to the recording and reporting requirements detailed in 9 VAC 20-80-570. The facility will be designed and constructed per the requirements of Permit Module III, operated and maintained per Permit Module II, closed and maintained in post-closure per Permit Module V and VI, and subject to a groundwater monitoring program per Permit Module IV and Permit Attachment IV-1. In addition to these requirements, the following additional conditions are invoked per 9 VAC 20-80-490, and shall be complied with:

I.B.1. Noncompliance may be authorized by a schedule of compliance [9 VAC 20-80-550.C and 9 VAC 20-80-550.G]. Any other permit noncompliance constitutes a violation of Virginia Waste Management Act and is grounds for enforcement action, or for permit revocation, revocation and reissuance, or modification [9 VAC 20-80-600 and 9 VAC 20-80-620].

I.B.2 The permittee shall comply with the requirements of this permit and any provisions of RCRA Subtitle D (Title 40, Code of Federal Regulations, Section

258) requirements as they become applicable upon their effective date. This permit may not act as a shield against compliance with any part of RCRA or any other applicable federal regulation, state regulation or state law.

I.B.3. In an enforcement action, it shall not be a defense for the permittee that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

I.B.4. In the event of noncompliance with this permit, the permittee shall take all reasonable steps to minimize releases of solid wastes or waste constituents to the environment and shall carry out measures to prevent substantial adverse impacts on human health or the environment.

I.B.5. The permittee shall at all times properly operate and maintain all units (and related appurtenances) which are installed or used by the permittee to achieve compliance with the operations manual and the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing, and training, and adequate laboratory and process controls, including appropriate quality assurance/quality control procedures. This provision requires the operation of back-up or auxiliary equipment only when necessary to achieve compliance with the conditions of this permit.

I.B.6. The permittee shall furnish to the Director, within a reasonable time, any relevant information that the Director may request to determine compliance with this permit, regulations or the Act. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit by the date specified in the request.

I.B.7. The permittee shall allow the Director, or an authorized representative, upon the presentation of appropriate credentials, to:

I.B.7.a. Enter at reasonable times upon the permitted facility where a regulated unit or activity is located or conducted, or where records must be kept under the conditions of this permit;

I.B.7.b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

I.B.7.c. Inspect at reasonable times any unit, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

I.B.7.d Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by Virginia Waste Management Act, any substances or parameters at any location within his control.

I.B.8. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample to be analyzed must be the appropriate method from the latest edition of Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA Publication SW-846.

I.B.9. This permit is not transferable to any person, unless approved by the Director. The Director may require modification or revocation and reissuance of the permit pursuant to 9 VAC 20-80-550.F. Before transferring ownership or operation of the facility during its operational life, the permittee shall notify the new owner or operator in writing of the requirements of Parts V and VII, of the Virginia Solid Waste Management Regulations, the Financial Assurance Regulations, 9 VAC 20-70-10, et seq., and this permit.

I.B.10. In accordance with § 10.1-1408.2, all facilities must have a Certified Operator as required by the Board of Waste Management Facility Operators-Licensing Regulations, 18 VAC 155-20-10, et seq.

I.B.11. Specifications for all drainage media should specify that the material shall contain no greater than 15% calcium carbonate equivalent. Department literature regarding research on leachate collection media indicates that weight loss greater than 15% results in an unacceptable loss of performance. If a greater percentage is specified or allowed, a demonstration that performance is not adversely affected must be provided to the Department for review and approval.

I.B.12. Recirculation of collected leachate shall not be allowed, in accordance with 9 VAC 20-80-290.D.3, except when the area to be irrigated is underlain by a composite liner system. Furthermore, in accordance with 9 VAC 20-80-280.C.3.c, decomposition gas condensate may be recirculated into the landfill provided the facility complies with the composite liner requirement and the leachate control system requirements of Part V of VSWMR. A composite liner system is a system designed to meet the requirements of 9 VAC 20-80-250.B.9.

I.B.13. The closure cost estimate must reflect the maximum cost of closure at all times. The owner has the responsibility to maintain the closure and post closure cost estimate and associated financial assurance funding as conditions change.

I.C. DOCUMENTS TO BE MAINTAINED AT THE FACILITY

The permittee shall maintain the following documents at the facility, or another location approved by the director, until post-closure is complete and certified by a professional engineer, and shall maintain amendments, revisions, and modification to these documents:

I.C.1. Design Plans.

I.C.2. Operations Manual.

I.C.3. Closure and Post-Closure Plan.

I.C.4. Groundwater Monitoring Plan.

I.C.5. Detailed, written estimate, in current dollars, of the cost of closing the facility, post-closure care and corrective action measures.

I.C.6. All other documents/records required and applicable from the following:

I.C.6.a. Monitoring records from leachate, gas, and groundwater monitoring.

I.C.6.b. Inspection records as required from construction/installation, operational, closure, post-closure inspection requirements.

I.C.6.c. Personnel training records.

I.C.6.d. Daily operational records (i.e., solid waste received and processed, fill area records, records of special wastes accepted, a logbook which is a daily narrative account of the activities at the landfill).

I.C.6.e. Construction quality assurance reports, record drawings and engineers certifications for all new liner and/or final cover construction.

I.C.7 An approved copy of the complete Part A permit.

I.D. DOCUMENTS TO BE SUBMITTED

In addition to the documents/records/reports to be submitted per the requirements of this permit or 9 VAC 20-80-10, et seq., the permittee shall also submit the following documents to the Director according to indicated schedules:

I.D.1. Prior to expansion into each new phase, the permittee shall submit all required certification documents per 9 VAC 20-80-550.A, and:

I.D.1.a. Report and supporting documents resulting from quality control/quality assurance activities performed during construction and installation of the liner/drainage systems, including the installation contractor's written acceptance of the surfaces to be lined, synthetic liner manufacturer and installer warranties, laboratory test results of the permeability of the clay liner and the drainage media overlying the liner, and representative copies (sufficient to demonstrate responsible control) of the accumulated

inspection schedules resulting from the professional engineer's oversight of the construction.

I.D.2. In accordance with 9 VAC 20-80-550.A, certification from a design engineer, who must be a professional engineer licensed to practice in Virginia, that the construction of the facility has been completed in accordance with the permit, approved plans and specifications and is ready to begin operation. A certification will be required for each lined phase of development.

I.D.3. Certification (separate from I.D.2, above) from the Construction Quality Assurance (CQA) officer that the approved CQA plan has been successfully carried out and that the constructed unit meets all requirements of the permitted CQA plan, in accordance with 9 VAC 20-80-250.B.18. A certification will be required for each lined phase of development. The CQA officer must be a professional engineer licensed to practice in Virginia.

I.D.4. The as-built plans of all new groundwater and gas monitoring wells shall be submitted as these wells are installed. Information to be included on the as-built plans shall include, but is not limited to, the total depth of the well, the surveyed elevations of the top of casing and ground surface (or apron), and the length and location of the screened interval and annular space seal. All dimensions are to be shown on well construction schematics.

I.D.5. Not less than 180 days prior to the completion of the post-closure monitoring and maintenance period as prescribed by the Board's regulations or by the Director, the owner or operator shall submit to the Director a certificate, signed by a professional engineer licensed in the Commonwealth, that post-closure monitoring and maintenance have been completed in accordance with the facility's Closure Plan, Permit Attachment XII-1.

I.D.5.a. The certificate submitted under I.D.5, shall be accompanied by an evaluation prepared by a professional engineer licensed in the Commonwealth, and signed by the owner or operator, which assesses and evaluates the landfill's potential for harm to human health and the environment in the event that post-closure monitoring and maintenance are discontinued.

I.D.5.b. If the Director determines that continued post-closure monitoring or maintenance is necessary to prevent harm to human health or the environment, he shall extend the post-closure period for such additional time as the Director deems necessary to protect human health and the environment and shall direct the owner or operator to submit a revised post-closure plan and to continue post-closure monitoring and maintenance in accordance therewith. Requirements for financial assurance shall apply throughout such extended post-closure period.

I.E. REPORTS, NOTIFICATIONS, AND SUBMISSIONS TO THE DIRECTOR

All reports, notifications, or other submissions which are required by this permit to be sent or given to the Director should be sent to:

Director
Virginia Department of Environmental Quality
Office of Solid Waste
P.O. Box 1105
Richmond, VA 22318

With a copy to:

Virginia Department of Environmental Quality
Solid Waste Permitting/Compliance
Northern Regional Office
13901 Crown Court
Woodbridge, Virginia 22193

I.F. SITE SPECIFIC CONDITIONS

I.F.1. The final permit is based on permit application submittals (drawings and reports) that contain the word "proposed" and similarly tentative language. The documents that are incorporated into Permit No. 542, and the amendments thereof, have been evaluated for administrative and technical adequacy and have been approved as proposed. Therefore, any reference to a design, construction, operation monitoring or closure criteria are to be considered to be approved as proposed.

I.G. PERMIT AMENDMENTS

I.G.1. The permit was amended by a minor amendment issued August 23, 1993. This amendment altered the landfill liner design to include the use of a 12-inch layer of aggregate in place of a 12-inch layer of sand in the leachate collection zone. This amendment also incorporated a revised Permit Module III into Permit No. 542.

I.G.2. The permit was amended by a major amendment issued October 21, 1999. This amendment incorporated a modification to the groundwater monitoring network, replacing monitoring wells MW-6, MW-7, MW-12, and MW-13, with monitoring wells MW-14 and MW-15.

I.G.3. The permit was amended by a minor amendment issued October 19, 2001. This amendment incorporated a modification to the groundwater monitoring network,

replacing monitoring well MW-15 with MW-16. This amendment also incorporated a revised Groundwater Monitoring Plan as Permit Attachment IV-1.

I.G.4. The permit was amended by a minor amendment issued February 2, 2006. This amendment incorporated a modification to the groundwater monitoring network, adding upgradient monitoring well MW-17 to the network, and a revised Groundwater Monitoring Plan as Permit Attachment IV-1.

I.G.5. The permit was amended by a minor amendment issued March 31, 2008. This amendment incorporated a revised Groundwater Monitoring Plan dated July 18, 2007, as Permit Attachment IV-1 and a revised Chapter VI (Control and Monitoring of Solids, Liquids, and Gas) of the Operation and Maintenance Manual dated April 9, 2007, as Permit Attachment II-1. This amendment also incorporated a modification to the groundwater monitoring network, replacing monitoring well MW-10 with wells MW-8 and MW-9.

END OF MODULE I

PERMIT MODULE II

CONDITIONS OF OPERATION

II.A. DESIGN & OPERATION OF FACILITY

The permittee shall construct, maintain, and operate the facility to minimize the possibility of a fire, explosion, or any unplanned, sudden or non-sudden release of waste constituents to air, soil, or state waters, which could threaten human health or the environment.

II.B. TYPES OF WASTE

II.B.1. *Service Areas and Wastes that may be Handled* [9 VAC 20-80-520.B.1]

The facility may only receive lime solids processed at the Upper Occoquan Sewage Authority Wastewater Treatment Plant for disposal.

II.B.2. *Wastes Specifically Forbidden*

The facility is prohibited from receiving wastes from any other sources not listed in II.B.1. The facility is specifically prohibited from receiving hazardous wastes, as determined by the Virginia Hazardous Waste Management Regulations [9 VAC 20-60-10 et seq.]

II.C. LIME SOLIDS ANALYSIS [9 VAC 20-80-490]

II.C.1. The permittee shall verify the analysis of lime solids ***annually*** as part of its quality assurance program, in accordance with Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA Publication SW-846.

II.C.2. At a minimum, the permittee shall use approved sampling and analytical methods, verify the validity of sampling and analytical procedures, and perform correct calculations. If the analyses are performed by a contract laboratory, then the permittee shall inform the laboratory in writing that it must operate under the waste analysis conditions set forth in this permit.

II.D. SECURITY AND SITE ACCESS

The permittee shall comply with the security provisions of 9 VAC 20-80-270.B.1. and 9 VAC 20-80-520.A.1.i., and the Security Plan (Permit Attachment II-1, § V.1.). Waste may be accepted at the landfill during daylight hours, Monday through Friday. An attendant must

be on duty at all times when wastes are accepted. During non-operating hours (evenings, weekends, and holidays), lime solids shall be stored on the lime solids storage pad located adjacent to the west side of the landfill.

II.E. INSPECTION REQUIREMENTS

The permittee shall inspect the landfill, maintain records of the inspections, and shall remedy any deterioration or malfunction discovered by an inspection in accordance with the following conditions:

II.E.1. The permittee shall inspect liner and cover systems during construction and installation for uniformity, damage, and imperfections (e.g. holes, cracks, thin spots, or foreign materials). [9 VAC 20-80-270.B.19.c.]

II.E.2. The permittee shall inspect synthetic liners and covers immediately after construction or installation to ensure tight seams and joints, and the absence of tears, punctures, or blisters. [9 VAC 20-80-270.B.14.b.]

II.E.3. The permittee shall inspect the facility in accordance with 9 VAC 20-80-520.C.2.f. and the Inspection Plan (Permit Attachment II-1, § V.6.).

II.E.4. The permittee shall inspect the landfill at least weekly and after storms to detect evidence of any of the following [9 VAC 20-80-490]:

II.E.3.a. Deterioration or improper operation of run-on and run-off systems; and

II.E.3.b. The presence of leachate in, and the proper functioning of, leachate collection and removal systems.

II.E.5. The permittee shall ascertain that hazardous wastes and otherwise non-permitted wastes are not accepted at the facility [9 VAC 20-80-113].

II.F. PERSONNEL TRAINING

The permittee shall conduct personnel training which follows the guidelines of the Personnel Training Outline (Permit Attachment II-1, § III.). The permittee shall maintain training documents and records. [9 VAC 20-80-270.C.17.]

II.G. LOCATION STANDARDS

The permittee shall limit the construction and operation of the landfill within the area described in the Locational Limitations (Permit Attachment II-3).

II.H. PREPAREDNESS AND PREVENTION

II.H.1. *Required Equipment*

At a minimum, the permittee shall maintain at the facility the equipment set forth in Permit Attachment II-1, § V.3. [9 VAC 20-80-270.C.4. and C.17.]

II.H.2. *Testing and Maintenance of Equipment*

The permittee shall test and maintain the equipment specified in Permit Attachment II-1, as necessary, to assure its proper operation in time of emergency. [9 VAC 20-80-270.C.4.]

II.H.3. *Arrangements with Local Authorities*

The permittee shall maintain arrangements with local police and fire authorities, rescue squads, hospitals, and the local emergency coordinator. [9 VAC 20-80-520.C.2.k.]

II.H.4. *Access to Communications/Alarm System*

The permittee shall maintain access to the communications/alarm system. [9 VAC 20-80-270.B.5.]

II.H.5. *Safety Program*

The permittee shall conduct an active safety program to abate hazards to operating personnel in accordance with Permit Attachment II-1a, including the safety training as described in Permit Attachment II-1, § III. [9 VAC 20-80-C.3.]

I.H.6. *Access to Utilities*

The permittee shall construct and maintain personnel shelters and sanitary facilities as required by 9 VAC 20-80-270.B.3.

II.H. LEACHATE MANAGEMENT

Leachate shall be treated in accordance with Section III.C.3. of Module III.

II.I. LANDFILL GAS MANAGEMENT

Landfill gas monitoring is not required at this time.

II.J. GROUNDWATER SAMPLING & ANALYSIS

Groundwater shall be monitored in accordance with Module IV and its attachments as applicable.

II.K. AMENDMENTS

All permit amendments are outlined in Section I.G of Module I.

END OF MODULE II

Groundwater Monitoring Plan

Upper Occoquan Service Authority
Industrial Landfill
Solid Waste Permit #542

Presented to:

Upper Occoquan Service Authority
14631 Compton Road
Centreville, Virginia 20121

SCS ENGINEERS

02200089.28 | October 13, 2021

296 Victory Road
Winchester, VA 22602
540-662-7097

Signature/Certification Sheet

Author:

Name: Kimberley M. Starks, Senior Project Professional

Signature: 

Date: October 12, 2021

Reviewer:

Qualified Groundwater Scientist Certification:

I certify that I have prepared or supervised the preparation of this report, that it has been prepared in accordance with industry standards and practices, and that the information contained herein is truthful and accurate to the best of my knowledge.

Name: Jennifer S. Robb, Vice President

Signature: 

Date: October 13, 2021

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List of Acronyms

ACL	Alternate Concentration Limit
ARSC	Annual Report Submission Checklist
ASD	Alternate Source Demonstration
EPA	Environmental Protection Agency
GMP	Groundwater Monitoring Plan
GPS	Groundwater Protection Standard
HDPE	High Density Polyethylene
LOD	Limit of Detection
LOQ	Limit of Quantitation
MCL	Maximum Contaminant Level
mL/min	milliliters per minute
PVC	Poly Vinyl Chloride
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SCS	Stearns Conrad & Schmidt Consulting Engineers, Inc. (SCS Engineers)
SW	Solid Waste
UPL	Upper Prediction Limit

USGS	United States Geologic Survey
VAC	Virginia Administrative Code
VDEQ	Virginia Department Of Environmental Quality
VELAP	Virginia Environmental Laboratory Accreditation Program
VOC	Volatile Organic Compound
VSWMR	Virginia Solids Waste Management Regulation

1.0 INTRODUCTION

This revised Groundwater Monitoring Plan (GMP) documents procedures and instructions necessary to implement a groundwater monitoring program for the Upper Occoquan Service Authority (UOSA) Industrial Landfill (Solid Waste Permit #542) located in Centreville, Virginia. This plan was prepared in accordance with Virginia Administrative Code (VAC) Title 9, Agency 20, Chapter 81, Section 250 and applicable Virginia Department of Environmental Quality Submission Instructions (VDEQ, 2003 & 2011). Below is a summary of prior revisions made to the GMP.

- April 2005: Modify the monitoring network.
- April and July 2007: Modify the monitoring network and parameter list. Address statistical comments provided by VDEQ in letter dated June 22, 2007.
- August 2017: Modify the monitoring network and parameter list and the addition of leachate monitoring trigger actions.

This revision incorporates additional groundwater monitoring network changes to incorporate new well MW-14R and to add volatile organic compounds (VOCs) to the parameter list.

1.1 SITE BACKGROUND

UOSA, formed in 1971, owns and operates a state-of-the-art water reclamation plant in Centreville, Virginia. The plant serves the Counties of Fairfax and Prince William and the Cities of Manassas and Manassas Park and has a current capacity of 54 million gallons per day.

The water reclamation plant generates lime solids as part of the chemical treatment process. During chemical treatment, secondary effluent is treated with slaked lime [$Ca(OH)_2$] to a pH of 11.3 standard units to precipitate and coagulate phosphorus and inactivate viruses. The coagulated particles are flocculated and the pH restored to neutral by a two-stage re-carbonation process. The solids are removed from the process and are dewatered to approximately 38% total solids via several filter presses before being disposed in the on-site, active UOSA industrial landfill. In addition to lime solids, stabilized spoils from the facility's emergency retention ponds are placed in the UOSA landfill as approved by the VDEQ in a letter dated December 9, 2013.

The lined UOSA Landfill was designed and permitted in several phases. The Part A application was submitted to VDEQ in December 1988. Part A was later approved, and the Part B application was submitted in 1991. Final approval and issuance of the operating permit was dated August 5, 1992. The landfill was constructed and began accepting lime solids from one of the old landfill areas in April 1994. In 1995, the new Landfill began accepting fresh lime solids from the water reclamation plant.

1.2 GROUNDWATER MONITORING HISTORY

Late 1988: The initial groundwater monitoring network for the old landfill (Solid Waste Permit #243) consisted of wells MW-1 through MW-5. In support of development of the current landfill (Solid Waste Permit #542), four monitoring wells (MW-6 through MW-9) were installed as part of the Part A investigation.

December 1989 to March 1990: Based on additional information gained during the Part A process, three additional wells (MW-10, MW-11, and MW-12) were installed.

1999: Monitoring wells MW-6, MW-7, MW-12, and MW-13 were permanently abandoned. Monitoring wells MW-8 and MW-9 were taken out of the permitted network but were retained for water level measurement purposes.

October 21, 1999: The Landfill's Solid Waste Permit was amended by a major permit amendment incorporating a modification to the groundwater monitoring network, replacing monitoring wells MW-6, MW-7, MW-12, and MW-13, with monitoring wells MW-14 and MW-15.

2000: Several statistically significant increases above background for Phase I monitoring parameters had been detected in the past, total organic carbon in particular.

August 22, 2000: The Total Organic Carbon Demonstration Study report was submitted to VDEQ. This study did not detect significant concentrations of Column A VOCs in the groundwater samples collected from the monitoring wells of concern. A response letter from VDEQ, dated February 5, 2001, allowed the Landfill to remain in a Phase I Monitoring Program.

May 2001: As approved by VDEQ, MW-15 was decommissioned and replaced with well MW-16. In addition, monitoring well MW-17 was installed as a possible future upgradient well.

October 19, 2001: The Landfill's Solid Waste Permit was amended by a minor amendment incorporating a modification to the groundwater monitoring network, replacing monitoring well MW-15 with MW-16. This amendment also incorporated a revised GMP.

2003: For the 1st semi-annual 2003 groundwater sampling event, an intra-well exceedance for total organic halides in MW-10 and an intra-well exceedance for pH in MW-16 were identified. For the 2nd semi-annual 2003 groundwater sampling event, an intra-well exceedance was identified for total organic halides in MW-10. The Landfill remained in a Phase I Monitoring Program.

June 11, 2004: An Alternate Source Demonstration (ASD) was submitted to VDEQ suggesting that the intra-well exceedance during the 1st semi-annual 2004 groundwater sampling event for specific conductivity in MW-16 was potentially caused by off-site activities.

October 22, 2004: The VDEQ requested the initiation of a Phase II monitoring program in response to the March 2003 pH exceedance.

November 1, 2004: An ASD was submitted to VDEQ pertaining to the pH exceedance identified in MW-16 for the 1st semi-annual 2003 monitoring event.

February 15, 2005: A letter from VDEQ recommended UOSA withdraw the November 2004 ASD and initiate a Phase II monitoring program. The November 2004 ASD was subsequently withdrawn and a meeting with the VDEQ was requested to discuss the specifics of a proposed Demonstration Study to be performed rather than implementing a Phase II Monitoring Program.

April 7, 2005: An updated GMP was submitted to VDEQ. The GMP added upgradient monitoring well MW-17 to the groundwater monitoring network. The GMP was approved by VDEQ on February 7, 2006.

July 22, 2005: VDEQ requested that UOSA implement a Phase II Monitoring Program due to the 2004 specific conductivity exceedance in MW-16.

August 4, 2005: In response to VDEQ's request dated July 22, 2005, a meeting with VDEQ occurred to discuss the following: changes in the groundwater monitoring program, the preparation of a Variance Petition, and a Demonstration Study. In the months following the meeting, a Variance Petition and a Demonstration Study were submitted to VDEQ recommending the semi-annual monitoring for 10 site-specific inorganic constituents and performing only inter-well statistical comparisons.

February 2, 2006: The Landfill's Solid Waste Permit was amended by a minor amendment incorporating a modification to the groundwater monitoring network, adding upgradient monitoring well MW-17 to the network and a revised GMP.

April 5, 2006: The Variance Petition was approved by VDEQ with the following requirements. This petition is no longer applicable due to the changes in the VSWMR in March 2011.

- The facility shall sample the permitted groundwater monitoring wells for arsenic, barium, chromium, cobalt, copper, nickel, phosphorus, silver, vanadium, and zinc instead of the four indicator parameters listed under 9 VAC 20-80-300 C 3 a.

- The facility shall perform only an *inter-well* statistical comparison instead of both *intra-* and *inter-well* comparisons.

- An exceedance over facility background for a constituent named above shall trigger the implementation of Phase II monitoring as defined under 9 VAC 20-80-300 C 4.

April 9, 2007: An updated GMP was submitted to VDEQ in response to changes in the permitted groundwater monitoring network and monitoring parameters. In a letter dated June 22, 2007, VDEQ requested revisions to the data evaluation section of the GMP. The requested revisions were submitted to VDEQ on April 23, 2007.

November 8, 2007: An ASD was submitted to VDEQ for the inter-well statistical exceedance identified for the barium concentration detected in MW-16 for the July 2007 groundwater monitoring event. As presented in the ASD, upper prediction limit (UPL) comparison results utilizing the proposed, revised upgradient pool (MW-8, MW-9, and MW-17) exhibited no inter-well exceedance for the July 2007 barium concentration detected in MW-16. The ASD was approved by VDEQ on February 4, 2008. The November 8th letter also included a request for a minor permit amendment reflecting the proposed change in the permitted groundwater monitoring well network such that MW-10 would be removed as a permitted upgradient monitoring well and replaced with MW-8 and MW-9.

December 11, 2007: VDEQ requested additional information prior to proceeding with their review of the November 8, 2007 minor permit amendment request. Boring logs and construction diagrams for MW-8 and MW-9 were submitted on January 10, 2008 and cross-sections were submitted on January 23, 2008. The minor permit amendment was approved by VDEQ on March 31, 2008.

January 10, 2008: An ASD was submitted to VDEQ for the inter-well statistical exceedance identified for the zinc concentration detected in MW-14 during the July 2007 groundwater monitoring event. In a letter dated May 15, 2008, VDEQ stated that the concentrations of zinc in downgradient well MW-I4 have not shown a verified exceedance for the 2nd semi-annual 2007 sampling event. Therefore, groundwater continued to be monitored in the modified Phase I program.

February 9, 2011 and July 13, 2011: VDEQ notified UOSA that Amendment 7 of the Virginia Solid Waste Management Regulations (VSWMR) became effective March 16, 2011. As a result, the Phase I monitoring program was no longer available to industrial landfills. Consequently, the Landfill's April 2006 Variance Petition was no longer valid. With these changes, during subsequent monitoring events, the groundwater was monitored in accordance with the First Determination Program (9 VAC 20-81-250 C 2).

July 2011: Implementation of the First Determination Program was initiated with the performance of the 2nd semi-annual 2011 groundwater monitoring event.

April 2012: A First Determination Report was submitted to VDEQ in accordance with 9 VAC 20-81-250 C 2 b as a result of regulatory changes in Amendment 7 of the VSWMR.

November 8, 2012: In accordance with 9 VAC 20-81-250 C 2 d b, a Variance Petition was submitted to VDEQ for the removal of Column A VOCs from the semi-annual monitoring list as these parameters were not reasonably expected to be in or derived from the waste. VDEQ subsequently approved this Petition in a letter dated March 13, 2013. The Variance Petition permitted monitoring of the groundwater monitoring wells for the analysis of 15 Column A inorganic parameters unless a Column A VOC is quantifiably detected in the annual leachate sample. The petition is no longer valid as a result of the verified and validated detections of VOCs in the August and September 2018 leachate samples. Semi-annual monitoring of Column A VOCs in the groundwater monitoring wells was reinstated in 2019.

August 9, 2017: An updated GMP was submitted to VDEQ to address modifications to the groundwater monitoring well network, modifications to the monitoring parameter list, addition of leachate monitoring and trigger actions, regulatory references updates, and general formatting updates.

November 6, 2018: The 2018 Annual Leachate Monitoring Report was submitted to VDEQ. As a result of verified and validated detections of VOCs in the August and September 2018 leachate samples, semi-annual monitoring of Column A VOCs in the groundwater monitoring wells was reinstated in 2019. Groundwater has been monitored in accordance with an un-modified First Determination Program since the 1st semi-annual 2019 groundwater monitoring event.

April 1, 2021: MW-14 was abandoned due to a blockage in the well and the inability to penetrate or remove the blockage. The abandonment was documented in a report submitted to VDEQ on May 11, 2021. The well was replaced with MW-14R which was installed on August 10, 2021. The well installation was documented in a report submitted to VDEQ on September 23, 2021.

1.3 PHYSICAL SETTING

The location of the Landfill is illustrated on a portion of the Centreville, Virginia, USGS 7.5-minute topographic quadrangle map presented as **Figure 1**. Topographically, the landfill property is generally flat with a slight slope to the west. The landfill property drains westward towards Cub Run.

The UOSA Landfill consists of one main disposal area with a permitted area of approximately 50 acres. The Landfill is located in western Fairfax County, near Centreville, Virginia. The landfill is located on the north side of the main UOSA plant, on the west side of Compton Road, just south of Interstate 66. Cub Run borders the property to the west. A large man-made reservoir, formed to hold the final effluent water, is located south of the landfill. A mixture of rural and residential property surrounds the landfill property. Adjacent properties are serviced by a municipal water supply.

1.4 GEOLOGIC SETTING

The Landfill is located within the Culpeper Basin and is underlain by Mesozoic bedrock. A Geologic Map is provided as **Figure 2**. The particular unit beneath the site consists of a reddish-brown siltstone and shale that is a unit of the Late Triassic Newark Supergroup. This unit is also known as the Balls Bluff siltstone and the Bull Run Formation. The reddish-brown siltstone unit is described as a micaceous, feldspathic siltstone with minor sandstone and shale. These rocks are highly jointed and readily eroded, forming gently rolling lowlands. The bedrock is typically mantled by thin residuum and clayey loam soil.

1.5 HYDROLOGIC SETTING

Although minor quantities of perched groundwater may be found in the overburden, the upper-most aquifer is typically developed within fractured bedrock. The upper-most aquifer is found in the siltstone as water-bearing fractures that range from horizontal to vertical in orientation. Because of the variability in the size and spacing of the fractures, the quantity and quality of the groundwater can vary widely over short distances.

Although the man-made UOSA reservoir is located to the south of the Landfill, it does not appear to have an effect on the groundwater gradient. If the effect is present, it is localized and does not appear to influence the water levels in the current groundwater monitoring network. The reservoir was drained almost empty from June 1999 to September 2000. This did not appear to have an appreciable effect on the water levels in the groundwater monitoring network. Based on water level measurements from the monitoring wells, the groundwater gradient appears to slope west-northwest, towards Cub Run.

2.0 HYDROLOGIC EVALUATION

The following hydrologic evaluation was performed to establish a groundwater monitoring network for the facility which satisfies the requirements of 9 VAC 20-81-250 A 3 a. The components of the evaluation include an assessment of groundwater flow and calculation of groundwater flow rate.

2.1 GROUNDWATER ELEVATIONS

Dating back to 2001, static water level measurements (aka depth to water) have been collected from the facility's groundwater monitoring well network. Static water levels were collected using an electronic water level probe and measured to ± 0.01 foot. The static water level measurements at each groundwater monitoring well were used to calculate the elevation of the groundwater, which was then used to create a groundwater contour map and establish groundwater flow direction. As shown in the following subsections, groundwater elevations were also utilized to calculate groundwater flow velocity.

Historical groundwater elevations for the monitoring wells are included in **Appendix A**. In addition, a time-series plot is provided in **Appendix A** illustrating the variability of groundwater elevations over time in each monitoring well. Groundwater elevations for the 1st half of the year are generally greater than groundwater elevations for 2nd half of the year reflecting a seasonal fluctuation in measured elevations.

2.2 GROUNDWATER FLOW DIRECTION

A groundwater contour map based on elevations measured on August 20, 2021 is included as **Figure 3**. Groundwater contours were generated using the Surfer™ (Golden Software Vers. 7.04) surface mapping system software using the kriging gridding method and altered utilizing professional judgement.

As illustrated on the groundwater contour map, groundwater within the upper-most aquifer flows west-northwest towards Cub Run. Groundwater monitoring wells MW-8, MW-9, MW-10, and MW-17 are upgradient of the landfill and MW-11, MW-14R, and MW-16 are downgradient of the landfill.

2.3 GROUNDWATER FLOW RATE CALCULATION

An aquifer's flow rate is influenced by the hydraulic gradient, hydraulic conductivity, and porosity of the aquifer. Details regarding each component of the flow rate calculation and groundwater flow rate calculations for the upper-most aquifer in the vicinity of the Landfill are presented in the following sub-sections.

2.3.1 Hydraulic Gradient

The horizontal hydraulic gradient (*i*) is the change in head (dH) per unit of distance (dL) in the direction of groundwater flow. Hydraulic gradient is the one factor for groundwater flow rate calculations that may change over time. Horizontal hydraulic gradients were calculated using the difference between various groundwater contour lines as shown on the August 2021 Groundwater Contour Map included as **Figure 3**. The August 2021 hydraulic gradient calculations are included in **Appendix A**. The hydraulic gradients for August 2021 ranged from 0.014 to 0.023 feet per foot with an average of 0.019 feet per foot.

2.3.2 Hydraulic Conductivity

Hydraulic conductivity (*K*) is the measure of a specific geological unit's ability to transmit water and is necessary to calculate groundwater rate. It is expressed as the volume of water that will move in a unit time under unit hydraulic gradient through a unit area measured at right angles to the direction of flow. Values for hydraulic conductivity are necessary to calculate groundwater flow rates.

Aquifer (slug) testing was conducted by SCS on May 24, 2001, to estimate the hydraulic conductivity of the upper-most aquifer at groundwater monitoring wells MW-16 and MW-17. Water levels during each slug test were recorded using a pressure transducer and data logger. The data logger recorded the change in the water levels in the well after a slug (solid-weighted PVC tube) was inserted into or removed from the well (falling head test and rising head test, respectively). Using the field measurements and the well construction details, the formation hydraulic conductivity was calculated using the KGS Model (Hyder, 1994) method in the Aqtesolv (HydroSOLVE Vers. 4.50.002) software as the curve best fit the slug test data. A summary of the aquifer test results is shown on **Table 1**.

Table 1. Hydraulic Conductivity Summary

Well ID	Hydraulic Conductivity, K (ft/yr)			
	Falling Head Slug Test	Solution Method	Rising Head Slug Test	Solution Method
MW-16	135	KGS	111	KGS
MW-17	1,529	KGS	1,156	KGS

ft/yr = feet per year

2.3.3 Porosity

Porosity (n_e) is the measure of a material's pore space through which water can flow and is necessary to calculate groundwater flow velocity. Based on references from Freeze & Cherry (1979), the effective porosity of the fractured siltstone/shale aquifer can range from 0 to 30%.

2.3.4 Groundwater Flow Rate

Groundwater flow rate was calculated using the Darcy equation (Fetter, 1994):

$$v_x = \frac{Ki}{n_e}$$

where:
- v_x = groundwater flow rate
- K = hydraulic conductivity
- i = horizontal hydraulic gradient
- n_e = effective porosity of the aquifer

As shown on the table included in **Appendix A**, groundwater flow rates were calculated utilizing the following:

- Horizontal hydraulic gradients between various groundwater contour lines as shown on the August 2021 Groundwater Contour Map
- The minimum and maximum values for hydraulic conductivity; and
- The maximum porosity value of 30%.

The estimated groundwater flow rates for August 2021 ranged from 5 to 115 feet per year. Regulated chemical constituents may travel through the subsurface at rates that may be more or less than the groundwater flow velocity due to natural physical, chemical, and biological factors (e.g., dispersion, soil adsorption, chemical degradation, oxidation, and biodegradation).

3.0 GROUNDWATER MONITORING NETWORK

In accordance with 9 VAC 20-81-250 A 3 a, the groundwater monitoring network was installed and is capable of yielding groundwater samples from the upper-most aquifer that represent the quality of background groundwater that has not been affected by a release from the waste management unit and represents the quality of groundwater downgradient of the waste management unit boundary. Downgradient and upgradient monitoring well placement was based on the knowledge of the following:

- In the vicinity of the landfill, the fractured siltstone bedrock aquifer is considered the upper-aquifer.
- Shallow groundwater flows west-northwest towards Cub Run.

The groundwater monitoring network for the Landfill consists of the following wells. A site map illustrating the monitoring well locations is included as **Figure 4**.

- **Background Wells (3):** MW-8, MW-9, MW-17
- **Compliance Wells (3):** MW-11, MW-14R, MW-16

4.0 WELL INSTALLATION AND MAINTENANCE

The following well operation procedures will be implemented for new groundwater monitoring wells. Available geologic boring logs and well construction details for the existing monitoring wells and a table summarizing selected groundwater monitoring well details are included in **Appendix B**.

4.1 WELL INSTALLATION PROCEDURES

Monitoring well construction and design will incorporate techniques and materials in accordance with 9 VAC 20-81-250, the facility's Solid Waste Permit, and United States Environmental Protection Agency guidance documents (EPA, 1993 & 2001). In addition to well drilling and construction, well installation procedures include surveying, development, and aquifer testing which are described in the following sub-sections.

4.1.1 Well Drilling and Construction

Well borings will be advanced into the subsurface using hollow-stem auger, air rotary, or another appropriate method. Based on the drilling logs for the existing monitoring wells and historical knowledge of the facility, the air rotary method was utilized for the drilling of the existing groundwater monitoring wells. Drilling equipment will be kept decontaminated between well installations.

The well will be constructed with two inch diameter, flush-threaded, PVC screen, and riser. The well screen will have a 0.02-inch factory slot and be 10 feet in length, unless the hydrogeologic conditions warrant or necessitate the use of a longer well screen for adequate detection monitoring.

The filter pack material will be clean, silica filter sand (#2). When placing the sand into the borehole, a minimum of six inches of the sand will be placed under the bottom of the well screen. In addition, the filter pack will extend a minimum of two feet above the top of the well screen. A bentonite pellet seal, with a minimum two feet in thickness, will be placed above the sand. The well annulus between the bentonite and the concrete apron will be filled with cement grout or bentonite. Steel surface casings, concrete aprons, and locking caps will be installed to secure and protect the well.

The following items will be observed and recorded during monitoring well installation.

- Date/time of construction
- Drilling Method and drilling fluid used, if any
- Borehole and well casing diameter
- Casing materials
- Screen materials and design
- Casing and screen joint type
- Screen size/length
- Filter pack material and size
- Length of filter pack
- Sealant materials
- Length of sealant
- Surface seal design and construction
- Type of protective well cap
- Drilling and lithologic logs

4.1.2 Well Surveying

Once installed, the northing, easting, and top of PVC casing elevation for each monitoring well will be surveyed to ±0.01-foot accuracy and each well will be marked with a unique identification number. The network summary table included in **Appendix B** provides the northing and easting orientation and the elevation of the top of the PVC casing for each existing groundwater monitoring well.

4.1.3 Well Development

Upon completion of installation of a new groundwater monitoring well, the well will be developed to remove residual sediment from the well and well's screen. The well will be developed using surging and over-pumping techniques. During development, measurements of pH, conductivity, temperature, turbidity, and color and sediment load of the groundwater may be recorded.

4.1.4 Aquifer Testing

Rising and/or falling head aquifer (aka slug) testing may be performed to establish aquifer properties. During aquifer testing, a sealed PVC slug is inserted into the well to cause the water level to rise. A water level meter or pressure transducer/data logger measures the falling head. After the water level has recovered to at least 90% of the original static water level, the slug is removed, and the rebound of the water (rising head) is measured in the same manner as the falling head test. The Bouwer and Rice, KGS Model, or Hvorslev methods will be used to analyze the raw data and to calculate the hydraulic conductivity at the well. Items introduced into a well will be decontaminated before and after insertion.

4.2 WELL MAINTENANCE

During each monitoring event, the groundwater monitoring wells will be observed for evidence of damage. Cracks in the steel surface casings and concrete aprons will be noted and subsequently repaired, if needed. Rusty hinges and padlocks will also be repaired. Should a locking cap be broken or missing, a replacement will be provided. If significant water accumulates within the stick-up cover, drainage holes may be drilled through the steel casing for drainage purposes.

Each well will be re-marked with its unique identification number should it become indiscernible. Vegetative overgrowth posing an access or workspace issue around a monitoring well will be mowed. The application of chemicals (herbicide, pesticide, etc.) to control weeds and insects will be undertaken on a limited basis to avoid introducing potential contamination around the well.

4.3 WELL RE-DEVELOPMENT

Upon installation, each groundwater monitoring well is initially developed. However, over time, debris (sand, silt, clay, etc.) may accumulate within the well. The well will be re-developed as described in the previous sub-section should this occur.

4.4 WELL REPLACEMENT

A well which has incurred damage beyond repair, does not produce an adequate water column thickness for sampling, or otherwise does not perform in accordance with 9 VAC-20-81-250 A 3 will be replaced before the next anticipated monitoring event. VDEQ will be notified and provide approval prior to the replacement activities.

4.5 WELL ABANDONMENT

Wells may be abandoned following the post-closure monitoring period or if a monitoring well is damaged beyond repair, contains excessive sediment within the well screen, or consistently does not provide an adequate water column for purging and sampling. VDEQ will be notified in advance of the intent to decommission a well. In accordance with industry standard procedures, a well will be abandoned in the following manner. Well abandonment by over-drilling may be used if site conditions require its applicability (i.e. wells located within future waste cells).

1. If applicable, the dedicated sampling pump will be removed from the well.
2. Observations of the well will made to verify the well is free of debris to its entire depth.
3. Filter pack, screen, and riser will be abandoned in place by filling the well with a bentonite/cement slurry to its entire length by tremie methods.
4. Surface protective casing will be removed and the site re-graded as necessary.

4.6 DEDICATED GROUNDWATER SAMPLING SYSTEM

Each monitoring well contains a dedicated groundwater sampling system which includes a bladder pump, associated tubing, and well cap for the collection of groundwater samples. Should the groundwater sampling system operate abnormally, or cease to operate altogether, it will be removed from the well, examined, and repaired. If necessary, a replacement system will be procured and installed.

5.0 GROUNDWATER MONITORING PROGRAM

The following subsections describe the requirements of each monitoring program (First Determination and Phase II) for Industrial Landfills as outlined in 9 VAC 20-81-250 C. The following subsection also describes the requirements for background monitoring should a new well be installed. As of the date of this GMP, groundwater monitoring is performed in accordance with the First Determination Monitoring program (9 VAC 20-81-250 C 2).

5.1 BACKGROUND MONITORING

In accordance with 9 VAC 20-81-250 C 2 B (1) (a), a minimum of four independent monitoring events will be performed for each new well (background or compliance) not installed as a replacement well or installed downgradient of a waste disposal unit that has already received waste. Each monitoring event will occur no less than 30 days from the previous monitoring event. The four independent samples will be collected and analyzed for the Column A parameters. A list of the specific Column A and B parameters is included in **Appendix C**.

5.2 FIRST DETERMINATION PROGRAM

In accordance with the First Determination Monitoring program (9 VAC 20-81-250 C 2), groundwater samples are collected from the background and compliance groundwater monitoring wells on a semi-annual basis. Samples are analyzed for parameters listed on Table 3.1 Column A of 9 VAC 20-81-250 D. The sampling frequency, monitoring locations, and required parameters associated with this Program are summarized on **Table 2** A list of the specific Column A parameters is included in **Appendix C**. If a confirmed SSI for a Column A constituent is identified and a successful ASD is not made within 90 days, the Phase II Monitoring Program will be initiated.

Table 2. First Determination Monitoring Program Summary

Well Classification: Well IDs	Sampling Frequency	Parameter Groups
Background: MW-8, MW-9, MW-17 **Compliance:** MW-11, MW-14R, MW-16	Semi-Annual	Table 3.1 Column A Parameters Total Metals Volatile Organic Compounds

5.3 PHASE II MONITORING PROGRAM

If a Phase II Monitoring Program (9 VAC 20-81-250 C 3) is initiated, each background and compliance groundwater monitoring well will be initially sampled and analyzed for Table 3.1 Column B parameters within 90 days of identifying a SSI. Within 180 days of the initial sampling event, four independent samples will be collected from each well to establish background concentrations for the detected Column B parameters.

Subsequent monitoring events will occur semi-annually. In accordance with 9 VAC 20-81-250 C 3 b, semi-annual monitoring event samples will be analyzed for Column A parameters and Column B parameters (not listed in Column A) historically detected above the laboratory's limit of detection (LOD). Lists of the Column A and B parameters are included in **Appendix C**.

In accordance with 9 VAC-20-81-250 C 3 b (3), once each Table 3.1 parameter is below background levels for two consecutive Table 3.1 Column B sampling events in the Phase II compliance wells,

VDEQ will be notified in the corresponding Semi-Annual and/or Annual Groundwater Monitoring Report and groundwater monitoring will be performed in accordance with the First Determination Monitoring Program for subsequent monitoring events.

6.0 GROUNDWATER SAMPLING PROCEDURES

Samples will be collected and handled in accordance with 9 VAC 20-81-250, the facility's Solid Waste Permit, and EPA guidance documents (EPA, 1993, 2001, and 2010). The following subsections discuss the aspects of sample collection from equipment selection and bottle ordering to sample collection and quality assurance and quality control.

6.1 EQUIPMENT SELECTION AND CALIBRATION

Equipment to be utilized for sampling purposes will meet the requirements of this GMP and analytical methods. Sample collection devices will be carefully chosen to minimize the potential for altering the quality of the sample. Teflon and stainless steel are preferred materials, although PVC, HDPE, and other materials are considered sufficient for the analysis described herein.

Field instruments will be calibrated for accurate readings. Calibrations will be conducted with approved standards and in accordance with the manufacturer-supplied manuals for each instrument.

6.2 BOTTLE KIT PREPARATION

A sample collection bottle kit will be prepared by the laboratory according to the laboratory analytical/bottle kit request sheet and in accordance with approved sample analysis methods. A summary of the types of sample containers and sample handling/preservation methods are listed in **Appendix C** for the corresponding parameters. A sample of the laboratory analytical/bottle kit request sheet is included in **Appendix D**. The sample kit will be stored in clean laboratory-provided coolers for transport to the facility.

6.3 STATIC WATER LEVEL DETERMINATION

In accordance with 9 VAC 20-81-250 A 4 c, groundwater elevations in wells that monitor the same waste management area will be measured within a period of time short enough to avoid temporal variations in groundwater flow, which could preclude accurate determination of groundwater flow rate and direction. Therefore, static water level measurements will be collected from the entire monitoring network within the same day during each semi-annual monitoring event and will be measured to $\pm$ 0.01 foot.

Well measurements will be made using an electronic water level probe and referenced to the top of the PVC well casing. The static water level measurements of each groundwater monitoring well will be used to calculate groundwater elevations and characterize changes in hydraulic conditions that may occur over time. A sample, groundwater level measurement log is included in **Appendix D**.

6.4 WELL PURGING PROCEDURES

Well purging procedures begin upon arrival at the well. The time of arrival and atmospheric and well conditions will be recorded. The water column will be calculated using the difference between the total well depth from the top of PVC casing and the depth to water from top of PVC casing. In addition, the water volume within the well will be calculated using the depth to water, total well depth, and well diameter.

Clean, disposable nitrile gloves will be worn and appropriate measures will be taken to reduce the opportunity for surface soils and other sources of potential constituents of concern from coming in contact with the purging equipment. During the evacuation period, dissolved oxygen, oxidation-

reduction potential, pH, specific conductivity, temperature, and turbidity will be measured at regular intervals of two to five minutes. Purge water appearance and odor (if any) will be noted and recorded at each interval. Purging will continue until three successive measurements of the indicator parameters meet the stabilization criteria shown on **Table 2**. If stabilization does not occur, the well will be purged till one well volume has been removed.

Table 3. Indicator Parameter Stabilization Criteria

Indicator Parameter	Stabilization Range
Dissolved Oxygen (DO)	< 0.5 mg/L or +/- 10% (when DO is > 0.5 mg/L)
Oxidation-Reduction Potential	+/- 10 mV
pH	+/- 0.1 s.u.
Specific Conductivity	+/- 3%
Temperature	+/- 3%
Turbidity	< 5 NTU or +/- 10% (when turbidity is > 5 NTUs)

mg/L = milligram per Liter
mV = millivolt
NTU = Nephelometric Turbidity Unit
s.u. = standard unit

To properly evacuate stagnant water from the monitoring wells, the wells will be purged at a low flow rate between 100 mL/min and 500 mL/min. The purge rate will be monitored by using a graduated container to measure the rate and volume being removed. Purge water resulting from each monitoring event will be stored on-site till the appropriate disposal method is selected in accordance with the VDEQ policy (VDEQ, 1995). The total volume actually purged and the time at which purging is terminated will be recorded on the purge log. If a well has an extremely low yield, it will be evacuated to dryness once, although purging to dryness will be avoided by reducing the purge rate. Dry wells and low recharge rates will be noted in the field observations.

6.5 SAMPLE COLLECTION PROCEDURES

Sampling will occur upon completion of the purging procedures as described in the previous sub-section. The samples will be transferred directly from the sampling device into a container that has been specifically prepared for the preservation and storage of groundwater samples for the specific analytical parameters.

In low yield formations where the well has been purged dry, samples will be collected when recovery is complete. Recovery is deemed complete when the well has recovered at least 80% of the draw down created by the purging or when the well has recovered for at least two hours since purging ceased. The well will be sampled within 24 hours of the completed purging time. If a monitoring well consistently will not supply adequate water for sampling, the condition of the well will be investigated and may be considered for replacement and/or exclusion from the sampling program.

If non-dedicated sampling equipment is utilized, the wells will be sampled beginning with the upgradient/cross-gradient wells followed by downgradient wells. If sampling is conducted utilizing only dedicated sampling equipment, the wells may be sampled beginning with the upgradient/cross-gradient wells followed by the downgradient wells, but the sampling order of the monitoring wells is

left to the discretion of the field personnel. Currently, the existing monitoring wells have been fitted with dedicated bladder pumps. Sample containers are to be filled in order of the parameter sensitivity to volatilization.

6.6 SAMPLE DOCUMENTATION

Sample documentation includes sample bottle labels, field logs, and chain-of-custody forms which are described in the following subsections. Sample labels, field logs, and a chain-of-custody form are included in Appendix D.

6.6.1 Sample Bottle Labeling

The sample containers will be laboratory certified bottles and properly labeled for identification including the following information.

- Sample ID
- Date and Time
- Sample Type – grab or composite
- Analysis Parameter(s)/Method
- Preservative
- Sampler(s)
- Project Name/Site ID

6.6.2 Field Logs

Field technicians will maintain field logs documenting information pertaining to field activities. The field notes will be reviewed to verify that the monitoring requirements of this Plan are met and to identify unusual circumstances which may affect the implementation of the Plan. Daily field logs and well sampling/micropurge logs will document the following:

- Personnel
- Site Name/Location
- Date of Sampling Event
- Climatic Conditions
- Well Identification
- Casing/Well Diameter
- Well Depth/Depth to Water
- Water Column in Feet
- Arrival/Departure Time
- Volume of One Well Volume
- Total Volume Purged
- Purge/Discharge Rate
- Well Evacuation Method
- Sampling Equipment
- Time of Sample Collection
- Comments on Sampling Event
- Field Analysis Data and Methods
- Purge Start/Completion Time

6.6.3 Chain-of-Custody

Sample transport and handling will be strictly controlled to reduce the opportunity of the samples to be tampered with. Chain-of-Custody control for the samples will consist of the following:

- Sample containers will be securely placed in coolers (iced) and will remain in the continuous possession of the field technician until transfer of the samples to the laboratory.

- If the samples leave the possession of the sampling crew, the sample containers or coolers will be individually sealed to reduce the opportunity for disruption/tampering of the samples during transportation.

- Upon delivery to a laboratory with Virginia Environmental Laboratory Accreditation Program certification, samples will be given unique laboratory sample numbers and recorded into a logbook indicating the: client, well number, and date and time of delivery. The laboratory director or his/her designee will sign the Chain-of-Custody form(s) and formally receive the samples. The field technician and laboratory director will work together to maintain proper refrigeration of the samples.

- The Chain-of-Custody document will contain the following information:

  - Client Name
  - Client Project Name
  - Client Contact
  - Client Address
  - Client Phone/Fax Number/Email Address
  - Sampler(s) Name and Signature
  - Sample ID(s)
  - Date of Collection
  - Time of Collection
  - Type of Container and Preservative
  - Number of Containers
  - Sample Matrix
  - Sample Type - Grab or Composite
  - Analysis Parameter(s)/Method

6.7 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA) and quality control (QC) measures will be taken to facilitate the collection of a groundwater samples representative of groundwater quality at the background and compliance wells. The QA/QC measures address the potential for atmospheric contamination, contamination between wells, and quality control sampling.

6.7.1 Atmospheric Contamination

Vehicle exhaust, particulates (i.e. dust and plant fallout), rain, or other potential constituents of concern must not be allowed to come into contact with the samples. When maneuvering to the monitoring well site by vehicle, efforts will be made to approach the well from downwind and to park the vehicle downwind of the well. The vehicle's engine will not be running in close proximity to the well. If necessary, clean plastic sheeting will be placed around the monitoring well as well as on the working surface where sample containers or equipment may make contact.

In the event the field technician observes a situation that, in his/her judgment, could compromise the validity of the sampling or the health and safety of personnel, the field technician will immediately cease sampling and contact the field supervisor. Some instances include, but are not limited to:

- Inclement weather,
- Dust or particulate from plants or equipment,
- Mowing in close proximity of monitoring well,
- Spraying of chemicals, and
- Dramatic changes in water quality (muddy or dry well).

The field technician will contact the project manager who will make a decision to continue sampling or terminate the event. If the event is terminated, the re-sampling will be rescheduled and completed within 30 days of the original sampling event.

6.7.2 Decontamination Procedures

Equipment used for drilling, development, sampling, and other activities associated with on-site work will be decontaminated before and after performance of the activity. Non-dedicated equipment will be thoroughly cleaned between wells in the manner outlined below. The decontamination fluids will be managed and disposed of in accordance VDEQ policy (VDEQ, 1995). Disposable items will be disposed of as solid waste in an approved, permitted facility.

- Rinse with tap water
- Wash with a non-phosphate laboratory detergent and tap water
- Rinse with deionized/distilled water
- Allow to air dry

6.7.3 Quality Control Sampling

Field quality control involves the routine collection and analysis of two types of QC blanks, trip and field blanks, to verify that the sample collection and handling processes have not impaired the quality of the samples.

- **Trip Blank** – Trip blanks are prepared for VOC analysis via SW-846 Methods 8011 and 8260. Laboratory personnel fill one of each type of sample bottle with distilled/deionized water and transport them to the facility. Trip blanks are prepared immediately prior to the sampling event and transported with the empty bottle kits. Field personnel handle the trip blanks like a sample; they remain un-opened, are transported in the sample cooler, and are returned to the laboratory for analysis. A trip blank is used to indicate potential contamination due to migration of VOCs from the air on-site or in the sample shipping containers through the septum or around the lid of the sampling vials and into the sample.

- **Field Blank** – The field blank is a sample of deionized/distilled water, which is taken to the field and used as rinse water for sampling equipment. The field blank is prepared like an actual sample and sent to the laboratory for identical analysis. A field blank is used to evaluate if certain field sampling or cleaning procedures result in cross-contamination of site samples or if atmospheric contamination has occurred.

Field and laboratory QA/QC also involves the routine collection and analysis of a duplicate field sample. This sample is collected at a rate of one per sample event. A duplicate is a separate sample collected independently in such a manner that it equally represents the medium at a given time and location. Co-located samples provide intra-laboratory precision information for the entire measurement system, including sample collection, homogeneity, handling, shipping, storage, preparation, and analysis.

7.0 LABORATORY ANALYSIS

Upon receipt by the laboratory, samples, including the blanks, will be assigned a unique laboratory identification number and inspected for integrity and consistency with information entered on the Chain-of-Custody document. The samples will also be tested for proper preservation or, in the case of volatile organic samples, inspected for lack of air bubbles in the sample vials. Deviations from applicable protocol will be noted on the Chain-of-Custody document and laboratory's sample conditions checklist. If possible, missing, broken, or improperly preserved samples will be replaced within 10 working days from the date that the deviation is first noted.

Sample analyses will be completed within 30 days after receipt by the laboratory. Once completed and reviewed, the project manager will be alerted to issues with the analysis results and the potential need for re-sampling. In accordance with 9 VAC 20-81-250 A 4 i, re-sampling will occur within 30 days of issuance of the laboratory analytical results in question.

The laboratory's QA/QC Manual will be used to maintain the integrity of the data. Analyses will be conducted in accordance with the methods presented in EPA SW-846, Test Methods for Evaluating Solid Waste (EPA, 2014). In addition, laboratory analysis will be performed by a VELAP certified laboratory.

While awaiting analysis, samples will be stored in a secure location under the appropriate method of preservation (i.e. refrigeration). If a method-prescribed holding time is exceeded, the sample will be discarded and replaced.

Analytical results will be reported relative to both a method limit of detection (LOD) and limit of quantitation (LOQ). LOD and LOQ values are parameter, method, and matrix-specific. Sub-LOD results will be reported as not detected. Results equal to or above the LOD value but below the LOQ value will be reported as estimated values. Results equal to or greater than the LOQ value will be reported without estimation. Analytical methods are selected to yield LOQ values that are equal to or below the EPA's Maximum Contaminant Level (EPA-MCL) if such a method is available.

8.0 DATA EVALUATION

In accordance with the VSWMR, the following data evaluations will be performed within 30 days of receipt of the final laboratory's certificate of analysis for each semi-annual monitoring event. If an extreme value is identified, the facility may collect a verification sample within 30 days of final issuance of the associated laboratory's certificate of analysis in accordance with 9 VAC 20-81-250 A 3 i or seek further data validation as allowed under 9 VAC-20-81-250 A 4 j.

In accordance with 9 VAC 20-81-250 A 4 g, the following subsections provide details regarding the statistical methods used in the evaluation of groundwater monitoring data for each monitoring constituent. The statistical tests have been selected based on the data evaluation requirements of 9 VAC 20-81-250 B 2 and 3. Statistical tests are performed using significance levels of 95% or 99% (i.e. a false positive rate of 5% or 1%).

8.1 EVALUATION OF GROUNDWATER ELEVATION DATA

The static groundwater surface elevations obtained prior to each sampling event will be used to calculate the rate of groundwater flow and create a groundwater contour map illustrating the direction of groundwater flow. Groundwater elevations and flow direction will be compared to previous historical data to evaluate seasonal fluctuations observed at the facility. Groundwater flow and elevation information will then be utilized to evaluate whether the requirements for locating the monitoring wells continue to be satisfied. If it is assessed that the depths, location, or number of wells is insufficient to meet the requirements of 9 VAC 20-81-250 A 3 a, new well locations will be submitted to VDEQ for approval prior to installation.

8.2 DATA VALIDATION

To identify analytical data that may not represent valid results, data from the monitoring events are validated in accordance with EPA guidance (EPA, 1992 and 2017). Data flagged with a "J" qualifier indicates the quantitation of the parameter is less than the laboratory's LOQ but greater than the laboratory's LOD; thus, the concentration is considered estimated. Samples with parameter detections less than five times that of the trip blank, field blank, and/or method blank detection but greater than the laboratory laboratory's LOD are flagged with a "B" qualifier. Samples with common lab contaminant parameter detections less than 10 times that of the trip blank, field blank, and/or method/laboratory blank detection but greater than the laboratory laboratory's LOD are flagged with a "B" qualifier (Yacoub, 2016). B qualified detections are considered not validated as the detection may be anomalous to due to sampling, laboratory, or transportation errors.

8.3 INTER-WELL STATISTICAL ANALYSIS

In accordance with 9 VAC 20-81-250 C 2 d, inter-well statistical analysis is conducted to evaluate if compliance well parameter detections are potentially due the waste management unit and assess if the landfill will be monitored in accordance with the First Determination or Phase II monitoring program. The inter-well statistical analysis process involves:

- Establishing Upgradient Data Sets for UPL Calculations
- Assessing Data Distribution of Upgradient Data Sets
- Calculating and Comparing to UPLs

8.3.1 Background Data Screening

Prior to the performance of the inter-well analyses, each data set will be screened for outliers and assessments will be made as to the treatment of non-detects and duplicate samples. Duplicates will be averaged with the original sample to form an independent data point before statistical analyses are performed. The following subsections describe the data manipulations applied for non-detects and outliers.

8.3.1.1 Treatment of Non-Detects

The amount of data that are below the laboratory's LOD plays an important role in selecting the appropriate statistical evaluation method and the resulting statistical calculation. In accordance with EPA guidance (EPA, 2009), non-detect data are adjusted accordingly for data sets in which statistical analysis is performed.

- If greater than 0% but fewer than 25% of the values were "not detected", the non-detect results were replaced with the laboratory's LOD divided by two.
- If 25% or more, but less than 50%, of the values were reported as "not detected", the non-detect results were adjusted using the Aitchison's Method.
- If 50% or greater of the data were reported as "not detected", the non-detect results were replaced with the LOD and a non-parametric statistical method was utilized.

8.3.1.2 Outlier Analysis

Outlier analyses is completed on data from the background wells for parameters in which inter-well statistical analyses is performed. The identification of an outlier may be the result of fluctuations in aquifer geochemistry, a release from the landfill, changes in laboratory analytical method or detection/quantitation limits, errors during sampling or laboratory analysis, etc.

The test for outliers consists of comparing the historical analytical results for each parameter within each well. The Dixon's test is performed for small data sets (i.e., $n \leq 25$). The Rosner's test is performed for large data sets (i.e., $n > 25$). The Discordance Test is performed to test if a single extreme value is an outlier.

8.3.2 Establishing Background Data Set for UPL Calculation

Inter-well statistical analysis will be conducted for Column B parameters validated and quantified at a concentration equal to or above the laboratory's LOQ in the compliance monitoring wells. To compare the compliance well parameter detections to the UPL, a UPL is calculated for each parameter utilizing historical data from upgradient/background wells.

The background data set must contain at least eight results for the calculation of a parametric UPL and at least 13 results for the calculation of a non-parametric UPL. Data from the upgradient/background wells identified as outliers will not be included in the data set to preserve the power of the test to detect a potential release from the landfill. In addition, parameter results from the upgradient/background wells flagged with a "B" qualifier will not be included in the data set to preserve the power of the test to detect a potential release from the landfill.

8.3.3 Assessing Data Distribution of Upgradient Data Set

The distribution of each upgradient data set with less than 50% non-detects is established in order to select the appropriate UPL calculation method. The Shapiro-Wilks test is performed to establish data distribution for data sets with less than 50 data points. The Shapiro-Francia test is performed to establish data distribution for data sets with 50 or more data points. Data sets with greater than 50% non-detects are not subjected to a data distribution evaluation as the UPL is set to the non-parametric UPL.

8.3.4 Calculating and Comparing to UPLs

A parametric UPL is calculated for upgradient data sets in which the distribution of the data is normal and there are less than 50% non-detects in the data set. A non-parametric UPL is calculated for upgradient data sets in which the distribution of the data is non-normal or there are greater than 50% non-detects in the data set. If the UPL is less than the laboratory's current LOQ, the UPL is set to the laboratory's current LOQ. Validated Table 3.1 parameter detections identified in the compliance monitoring wells for each semi-annual monitoring event are directly compared to the UPL.

8.3.5 Responses to Inter-Well Exceedances

If a verified inter-well exceedance is identified for a compliance well while in the First Determination monitoring program, VDEQ will be notified of the inter-well statistical exceedance within 44 days of final issuance of the associated laboratory's certificate of analysis in accordance with 9 VAC 20-81-250 C 2 d (2). The statistically significant increase notification will include a statement that within 90 days of the notification, the Phase II Monitoring Program will be initiated as required under 9 VAC 20-81-260 C 2 d (2) (a) or an ASD will be submitted as specified in 9 VAC 20-81-250 A 5.

If an inter-well exceedance is identified for a compliance well monitored in accordance with the Phase II monitoring program, the inter-well exceedance will be presented in the corresponding Semi-Annual and/or Annual Groundwater Monitoring Report.

In accordance with 9 VAC-20-81-250 C 3 e (1), once the facility demonstrates each Table 3.1 parameter is below background levels for two consecutive Column B sampling events in the Phase II compliance wells, VDEQ will be notified in the corresponding Semi-Annual and/or Annual Groundwater Monitoring Report and return to the First Determination Monitoring Program (9 VAC 20-81-250 C 2).

8.4 GROUNDWATER PROTECTION STANDARDS

If a Phase II Monitoring Program is initiated in accordance with 9 VAC 20-81-250 C 3, facility-specific GPS values will be established for parameters listed on Table 3.1 by comparing the EPA-MCL and the VDEQ Alternate Concentration Limit for each parameter in accordance with 9 VAC 20-81-250 C 3 c and 9 VAC 20-81-250 A 6 as outlined below. The list of the facility's GPS for the Column B parameters will be maintained within the facility's Operating Record in accordance with 9 VAC 02-81-250 A 6 c.

1. If an EPA-MCL existed for a given parameter, and the UPL of the background data does not exceed the EPA-MCL, the GPS is set to the MCL.

2. If the background concentration for a given parameter (metals only) was greater than the EPA-MCL, the background is chosen as the GPS.

3. If the EPA-MCL does not exist (not promulgated), the use of the VDEQ-ACL as the GPS is granted in the form of participation in a variance petition.

4. The LOQ is used for those parameters without a background value, EPA-MCL, or VDEQ-ACL.

In accordance with 9 VAC 20-81-250 A 6 d, if a GPS value is modified as the result of a revision to an EPA-MCL or facility background value, an updated GPS list will be placed in the facility's Operating Record. In addition, the new value will be used for subsequent comparisons of monitoring data.

In accordance with 9 VAC 20-81-250 A 6 e, if a GPS value is modified as the result of a revision to a VDEQ-ACL, the new value will be used for subsequent comparisons of monitoring data. To the extent practical, VDEQ will issue revisions to the VDEQ-ACLs no more frequently than annually.

8.4.1 Comparison to Groundwater Protection Standards

In accordance with 9 VAC 20-81-250 C 3, validated Column B parameter detections will be subjected to a direct comparison to GPS within 30 days of final issuance of the associated laboratory's certificate of analysis. If a GPS exceedance is noted during the value-to-value comparison for a parameter, a verification sample may be collected and results from the verification sample will be compared to the GPS in a value-to-value comparison as long as the comparison is completed within 30 days of the initial sampling event.

Three additional independent groundwater samples may be collected for the suspect parameter to perform a statistical comparison to GPS (VDEQ-ACL or EPA-MCL based values only). The statistical comparison entails pooling the last four independent results (within the same compliance period) for the suspect parameter at the same well and calculating the lower confidence limit. The LCL value is compared to the GPS to establish compliance.

8.4.2 Responses to Groundwater Protection Standard Exceedances

GPS comparisons will be presented in the associated Semi-Annual or Annual Groundwater Monitoring Report. In accordance with 9 VAC 20-81-250 C 3 e (3) (a), VDEQ will be notified of a verified GPS exceedance within 44 days of final issuance of the associated laboratory's certificate of analysis. The GPS exceedance notification will include a statement that within 90 days of the notification, the characterization and assessment action required under 9 VAC 20-81-260 C 1 will be initiated or the performance of an ASD as specified in 9 VAC 20-81-250 A 5 will be initiated.

If a successful ASD is made within 90 days of the associated GPS exceedance notification, groundwater monitoring will continue to be performed in accordance with the Phase II monitoring program. If the 90-day period is exceeded, the timeframes of 9 VAC 20-21-260 C will be met unless granted an extension by VDEQ.

9.0 REPORTING

The reporting requirements for Industrial Landfills described in the following sub-sections include: documentation of well installations, well abandonments, and performance of semi-annual monitoring events and subsequent data evaluations.

9.1 MONITORING WELL ABANDONMENT REPORT

Within 44 days of well abandonment, a Well Abandonment Report will be submitted to VDEQ. This report will contain information including field methods utilized and a certification from a qualified groundwater scientist verifying the well abandonment activities met the applicable requirements.

9.2 MONITORING WELL INSTALLATION REPORT

In accordance with 9 VAC 20-81-250 A 3 g, new permitted monitoring wells must be certified by a qualified groundwater scientist noting that the well(s) have been installed in accordance with applicable regulations (within 30 days of well installation). Within 14 days of this certification, the facility will submit the certification to VDEQ in the form of a Monitoring Well Installation Report.

This report will include a site map illustrating and description of the groundwater monitoring system including the number of monitoring wells and location of upgradient/background and downgradient/compliance monitoring wells. The report will also include details on drilling methods, construction materials, well intake design, well development, aquifer testing results, and associated documentation for well installation.

9.3 1ST SEMI-ANNUAL GROUNDWATER MONITORING REPORT

In accordance with 9 VAC 20-81-250 E 2 b (1), a Groundwater Monitoring Report documenting the 1st semi-annual monitoring event will be prepared and submitted to VDEQ within 120 days of final issuance of the associated laboratory's certificate of analysis. The report will be prepared in accordance with VDEQ Submission Instructions for Groundwater Semi-Annual and Quarterly Monitoring Reports (LPR-GWSI-2011-10) and will contain at a minimum the following:

- Signature page signed by a professional geologist or qualified groundwater scientist
- Facility name and permit number
- Statement noting that the monitoring well network meets the requirements of 9 VAC 20-81-250 A 3 and were sampled in accordance with 9 VAC 20-81-250 C
- Calculated groundwater flow rate
- Groundwater contour map illustrating direction of groundwater flow
- Statement regarding statistically significant increases over background or the facility's GPS, the supporting statistical calculations, and date of which the exceedance notification was submitted to VDEQ
- Copy of laboratory's certificate of analysis including the dated signature page.

9.4 ANNUAL MONITORING REPORT

In accordance with 9 VAC 20-81-250 E 2 a (1), an Annual Groundwater Monitoring Report will be prepared and submitted to VDEQ within 120 days of final issuance of the associated 2nd semi-annual laboratory's certificate of analysis. The report will be prepared in accordance with VDEQ Submission Instructions for Groundwater Annual Reports (LPR-GWSI-2011-09) and will contain at a minimum the following:

- Signature page signed by a professional geologist or qualified groundwater scientist
- A completed QA/QC VDEQ Form ARSC-01
- The landfill's name, type permit number, current owner or operator
- Location of the facility on a USGS topographic map
- The landfill's design type (i.e., lined versus unlined)
- Operational history (i.e., trench fill versus area fill)
- Size (acres) of the landfill
- Key operational dates such as beginning and termination of waste disposal actions
- Dates different groundwater monitoring phases were initiated
- Description of the surrounding land use noting whether adjoining land owners utilize private wells as a potable water source
- Discussion of the topographic, geologic, and hydrologic setting of the landfill including a discussion on the nature of the uppermost aquifer (i.e., confined versus unconfined) and proximity to surface waters
- Discussion of the monitoring wells network noting modifications that were made to the network during the year or any nonperformance issues
- A statement noting that the monitoring well network meets (or did not meet) the requirements of 9 VAC 20-81-250 A 3
- A listing of the groundwater sampling events undertaken during the associated calendar year
- A historical table listing the detected constituents, and their concentrations identified in each well during the associated sampling period
- Evaluations of, and appropriate responses to, the groundwater elevation data
- Groundwater flow rate as calculated using the associated years' elevation data
- Groundwater flow direction (as illustrated on a groundwater contour map)

- Sampling and analytical data obtained during the associated calendar year
- Required and/or anticipated actions for the upcoming year

9.5 RECORD KEEPING REQUIREMENTS

As required by 9 VAC 20-81-250 E 1, records pertaining to groundwater monitoring activities will be retained at UOSA throughout the post-closure care period of the facility, and will include at a minimum:

- Historical groundwater surface elevation data measurements
- Historical laboratory analytical results for groundwater sampling events required under the groundwater monitoring programs
- Record of well installation, repair, or abandonment actions
- VDEQ correspondence to the facility
- Approved variances, well subsets, wetlands, or other department approvals (if applicable)

The above documents will be stored at:

Upper Occoquan Service Authority
14631 Compton Rd.
Centerville, VA 20121

Contact: Ms. Mishelle Noble-Blair
Phone: (703) 227-0202
E-Mail: Mishelle.Noble-Blair@usoa.org

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Figures

Figure 1. Topographic Quadrangle Map
Figure 2. Geologic Map
Figure 3. Groundwater Contour Map –August 20, 2021
Figure 4. Site Map

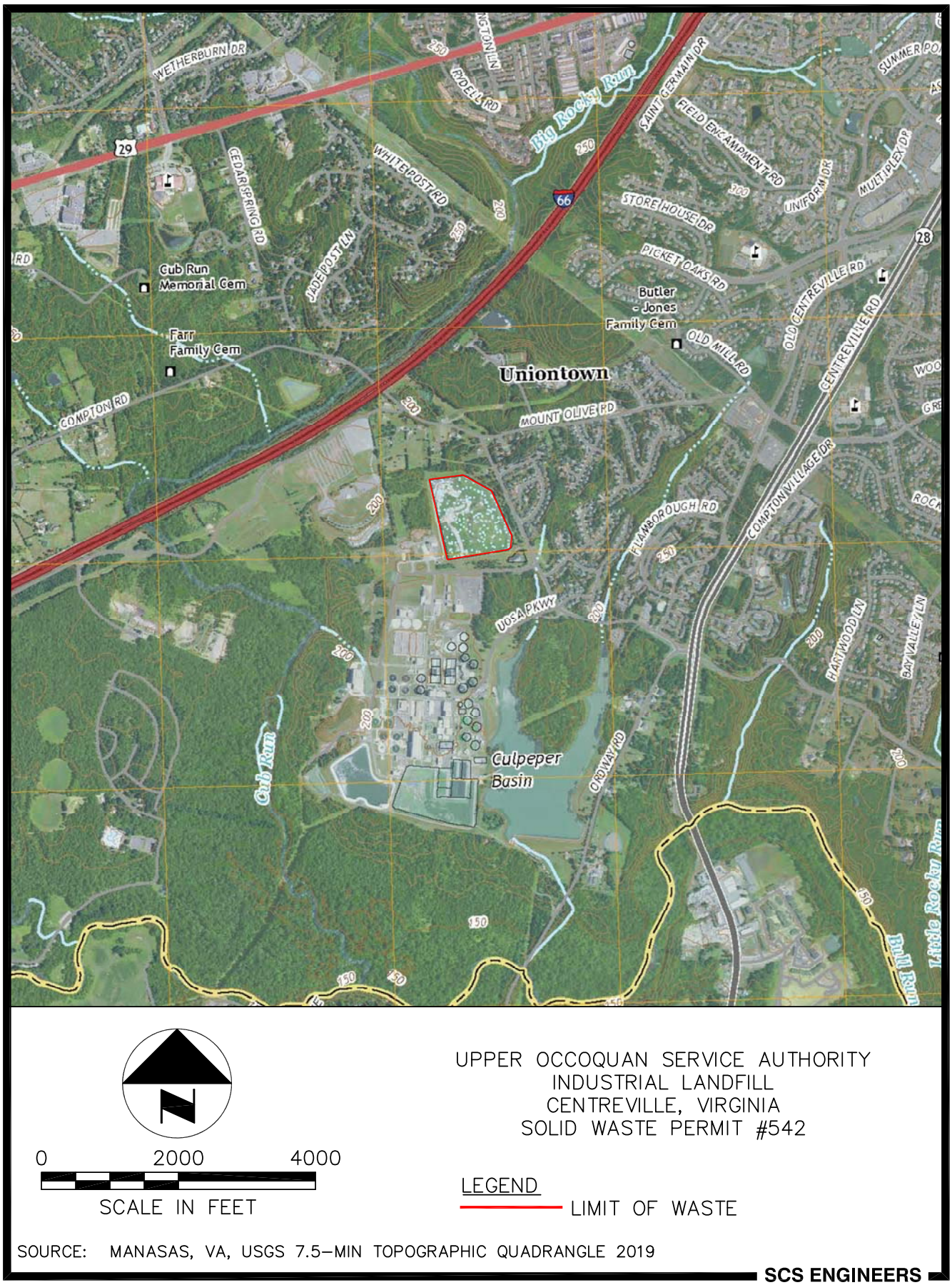
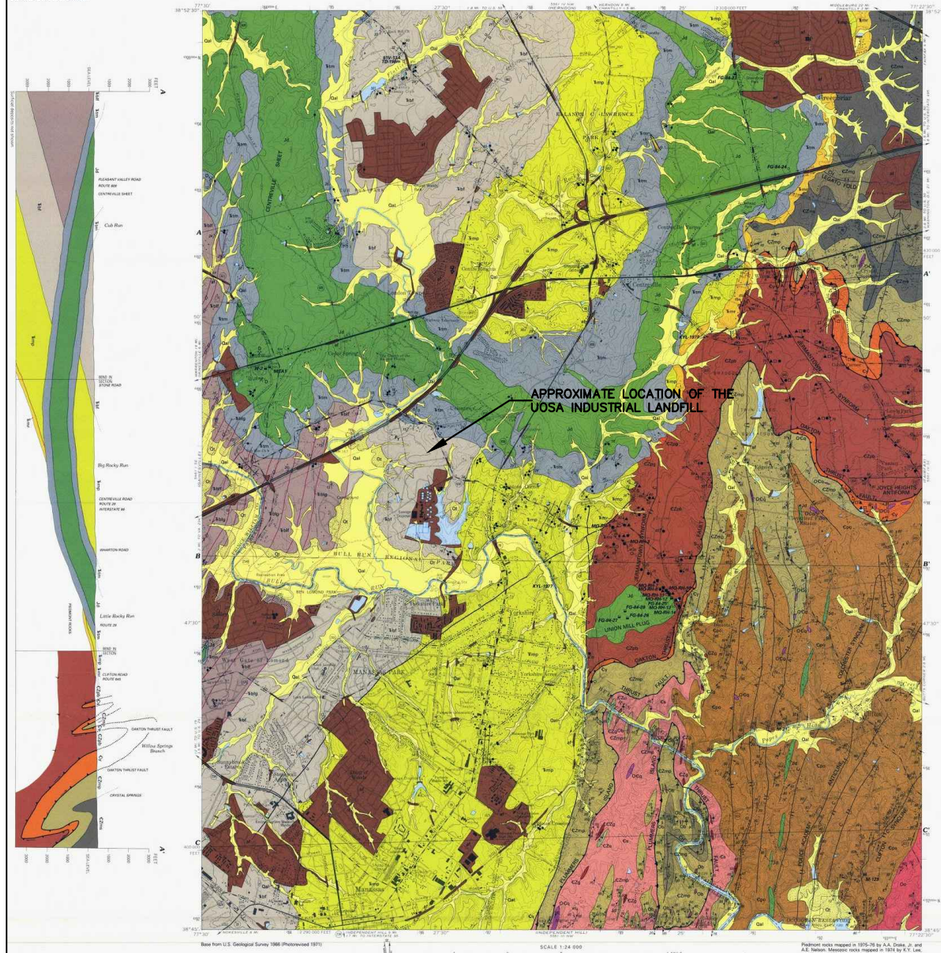
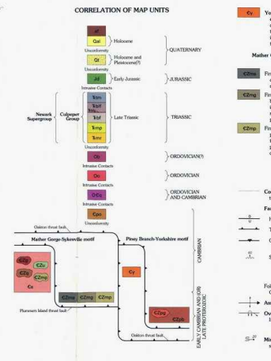
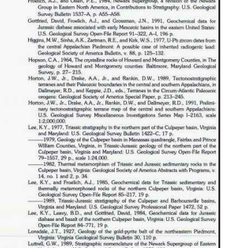
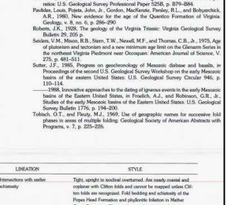


FIGURE 1 - TOPOGRAPHIC QUADRANGLE MAP









U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

DESCRIPTION OF MAP UNITS

af **Artificial fill**—Various sandy and gravelly materials of local origin; commonly in low-lying areas filled and compacted for construction of highways, bridges, overpass approaches, railroad beds, and in small earthfill dams. Includes extensive, recently graded, cut-and-fill areas of urban construction, and disturbed ground, spoil piles, and areas excavated for quarries and borrow pits

Qal **Alluvium (Holocene)**—Sand, gravel, silt, and clay underlying sinuous flood plains along most streams; clastic sediments are in fairly well-bedded, well- to poorly-sorted, graded, fluvial, cyclic deposits with gravel at base of upward fining sequences; locally as much as 16.5 ft thick. Commonly micaceous silts and sands with quartz and crystalline rock pebbles, cobbles, and boulders in streams draining crystalline Piedmont terrain; with subrounded sandstone, siltstone, hornfels, and diabase fragments in Triassic Lowland areas

Qt **Terrace deposits (Holocene and Pleistocene(?))**—Minor discontinuous erosional remnants of poorly bedded gravel, sand, silt, and clay deposits flanking Bull Run at elevations of 150 to 160 ft; also as gravel veneer (mostly unmapped) and isolated patches on local upland surfaces at elevations of about 200 ft

MESOZOIC ROCKS

Jd **Diabase (Early Jurassic)**—Light- to dark-gray, largely equigranular; locally fine crystalline to aphanitic in narrow dikes and near the chilled margins of thick sheets, but medium- to coarse-crystalline in the interior; encloses light gray to pink granophyric, syenitic and dioritic segregations (not mapped) most common along west flank of the thick, spoon-shaped Centreville sheet. Diabase consists mainly of grayish-green to black crystals of augite and pigeonite, subhedral to euhedral laths of light gray plagioclase (chiefly labradorite), with minor granules of interstitial magnetite and ilmenite; syenitic and dioritic granophyre also contain pink to white albite-oligoclase, orthoclase, minor hornblende and biotite; Union Mill noritic diabase body east of Yorkshire contains euhedral to subhedral phenocrysts of honey-yellow to brown orthopyroxene (mainly bronzite) and interstitial pyrrhotite. Thickness of narrow dikes is less than 10 ft, whereas the Centreville sheet may be locally as much as 1,000 ft thick

Ŧtm **Thermally metamorphosed rocks (Late Triassic)**—Light- to dark-gray, bluish-gray to olive-black hornfels, granulite (granofels), meta-arkose, and meta-conglomerate in zoned contact aureoles of Manassas Sandstone and Balls Bluff Siltstone adjacent to diabase intrusives. Cordierite-spotted hornfels and tourmaline granulite are common in the innermost zone of the aureole, with epidote and chlorite hornfels and epidote-rich meta-arkose characteristic of the outer zone (Lee, 1982; Lee and Froelich, 1989) enclosing the Centreville diabase sheet. Thickness of this unit is highly variable and is dependent on the thickness of the adjacent diabase; ranges from a meter or less near narrow dikes to more than 328 ft where it overlies and underlies the Centreville sheet

Ŧblg Ŧblf Ŧbf **Balls Bluff Siltstone (Late Triassic) (Lee and Froelich, 1989)**—Mainly dusky-red to grayish-red, calcareous, clayey, micaceous, feldspathic, sandy siltstone; thin-bedded to massive, bioturbated (roots and burrows), with irregular or convolute bedding and hackly fracture. Dusky red siltstone has climbing-ripple crossbedded, fine-grained, fluvial sandstone and medium-grained carbonate granule sandstone gradational with the upper Poolesville Member of the Manassas Sandstone (Ŧbf). The dusky-red siltstone sequence that overlies the fluvial siltstone commonly has mudcracks, carbonate nodules (caliche?), and oscillatory ripples, and is interbedded with numerous cyclic, medium- to dark-gray and light greenish-gray, laminated, thin bedded to massive, lacustrine, clayey siltstone and silty shale (Ŧblf). Some shale is fissile, microlaminated, pyritic, sparsely fossiliferous (ostracodes, conchostrachans, plant stems, small reptile tracks), with thin intercalations of fine grained sandstone, and argillaceous, dolomitic limestone. At least 19 cyclic greenish-gray silty lacustrine shale beds (Ŧblg) are poorly exposed. Thickness of Balls Bluff Siltstone in the area north of Centreville was calculated as 6,400 ft by Lee (1977), but that part present in the western part of the Manassas quadrangle ranges from less than 165 ft on the south to about 4,756 ft in the north. The lower, mainly fluvial part is about 1,700 ft thick, and the overlying cyclic lacustrine part preserved in this quadrangle is about 3,100 ft thick

Ŧmp **Poolesville Member of Manassas Sandstone (Late Triassic) (Lee and Froelich, 1989)**—Dusky-red, grayish-red, very dark-red, and light- to medium-gray, very fine- to coarse-grained, feldspathic, micaceous, ferruginous sandstone. Lower half of unit is mainly thin- to very thick-bedded and massive, commonly trough- and planar-crossbedded, with lenses and layers of very coarse grained, pinkish-gray, arkosic sandstone and quartzite pebble conglomerate at the base of scoured channels. The upper half of the unit consists mainly of fine- to medium-grained sandstone with abundant carbonate granules interbedded with reddish-brown, calcareous, sandy siltstone that is gradational into the overlying fluvial lower Balls Bluff Siltstone. Thickness is variable across the quadrangle, but may be as much as 3,280 ft. Lee (1977) calculated a thickness of 2,375 ft of Poolesville Member in the north Centreville area; he also documented a partial section measured in the lower part of the unit along the northeastern bank of Bull Run north of Yorkshore (Lee, 1977, Section 4, p. C11)

Ŧmr **Reston Member of Manassas Sandstone (Late Triassic) (Lee and Froelich, 1989)**—Predominantly deeply weathered pebble to boulder conglomerate with subangular clasts of schist, quartz, and quartzite in a friable matrix of fine- to coarse-grained arkosic sand or clayey silt; contains layers of micaceous, clayey, calcareous, feldspathic siltstone, fine- to medium-grained, subrounded, micaceous, crossbedded sandstone, and pebbly feldspathic, coarse-grained sandstone. Lee (1977, Section 3, p. C10-C11) documented a partial measured section of the upper part of the Reston Member southeast of Centreville along Braddock Road. Thickness of the unit in this area is variable, ranging from about 16.5 ft to possibly more than 82.5 ft

PIEDMONT ROCKS

Intrusive Rocks

Ob **Bear Island Granodiorite (Ordovician(?)) (Cloos and Cooke, 1953)**—Fine-grained, very leucocratic, muscovite-biotite granodiorite and related pegmatite composed largely of quartz, albite, and microcline. Forms small- to moderate-sized sheets and crosscutting bodies. Found only within the sheared rocks of the Mather Gorge Formation (ꞒZmp)

Oo **Occoquan Granite (Ordovician) (Lonsdale, 1927; Seiders and others, 1975)**—Medium- to coarse-grained, light-gray, muscovite-biotite monzogranite and lesser granodiorite and tonalite. Rock in many exposures has a strong quartz-rod lineation and two foliations

OꞒq **Quartz bodies (Ordovician and Cambrian)**—Lenticular bodies or irregular masses of quartz. Some bodies are foliated or polyfoliated, whereas other bodies are massive

Metasedimentary, Metavolcanic, and Transported Metaigneous Rocks

Ꞓpo **Old Mill Branch Metasiltstone Member of Popes Head Formation (Cambrian) (Drake and Lyttle, 1981)**—Light-greenish-gray, thin- to medium-bedded, medium- to very fine-grained, very mature, micaceous metasiltstone. The metasiltstone contains interbedded pelitic phyllite as well as felsic and mafic metatuff. Unit has an apparent maximum thickness of about 2,395 ft

ꞒZpb ꞒZpg **Piney Branch Complex (Early Cambrian and(or) Late Proterozoic) (Drake and Morgan, 1981)**—Intermixed complex consisting of roughly subequal parts of peridotite, pyroxenite, and gabbro now represented by serpentinite, soapstone, actinolite-tremolite schist, talc schist, and metagabbro, which constitute an autoclastic mélange. Commonly contains slip fiber "asbestos" where sheared. Contains small sheets and dikes of quartz-albite plagiogranite (ꞒZpg). Rock types in outcrop are indicated by the following symbols: metagabbro, ○ ; plagiogranite, ● ; serpentine, ▲ ; soapstone, △ ; actinolite-tremolite schist, □

Ꞓs ꞒZg ꞒZu ꞒZmp ꞒZq **Sykesville Formation (Cambrian) (Hopson, 1964; Drake, 1985a)**—Light- to medium-gray, medium-grained sedimentary mélange consisting of a quartzofeldspathic matrix that contains quartz "eyes", fragments of foliated felsic and mafic metavolcanic rocks, biotite schist, and mappable olistoliths of ultramafic rocks (ꞒZu), metagabbro (ꞒZg), quartzite (ꞒZq) and a large proportion of phyllonite (ꞒZmp). The unit, as mapped here, is the olistolith-rich part described along the Potomac River by Drake and Morgan (1981) and Drake (1989a), and mapped by Drake and Froelich (1994)

Ꞓy **Yorkshire Formation (Cambrian) (Drake and Morgan, 1981)**—Polygenetic mélange consisting of a dark quartz-plagioclase matrix that contains chips, fragments and small blocks of quartz, serpentinite ▲ ; actinolite-tremolite schist □ ; metagabbro ○ ; and plagiogranite ● . Characterized by abundant light-colored feldspar grains that contrast greatly with the dark phyllosilicate component of the matrix

Mather Gorge Formation (Lower Cambrian and (or) Late Proterozoic) (Drake and Froelich, 1994)

ꞒZms Fine- to coarse-grained, lustrous, greenish-gray to gray, reddish-weathering, quartz-rich schist that contains interbeds of metagraywacke as well as some calc-silicate rock

ꞒZmg Fine- to medium-grained, light- to medium-gray, yellowish- to reddish-brown-weathering metagraywacke and semipelitic schist that contains interbeds of quartz-rich schist and some calc-silicate rock. Much of the rock is graded, but some beds have a pseudo-lamination that is actually a pressure-solution cleavage

ꞒZmp Fine-grained, lustrous, greenish-gray, red-brown-weathering chlorite-sericite phyllonite that commonly is characterized by pods and knots of quartz that stand out on weathered surfaces. In this quadrangle, much of the phyllonite had a protolith of migmatite (high grade ꞒZms) as relict leucosome can be seen in most outcrops

EXPLANATION OF MAP SYMBOLS

Contact—Dotted where concealed. Distribution and concentration of structural symbols indicates degree of reliability

Faults—Dotted where concealed

- High angle—U, upthrown side; D, downthrown side
- Thrust—Sawteeth on upper plate
- Overturned thrust—Sawteeth in direction of dip; bar on tectonically higher plate
- Small fault seen in outcrop—Showing dip

FOLDS

(Dotted where concealed)

Fold phases are designated from oldest to youngest, CH, Captain Hickory; C, Clifton; A, Accotink Creek

Anticline—Showing crest line and direction of plunge

Overturned anticline—Showing trace of axial surface, direction of dip of limbs, and direction of plunge

MINOR FOLDS

Minor asymmetric fold—Showing bearing and plunge of axis and rotation sense viewed down plunge

PLANAR FEATURES

(May be combined with linear features)

Strike and dip of beds—Ball indicates top known from sedimentary structures
- Inclined
- Overturned
- Vertical

Strike and dip of tectonic foliation—In rocks of the Piney Branch Complex, Yorkshire Formation, Sykesville Formation, and Occoquan Granite, and schistosity of indeterminate generation in rocks of the Mather Gorge Formation
- Inclined
- Vertical

Strike and dip of phyllonitic foliation
- Inclined
- Vertical

Strike and dip of flow foliation in rocks of the Piney Branch Complex

Strike and dip of schistosity
- Inclined
- Vertical

Strike and dip of second-generation schistosity

Strike and dip of spaced cleavage

Strike and dip of joints
- Inclined
- Vertical

LINEAR FEATURES

(May be combined with planar features)

Bearing and plunge of stretching lineation

Bearing and plunge of quartz rod lineation

Bearing and plunge of intersection of bedding and schistosity

Bearing and plunge of crenulations

Bearing and plunge of intersection of schistosity and spaced cleavage

OTHER FEATURES

Quarry—D, diabase; S, serpentine or soapstone, H, hornfels

Copper prospect

TD-198m **Water well with subsurface geologic data**— TD, total depth in meters (Lee and Froelich, 1989)

F_T **Megafossil locality**—T, reptile trackway; P, plant

KYL-1977 **Measured Section (Lee, 1977)**

Gray or green lacustrine shale outcrop

Location of chemically analyzed samples
- FG-85-82 Diabase (Gottfried and others, 1991)
- M-29 Bear Island Granodiorite (Drake and Lee, 1989)
- M-21 Old Mill Branch Metasiltstone Member of Popes Head Formation volcaniclastic rocks (reported herein). See table 1
- MQ-RH-1 Piney Branch Complex ultramafic and mafic rocks (Drake and Morgan, 1981)

DISCUSSION

INTRODUCTION

The Manassas 7.5-minute quadrangle is mostly in southwestern Fairfax County, with the southwestern quarter in Prince William County, Va. It lies across the contact of the crystalline rocks of the central Appalachian Piedmont with the sedimentary and igneous rocks of the Mesozoic Culpeper basin. Alluvium (Qal) underlies most stream valleys, and terrace gravels (Qt) are present along Bull Run in the Culpeper basin and in isolated patches on the Piedmont rocks. Much of the quadrangle is urban and development is proceeding rapidly throughout the area. As a result, artificial fill (af) obscures much of the bedrock, especially within the Culpeper basin. Natural outcrops, many of which are saprolite, are largely restricted to stream valleys. Knowledge of the crystalline rocks of the Piedmont has been gained in recent years by the work of Drake and his colleagues (Drake, 1985a, 1985b, 1985c, 1986a, 1986b, 1986c, 1987, 1989a, 1989b, 1991; Drake and Morgan, 1981, 1983; Drake and others, 1979). Knowledge of the Mesozoic rocks of the Culpeper basin was gained by the work of Roberts (1928), Bennison and Milton (1954), Eggleton (1975), Lee (1977, 1979, 1982), Froelich and Gottfried (1988), Lee and Froelich (1985, 1989), and Lee and others (1984). In addition, unpublished data collected, in part, from now inaccessible sites by colleagues E.C.T. Chao, J.B. Epstein, P.M. Hanshaw, J.P. Minard, J.C. Reed, Jr., J.P. Smoot, and R.P. Volckmann were used in the preparation of this map.

LATE PROTEROZOIC AND PALEOZOIC CRYSTALLINE ROCKS

Metamorphosed sedimentary and lesser volcaniclastic rocks constitute most of the crystalline terrane in the Manassas quadrangle. These rocks were intruded by the Occoquan Granite, Bear Island Granodiorite, and bodies of quartz. Intrusive rocks also occur as olistoliths in the Sykesville Formation.

METASEDIMENTARY AND METAVOLCANIC ROCKS

The metasedimentary and metavolcanic rocks in this part of northern Virginia constitute a stack of four lithotectonic units (Drake and Lyttle, 1981; Drake and Morgan, 1981; Drake, 1985c). The youngest and highest of these units, the Popes Head Formation, unconformably overlies all the units that constitute three thrust sheet-precursory mélange pairs termed tectonic motifs (Drake, 1985a, 1985c). In this quadrangle the Old Mill Branch Metasiltstone Member of the Popes Head Formation (Ꞓpo) unconformably overlies the Mather Gorge-Sykesville and Piney Branch-Yorkshire motifs.

Piney Branch-Yorkshire Motif

The Piney Branch-Yorkshire is the highest motif. The thrust sheet element is the Late Proterozoic and (or) Early Cambrian Piney Branch Complex (ꞒZpb). The complex lacks discernible order and is interpreted to be a tectonic mélange resulting from the autoclastic deformation of a layered complex that contained repetitive cycles of dunite or harzburgite, olivine cumulate peridotite, olivine-rich peridotite, websterite, and gabbro. These rocks are intruded by small dikes and sheets of plagiogranite (ꞒZpg). Mineralogic and chemical data for the Piney Branch rocks are given in Drake and Morgan (1981).

The Yorkshire Formation (Ꞓy), a tectonized sedimentary mélange, forms a thin discontinuous lower border to the Piney Branch Complex. Its discontinuous nature is thought to result from partial shearing out along the Oakton thrust fault, the tectonic boundary between the Piney Branch-Yorkshire and Mather Gorge-Sykesville motifs.

Mather Gorge-Sykesville Motif

The Mather Gorge Formation (Drake and Froelich, 1994) was originally called Peters Creek Schist (Drake and Morgan, 1981). The unit was renamed (Drake and Froelich, 1994) in this area because recent work suggests that it may not correlate with the Peters Creek Schist at its type locality on the Susquehanna River in Pennsylvania. The Mather Gorge consists of quartz-rich schist (ꞒZms) and graywacke (ꞒZmg). It is interpreted to be a turbidite deposited under fairly high-energy conditions in a large submarine fan. Along the Potomac River, the Mather Gorge rocks have experienced a prograde metamorphic event that ranged from chlorite grade in the west to sillimanite grade in the east (Fisher, 1963, 1970; Drake and Morgan, 1981; Drake, 1985b, 1989). About coincident with the appearance of sillimanite, the rocks become migmatitic. In the eastern part of the Mather Gorge outcrop belt, the migmatitic rocks become severely sheared and are retrogressively metamorphosed to chlorite-sericite phyllonites. Phyllonite (ꞒZmp) is the principal Mather Gorge rock type in the Manassas quadrangle.

The Mather Gorge Formation overlies the Sykesville Formation (Ꞓs), the precursory mélange of the motif on the Plummers Island thrust fault. In this quadrangle the Sykesville is choked with olistoliths, many of which are mappable bodies of phyllonitic migmatite (ꞒZmp) of the Mather Gorge Formation. This zone, at the top of the Sykesville, constitutes a mappable unit along the Potomac River (Drake and Froelich, 1994). The Mather Gorge-Sykesville motif constitutes a major part of the Potomac terrane in the central Appalachians (Drake, 1985b; Horton and others, 1989, 1991).

Old Mill Branch Metasiltstone Member of the Popes Head Formation

The Old Mill Branch Metasiltstone Member of the Popes Head Formation (Ꞓpo) consists of alternating coarse and finer grained strata that are interpreted to belong to Bouma's (1962) turbidite sequence T_{bcde} and to Mutti and Ricci Lucchi's (1978) turbidite facies D, suggesting deposition from weak turbidity flows (Drake and Lyttle, 1981).

The unit contains both felsic and mafic metatuff in layers as thick as 23.6 in. and series of layers as much as 70.5 in. thick. These rocks are graded and are tuff turbidites. Felsic material appears to be more abundant, but this may not be correct because it is difficult to differentiate between mafic volcaniclastic material and other chlorite-rich rocks. Areas of better exposure, such as along Popes Head Creek and at the type locality, Old Mill Branch, suggest that the volcaniclastic material constitutes a calc-alkalic bimodal suite. Chemistry of two samples of mafic material and one of felsic material is given in Table 1. The felsic material is quartz keratophyre and the mafic material is dacite (fig. 1).

PALEOZOIC INTRUSIVE ROCKS

The metamorphic rocks in the Manassas quadrangle are intruded by Occoquan Granite, small bodies of Bear Island Granodiorite, and several quartz bodies.

Occoquan Granite

Occoquan Granite (Oo) intrudes the Old Mill Branch Metasiltstone Member of the Popes Head Formation near the southeastern corner of the quadrangle. Small bodies intrude the Old Mill Branch about 2,490 ft northwest of the southeastern corner of the quadrangle, and phyllonite of the Mather Gorge Formation near the south border of the quadrangle about 1,150 ft east of the Plummers Island thrust fault. Seiders and others (1975) report a U-Pb age of about 560 Ma for the Occoquan. Higgins and others (1977) questioned this age largely because Seiders and others (1975) stated that the Occoquan intruded the Quantico Formation, thought by many to be Ordovician in age. It has subsequently been found that the Quantico is Ordovician in age and that the Occoquan does not intrude it (Pavlides and others, 1980). More recently, Mose and Nagel (1982) determined a Rb-Sr whole-rock isochron age of the Occoquan of 494±14 Ma. This was interpreted to be a metamorphic age by Drake and Lyttle (1981). Even more recently, however, single crystals from the Occoquan were found to have an age of 479± Ma (J.N. Aleinikoff, U.S. Geological Survey, written commun., 1993).

Table 1. Chemical analyses and CIPW Norms of metatuff from the Popes Head Formation

Sample No.	1	2	3
Chemical Analysis (weight percent)			
SiO_2	50.7	53.5	72.0
Al_2O_3	13.8	13.4	13.4
Fe_2O_3	3.0	2.6	2.8
FeO	8.3	4.8	0.88
MgO	6.2	4.5	0.30
CaO	8.0	7.6	1.8
Na_2O	3.2	2.4	3.7
K_2O	0.23	1.2	2.0
H_2O^+	3.0	3.3	1.1
H_2O^-	0.26	0.09	0.15
TiO_2	1.7	0.60	0.25
P_2O_5	0.24	0.14	0.09
MnO	0.18	0.20	0.10
CO_2	0.03	4.3	0.10
TOTAL	98.84	99.44	98.67
CIPW Norms (weight percent)			
Quartz	4.4	13.9	40.0
Orthoclase	1.1	7.8	12.2
Albite	27.8	22.0	32.0
Anorthite	23.4	24.5	8.1
Corundum	—	—	2.4
Diopside	13.9	13.2	0.8
Hypersthene	19.9	12.7	—
Magnetite	4.4	4.2	2.3
Apatite	0.3	0.3	0.3
Ilmenite	3.5	1.4	0.6
Hematite	—	—	1.3
TOTAL	98.7	100.0	100.0

Rapid rock analyses by Z.Hamlin, U.S. Geological Survey

DESCRIPTION OF SAMPLES

1. Sample M–123, mafic metatuff from outcrop along Old Mill Branch about 2,200 ft northeast from where the Branch crosses Virginia Route 641, Manassas 7.5-minute quadrangle, Virginia (lat. 38°45'18"N and long. 77°22'49"W). Chemically the rock is dacite.
2. Sample M–21, mafic metatuff from outcrop in cut along the Southern Railroad, about 2,575 ft west of trestle across Popes Head Creek, Manassas 7.5-minute quadrangle, Virginia (lat. 38°46'41"N and long. 77°24'W). Chemically rock is dacite.
3. Felsic metatuff from outcrop just south of bridge that carries Virginia Route 689 over a small tributary to Bull Run about 1,200 ft south of their confluence, Independent Hill 7.5-minute quadrangle, Prince William County, Virginia (lat. 38°44'38"N and long. 72°24'35"W). Sample site is about 2,800 ft south of Manassas-Independent Hill quadrangle boundary. Chemically, rock is quartz keratophyre.

Figure 1. Normative feldspar plot (O'Connor, 1965) of volcaniclastic rocks of the Old Mill Branch Metasiltstone Member of the Popes Head Formation. Samples 1, 2, and 3 are from Table 1.

Bear Island Granodiorite

Small intrusive bodies of Bear Island Granodiorite (Ob) are abundant in the phyllonite of the Mather Gorge Formation. Most are much too small to map and some mapped bodies may actually be zones of many small sheets. The Bear Island bodies crosscut the structures in the host rocks and are essentially undeformed, although there is a suggestion of weak shear tails on some bodies. Robert Wintsch (oral commun., 1991) suggests that the granodiorite bodies may have formed from fluids emplaced at the very end of the shear event. The Bear Island has a Rb-Sr muscovite age (cooling) of 469±20 Ma (Muth and others, 1979).

Quartz Bodies

Lenticular quartz bodies (Oq) are interleaved within the metasedimentary rocks. They are interpreted to result from metamorphic differentiation within the regime of greenschist-facies metamorphism, both prograde and retrograde.

Metamorphism of the Metasedimentary, Metavolcanic, and Transported Metaigneous Rocks

The metasedimentary, metavolcanic, and transported metaigneous rocks within the Manassas quadrangle have had different metamorphic histories (Drake, 1985b). Those of the Old Mill Branch Metasiltstone Member of the Popes Head Formation are at biotite grade and have experienced one metamorphic event (Drake and Lyttle, 1981). Rocks of the Sykesville Formation are at biotite±garnet grade and have apparently undergone only one metamorphic event (Drake and Lyttle, 1981; Drake and Morgan, 1981; Drake, 1986a; Drake and Froelich, 1986; Drake and Lee, 1989). It is uncertain whether the Old Mill Branch is at lower grade than the Sykesville or if its lack of garnet is the result of composition.

As mentioned previously, rocks of the Mather Gorge Formation have undergone a major prograde event and then a major retrograde event. A second prograde event caused the crystallization of chloritoid and at places biotite from retrograde sericite and chlorite. Most of the rocks in this quadrangle are chlorite-sericite phyllonites. The unsheared rocks immediately adjacent to the phyllonites in the northeastern part of the quadrangle contain shimmered porphyroblasts that appear to be staurolite. The rocks immediately adjacent to the Culpeper basin are at biotite±garnet grade.

Rocks within the Piney Branch Complex have been extensively metamorphosed to mineral assemblages stable in the greenschist facies of regional metamorphism; few original minerals survive (Drake and Morgan, 1981). Rocks of the Yorkshire Formation also appear to be in the greenschist facies. It is impossible at this time to relate this metamorphism to that in the other lithotectonic units.

Ages of the Metasedimentary, Metavolcanic, and Transported Metaigneous Rocks

The ages of the metasedimentary, metavolcanic, and metaigneous rocks cannot be directly determined. All the rocks are older than the Occoquan Granite so are Early Ordovician or older. The Old Mill Branch Metasiltstone Member of the Popes Head Formation unconformably overlies and is younger than the Piney Branch Complex, Yorkshire Formation, Mather Gorge Formation, and Sykesville Formation. The Mather Gorge Formation is older than the Sykesville because the Sykesville contains deformed olistoliths of Mather Gorge rocks. The Mather Gorge Formation, Yorkshire Formation, and Piney Branch Complex have had much more complicated structural and metamorphic histories suggesting they may be Late Proterozoic in age.

MESOZOIC ROCKS

Mesozoic rocks of the Culpeper basin in the Manassas quadrangle include the Reston and Poolesville Members of the type Manassas Sandstone (Roberts, 1928), as redefined (Lee and Froelich, 1989; Luttrell, 1989) and the lower one-third of the Balls Bluff Siltstone of the Culpeper Group (Lee and Froelich, 1989) of the Newark Supergroup (Froelich and Olsen, 1984). These sedimentary rocks were intruded and thermally metamorphosed by diabase and subsequently faulted, locally folded, and tilted regionally to the west. Much of the area underlain by Mesozoic rocks has been cut, filled, and extensively graded due to recent urbanization and highway construction.

Manassas Sandstone

The Reston Member of the Manassas Sandstone unconformably overlies or is in fault contact with rocks of the Mather Gorge Formation and Piney Branch Complex. South of Comptons Corner the Reston Member does not crop out due to normal faulting, but is known to be present at depth from sparse water well data. Conglomerate and coarse arkosic sandstone of this member grade upward and laterally into the Poolesville Member. The coarse clastic rocks of the Reston Member are interpreted to have been deposited by high-gradient streams, debris flows, and on alluvial fans at the base of highlands to the east and southeast.

The Poolesville is the upper member of the Manassas Sandstone and is the only unit that crops out at the type section near Bull Run and north and south of Manassas (Roberts, 1928; Luttrell, 1989). The Poolesville Member conformably overlies and grades laterally into the Reston Member; however, south of Comptons Corner, the Poolesville is in normal fault contact with rocks of the Mather Gorge Formation. The clastic rocks of the Poolesville are interpreted to have been deposited by braided and(or) meandering streams. Sparse plant fossils and palynomorphs collected from grayish-green siltstone of the Poolesville indicate that it is Late Triassic in age, and may range from late Carnian to middle Norian (Lee and Froelich, 1989; Luttrell, 1989); however, recent reexamination of palynomorphs from the Poolesville indicates an early Norian age (R.J. Litwin, oral commun., 1991).

Balls Bluff Siltstone

The Balls Bluff Siltstone (Lee, 1977; Lee and Froelich, 1989; Luttrell, 1989) is the uppermost formation of the Culpeper Group present in the Manassas quadrangle. It overlies the Poolesville Member gradationally, and the poorly exposed contact between the two fluvial units is placed arbitrarily at the top of a gray, fine- to coarse-grained, crossbedded sandstone bed that overlies a yellowish-green weathering siltstone; more commonly, the contact is concealed and projected, and in places may be faulted. Polynomorphs collected from grayish-green siltstone of the Balls Bluff indicate that it is Late Triassic in age, and ranges from early to late Norian (R.J. Litwin, oral commun., 1991), although the lowest parts of the unit previously had been interpreted as possibly late Carnian (Lee and Froelich, 1989; Luttrell, 1989).

Thermally Metamorphosed Rocks

Most of the thermally metamorphosed rocks mapped in the quadrangle were originally Triassic sedimentary rocks of the Manassas Sandstone and Balls Bluff Siltstone that were intruded by the Centreville diabase sheet. Siltstones and shales were metamorphosed to hornfels, arkosic sandstone to meta-arkose, granulite (granofels) and quartzite, and conglomerate to metaconglomerate. Lee and Froelich (1985) provide chemical analyses for two granulites (KYL–349; KYL–356) collected from metamorphosed Manassas Sandstone along the southeastern margin of the Centreville sheet. Drill hole 51V-13A, near Flatlick Branch west of Braddock Road, penetrated 370 ft of hornfels beneath 280 ft of Balls Bluff Siltstone, but did not encounter the Centreville diabase sheet (Lee and Froelich, 1989, Appendix 8, Well I).

Diabase

Most of the Centreville diabase sheet lies within the Manassas quadrangle; in addition, the Union Mill plug (Froelich and Gottfried, 1988) and a northerly oriented discontinuous dike system intrude the crystalline rocks of the Piedmont, and two minor north-striking dike systems cut the Triassic strata. Chemically, all of the diabase sampled in the quadrangle is high-TiO_2 (1.0–1.2 percent), quartz-normative (51–53 percent SiO_2) tholeiite (HTQ-York Haven-type), and belongs to the east-central lineage of Froelich and Gottfried (1988). Gottfried and others (1991) have provided complete chemical analyses of the four samples from the Union Mill plug and two samples from the eastern part of the lower Centreville sheet located on this map. Major- and trace-element chemistry for one sample near the upper contact of the Centreville sheet about a mile south of Centreville is documented by Lee and others (1984; KYL–364). Also, the Bull Run (Centreville) quarry, situated at the southwest margin of the sheet, is the site of one of the USGS chemical reference standards for mafic rocks (W–2, Flanagan, 1984). It is also the site of sample MS–A1, reported by Sutter (1985) to have a weight-average plateau age of 201.1±1.3 Ma, based on $^{40}Ar/^{39}Ar$ age determination on a whole-rock sample, which is very close to $^{40}Ar/^{39}Ar$ ages subsequently determined on mineral separates from other diabases in the Culpeper basin (Sutter, 1988).

LATE PROTEROZOIC AND PALEOZOIC STRUCTURAL GEOLOGY

The Old Mill Branch Metasiltstone Member of the Popes Head Formation was deposited on the already assembled stack of Piney Branch-Yorkshire and Mather Gorge-Sykesville tectonics motifs. Subsequently, these motifs and the Old Mill Branch were folded together. Fold phases in this quadrangle, following the usage of Tobisch and Fleuty (1969) were named for geographic locations where they are well displayed or for the major fold of a particular phase (table 2).

Folds in the Old Mill Branch Member of the Popes Head Formation

The Clifton is the oldest fold phase in the Old Mill Branch Member of the Popes Head Formation. It was named for the Clifton syncline (Drake, 1986a, 1987), the northern terminus of which is in the Falls Church 7.5-minute quadrangle (Drake and Froelich, in press). Its southern terminus is in the Independent Hill quadrangle. The characteristics of Clifton folds are given in Table 2. Other Clifton folds are the Police Academy anticline, the Colchester syncline, the Joyce Heights antiform, and the Jermantown synform.

The outcrop patterns of the Old Mill Branch Metasiltstone Member of the Popes Head Formation and the Piney Branch-Yorkshire motif, and direct observation in the field show that Clifton folds are folded about more northerly trending axes. These observations are supported by the fact that the axes of small Clifton folds plot on a girdle (fig. 2). These were named Accotink Creek folds for the creek of that name in the northerly part of the Fairfax quadrangle (Drake, 1986a, 1987). Clifton and Accotink Creek folds were interpreted to have resulted from progressive deformation within a stress continuum during progressive regional dynamic metamorphism (Drake, 1987).

Folds in the Piney Branch-Yorkshire Motif

Previously deformed rocks of the Piney Branch-Yorkshire motif are folded with the Old Mill Branch Metasiltstone Member of the Popes Head Formation and Mather Gorge-Sykesville motif by the Clifton phase (table 2) Jermantown synform and Joyce Heights antiform. No earlier folds could be mapped.

Folds in the Mather Gorge-Sykesville Motif

Deformation of the Mather Gorge Formation is quite complex and at most places bedding and first-generation schistosity are nearly parallel. This schistosity is axial surface to first phase folds, termed Captain Hickory folds (table 2) by Drake and Lee (1989). Only two Captain Hickory folds, the Legato antiform and an antiform in the southern part of the quadrangle, could be mapped here because they cannot be recognized unless metagraywacke constitutes their form surface. These folds were termed map-scale intrafolia folds by Drake (1989a).

No other pre-Clifton folds could be recognized. The Mather Gorge phyllonite is folded with Old Mill Branch rocks by Clifton and Accotink Creek folds. Axes of small folds in the phyllonite plot on essentially the same girdle as the axes of small folds in the Old Mill Branch rocks. These folds are overturned to the east and produce the east limb of the regional Potomac River fan structure (Drake, 1989a, 1989b).

Time of Deformation

The deformation here is thought to predate the Taconic orogeny because it is either synchronous with or predated the emplacement of the Occoquan batholith in Early Ordovician time (Drake, 1987). The Occoquan was emplaced synkinematically during Clifton folding, a Penobscotian event (Drake, 1987, 1991). Rocks of the Piney Branch-Yorkshire motif and the Mather Gorge Formation have experienced a much more complex history. Mather Gorge phyllonite occur in olistoliths in the Sykesville Formation that appears to be Early Cambrian in age, suggesting that the pre-Clifton structures may date from the Late Proterozoic Cadomian (Avalonian?) orogeny.

MESOZOIC STRUCTURAL GEOLOGY

The principal structural feature apparent in the Mesozoic rocks of the Culpeper basin is the gentle, regional, westward dip away from the unconformable eastern basin margin; however, south of Comptons Corner, the eastern margin is a north-striking, west-dipping normal fault with variable displacement (tens to possibly a few hundred meters). East of Comptons Corner the poorly defined fault may bifurcate, with one strand extending northward and a second extending northeasterly. Also in this area, the poorly exposed normal fault that forms the northeast-trending basin margin apparently extends to the southwest for several miles into the basin; there it is interpreted to separate nearly flat-lying beds on the east from moderately west-dipping beds along or near the contact between Manassas Sandstone and Balls Bluff Siltstone. Several other minor normal, north-striking faults were recognized by previous workers (Richard Volckmann, written commun., 1977; E.C.T. Chao, unpub. data), and the north-northeast-striking faults along and near Flatlick Branch near the northern boundary of the quadrangle were extended from faults mapped by Eggleton (1975) in the adjacent Herndon quadrangle. Other minor faults and local minor fold structures, such as those east of Comptons Corner, on the east side of Manassas Park, and near Cub Run Church, are probably far more common than indicated; unfortunately, outcrops are too poor and widely scattered to provide reliable control. Local areas of steep dip in proximity to diabase may indicate local adjustments to the intrusions, as well as later structural accommodation. A wedge-shaped uplifted fault block in the thermal aureole along Big Rocky Run near the upper northeastern margin of the Centreville sheet exposed an inlier of the basal conglomerate of the Reston Member and possibly saprolite of Mather Gorge Formation.

Figure 2. Equal area plot (lower hemisphere) of 77 axes of small folds of bedding in the Old Mill Branch Metasiltstone Member of the Popes Head Formation. Contours at 8, 4, and 1 percent per 1 percent area.

Table 2. Fold phases in the Manassas 7.5-minute quadrangle

PHASE	TREND	FOLIATION	LINEATION	STYLE
Accotink Creek	NNE to NNW	Spaced schistosity	Intersections with earlier schistosity	Tight, upright to isoclinal overturned. Are nearly coaxial and coplanar with Clifton folds and cannot be mapped unless Clifton folds are recognized. Fold bedding and schistosity of the Popes Head Formation and phyllonitic foliation in Mather Gorge Formation. Plunge either northeast or southwest.
Clifton	NE	Phyllitic schistosity in Popes Head Formation	Intersection with bedding in Popes Head Formation	Isoclinal overturned to tight upright. Have long planar limbs and most have interlimb angles of less than 50°. Fold bedding in Popes Head Formation and schistosity and phyllonitic foliation in the Mather Gorge Formation.
Captain Hickory	Apparently W or slightly N of W	Regional schistosity in Mather Gorge Formation	Mineral lineation in higher-grade rocks and intersections of schistosity with bedding in Mather Gorge Formation	Isoclinal, bedding nearly parallel to schistosity in most exposures. Small folds, intersection lineations and mineral lineations plunge down the dip of later foliations unless they have been rotated into parallelism with later fold axes.

Figure 3. Equal area (lower hemisphere) plot of 67 folds of phyllonitic foliation in the Mather Gorge Formation. Contours at 12, 6, and 1 percent per 1 percent area.

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GEOLOGIC MAP OF THE MANASSAS QUADRANGLE, FAIRFAX AND PRINCE WILLIAM COUNTIES, VIRGINIA

By

Avery Ala Drake, Jr., Albert J. Froelich[1], Robert E. Weems, and K.Y. Lee[1]

1994

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[1] Deceased

m(200)
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no. 1732

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NO.	REVISION	DATE
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SHEET TITLE
GEOLOGIC MAP

PROJECT TITLE
GROUNDWATER
MONITORING NETWORK

CLIENT
UPPER OCCOQUAN SERVICE
AUTHORITY, INDUSTRIAL LANDFILL
SOLID WASTE PERMIT #542
CENTREVILLE, VIRGINIA

SCS ENGINEERS
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PROJ. NO. 02200089.28
DWN. BY: KMS
Q/A RVW BY:
DSN. BY:
CHK. BY: JSR
APP. BY:

CADD FILE: GEOLOGIC MAP
DATE: 10/11/21
SCALE: AS SHOWN
DRAWING NO. 2 of 4

LEGEND

- 215 — TOPOGRAPHIC CONTOUR (FT, AMSL)
- FACILITY BOUNDARY
- LIMIT OF WASTE
- BACKGROUND GROUNDWATER MONITORING WELL
- COMPLIANCE GROUNDWATER MONITORING WELL
- ADDITIONAL GROUNDWATER MONITORING WELL
- 173.15 — GROUNDWATER ELEVATION (FT, AMSL)
- 160 — GROUNDWATER CONTOUR (FT, AMSL)
- GROUNDWATER FLOW DIRECTION
- HORIZONTAL HYDRAULIC GRADIENT

FT, AMSL = FEET, ABOVE MEA SEA LEVEL

NOTES:

1. GROUNDWATER CONTOURS WERE GENERATED USING SURFER SURFACE MAPPING SYSTEM SOFTWARE VIA THE KRIGING GRIDDING METHOD AND ALTERED UTILIZING PROFESSIONAL JUDGEMENT.
2. THE BASE MAP, INCLUDING TOPOGRAPHIC CONTOURS, WAS COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY. GRID BASED ON VIRGINIA STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 1983. VERTICAL DATUM BASED ON NAVD 1988.
3. TOPOGRAPHIC CONTOURS WITHIN THE LIMITS OF WASTE WERE UPDATED IN SEPTEMBER 2020.

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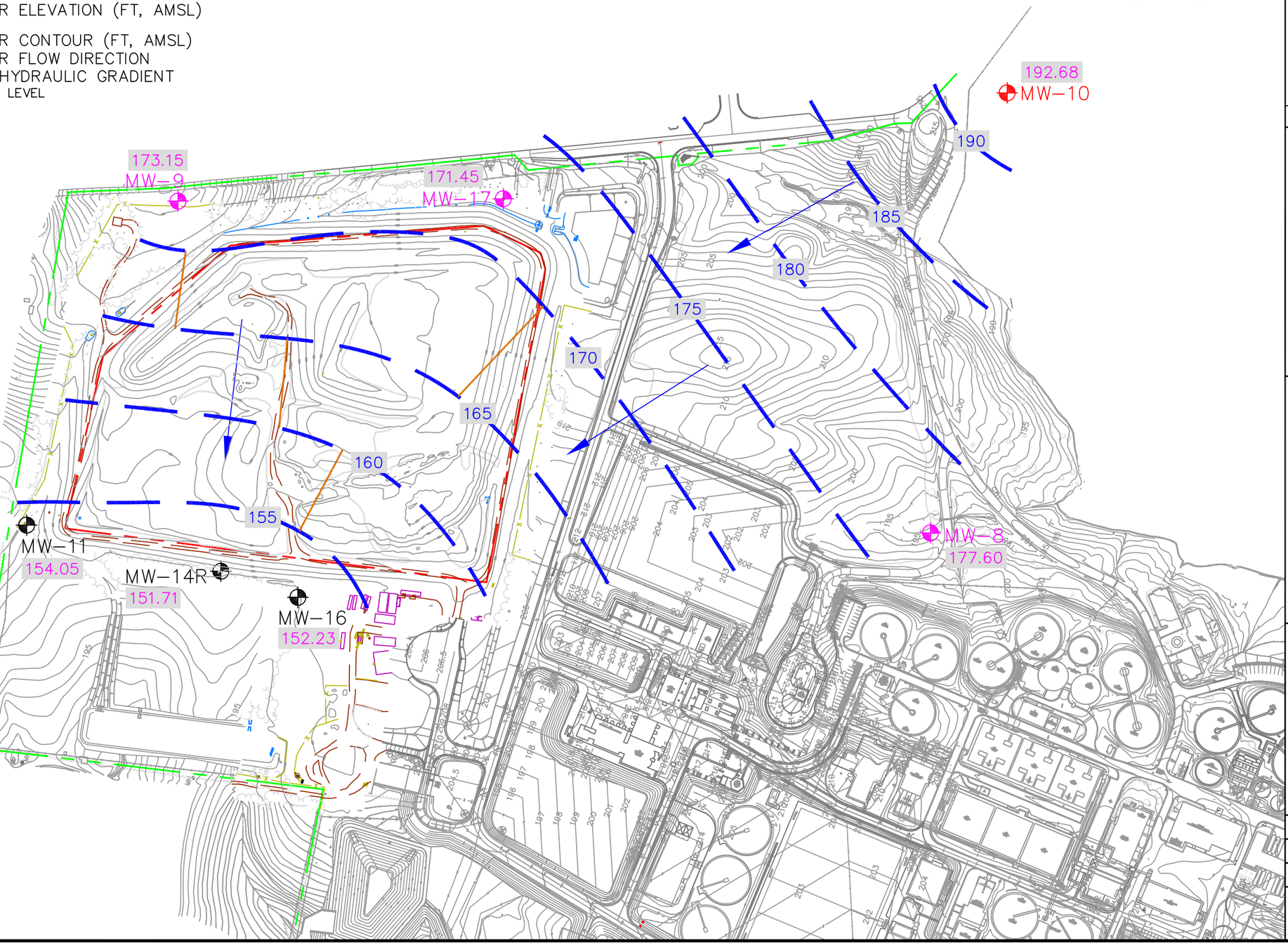
SCALE IN FEET



NO.	REVISION	DATE

SHEET TITLE: GROUNDWATER CONTOUR MAP AUGUST 20, 2021

PROJECT TITLE: GROUNDWATER MONITORING PLAN

CLIENT: UPPER OCCOQUAN SERVICE AUTHORITY, INDUSTRIAL LANDFILL
SOLID WASTE PERMIT #542
CENTREVILLE, VIRGINIA

SCS ENGINEERS
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PROJ. NO. 02200089.28
DSN. BY:
DWN. BY: KMS
CHK. BY: JSR
QA/QA RVW BY:
APP. BY:

CADD FILE: GWCONT

DATE: 10/13/21

SCALE: AS SHOWN

DRAWING NO. 3 of 4

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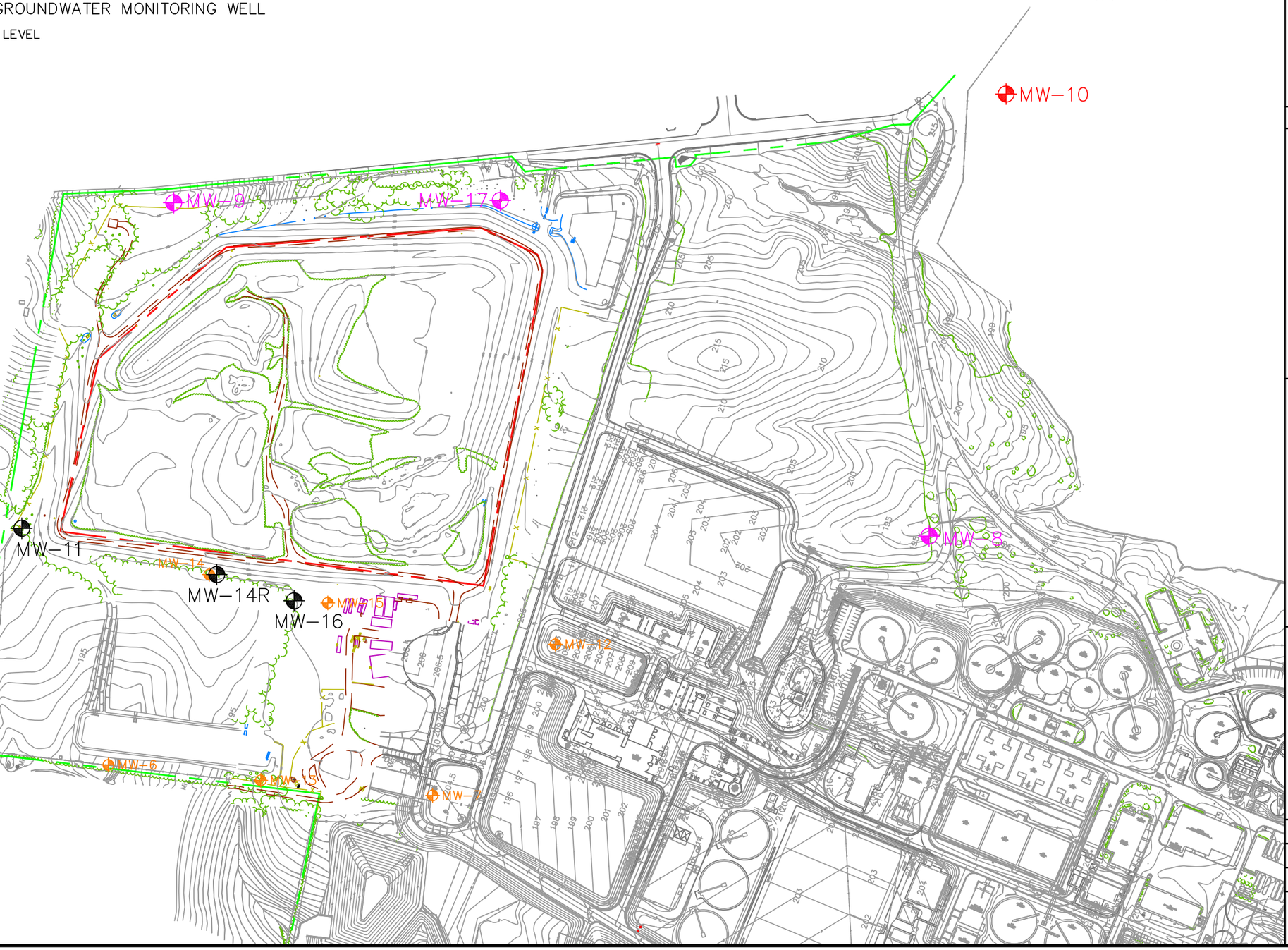
LEGEND

215 TOPOGRAPHIC CONTOUR (FT, AMSL)
FACILITY BOUNDARY
LIMIT OF WASTE
BACKGROUND GROUNDWATER MONITORING WELL
COMPLIANCE GROUNDWATER MONITORING WELL
ADDITIONAL GROUNDWATER MONITORING WELL
ABANDONED GROUNDWATER MONITORING WELL

FT, AMSL = FEET, ABOVE MEA SEA LEVEL

NOTES:
1. THE BASE MAP, INCLUDING TOPOGRAPHIC CONTOURS, WAS COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY. GRID BASED ON VIRGINIA STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 1983. VERTICAL DATUM BASED ON NAVD 1988.
2. TOPOGRAPHIC CONTOURS WITHIN THE LIMITS OF WASTE WERE UPDATED IN SEPTEMBER 2020.

0 300 600
SCALE IN FEET



NO.	REVISION	DATE

SHEET TITLE: SITE MAP

PROJECT TITLE: GROUNDWATER MONITORING PLAN

CLIENT
UPPER OCCOQUAN SERVICE AUTHORITY, INDUSTRIAL LANDFILL
SOLID WASTE PERMIT #542
CENTREVILLE, VIRGINIA

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PROJ. NO. 02200089.28 | DSN. BY: | DWN. BY: KMS | CHK. BY: JSR | Q/A RVW BY: | APP. BY:

CADD FILE: SITE MAP
DATE: 10/13/21
SCALE: AS SHOWN
DRAWING NO. 4 of 4

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Appendix A

Historical Groundwater Elevations
Time-Series Plot
Groundwater Flow Rate Calculations

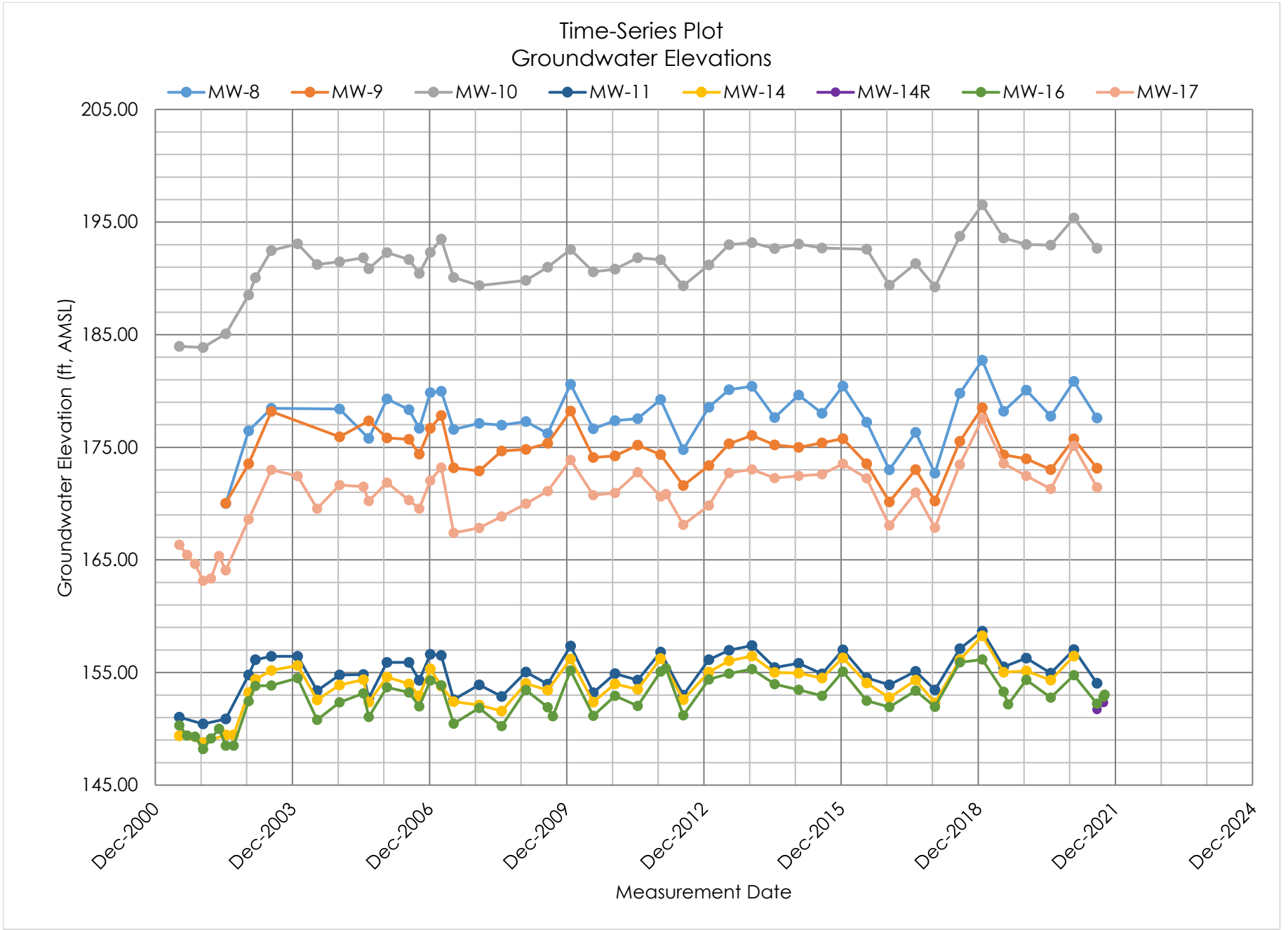
HISTORICAL GROUNDWATER ELEVATIONS

Well ID	MW-8	MW-9	MW-10	MW-11	MW-14	MW-14R	MW-16	MW-17
Measurement Date	Groundwater Elevation (ft, AMSL)							
7/10/2001	---	---	183.97	151.03	149.38	---	150.30	166.35
9/11/2001	---	---	---	---	---	---	149.40	165.45
11/14/2001	---	---	---	---	---	---	149.30	164.65
1/17/2002	---	---	183.87	150.43	148.78	---	148.20	163.15
3/21/2002	---	---	---	---	---	---	149.15	163.35
5/24/2002	---	---	---	---	---	---	150.00	165.34
7/17/2002	170.01	170.04	185.07	150.88	149.46	---	148.50	164.07
9/18/2002	---	---	---	---	149.46	---	148.50	---
1/16/2003	176.46	173.54	188.52	154.78	153.23	---	152.45	168.60
3/10/2003	---	---	190.07	156.13	154.38	---	153.80	---
7/15/2003	178.46	178.19	192.47	156.43	155.18	---	153.85	173.00
2/11/2004	---	---	193.07	156.43	155.63	---	154.50	172.45
7/15/2004	---	---	191.24	153.38	152.58	---	150.80	169.55
1/10/2005	178.41	175.94	191.47	154.78	153.88	---	152.35	171.65
7/19/2005	---	---	191.84	154.82	154.37	---	153.15	171.51
9/1/2005	175.80	177.34	190.85	152.74	152.38	---	151.06	170.24
1/23/2006	179.29	175.84	192.29	155.91	154.61	---	153.68	171.86
7/18/2006	178.35	175.71	191.68	155.91	153.99	---	153.23	170.32
10/9/2006	176.68	174.40	190.43	154.31	152.93	---	152.00	169.55
1/4/2007	179.85	176.69	192.32	156.61	155.32	---	154.29	172.05
4/3/2007	179.98	177.83	193.48	156.51	153.78	---	153.86	173.21
7/10/2007	176.59	173.19	190.09	152.60	152.41	---	150.45	167.41
1/30/2008	177.13	172.90	189.37	153.90	152.11	---	151.86	167.84
7/28/2008	176.97	174.67	---	152.87	151.57	---	150.24	168.86
2/6/2009	177.28	174.81	189.83	155.05	154.03	---	153.44	169.99
7/29/2009	176.22	175.36	190.99	153.97	153.43	---	151.92	171.10
9/9/2009	---	---	---	---	---	---	151.11	---
1/28/2010	180.60	178.23	192.58	157.35	156.20	---	155.19	173.87
7/28/2010	176.64	174.09	190.57	153.21	152.37	---	151.16	170.74
1/19/2011	177.37	174.23	190.81	154.91	153.99	---	152.94	170.95
7/19/2011	177.54	175.19	191.84	154.32	153.51	---	152.03	172.79
1/18/2012	179.23	174.35	191.65	156.81	156.24	---	155.09	170.63
3/1/2012	---	---	---	---	---	---	155.36	170.84
7/17/2012	174.80	171.61	189.34	152.99	152.60	---	151.19	168.11
2/6/2013	178.57	173.37	191.19	156.14	155.04	---	154.39	169.84
7/16/2013	180.12	175.32	193.00	156.98	156.05	---	154.91	172.72
1/15/2014	180.42	176.05	193.17	157.39	156.46	---	155.30	173.04
7/16/2014	177.65	175.22	192.65	155.45	155.00	---	153.96	172.26
1/23/2015	179.63	174.99	193.05	155.82	154.95	---	153.47	172.47
7/29/2015	178.03	175.39	192.69	154.89	154.50	---	152.93	172.60
1/12/2016	180.44	175.78	---	157.02	156.29	---	155.09	173.54
7/19/2016	177.22	173.53	192.60	154.53	154.07	---	152.49	172.25
1/17/2017	173.01	170.16	189.41	153.90	152.77	---	151.94	168.06
8/14/2017	176.33	173.03	191.31	155.11	154.32	---	153.39	170.98
1/16/2018	172.70	170.24	189.25	153.44	152.31	---	151.96	167.85
8/2/2018	179.80	175.53	193.75	157.12	156.13	---	155.90	173.46
1/29/2019	182.73	178.52	196.54	158.67	158.26	---	156.15	177.54
7/17/2019	178.20	174.33	193.58	155.50	155.02	---	153.28	173.56
8/23/2019	---	---	---	---	---	---	152.18	---
1/15/2020	180.08	173.97	193.02	156.27	155.14	---	154.35	172.47
7/29/2020	177.76	173.02	192.95	154.94	154.32	---	152.78	171.30
1/28/2021	180.86	175.76	195.36	157.04	156.46	---	154.76	175.14
8/1/2021	177.60	173.15	192.68	154.05	Aband.	151.71	152.23	171.45
9/22/2021	---	---	---	---		152.34	152.85	---
10/1/2021	---	---	---	---		---	153.03	---
MINIMUM	170.01	170.04	183.87	150.43	148.78	151.71	148.20	163.15
MAXIMUM	182.73	178.52	196.54	158.67	158.26	152.34	156.15	177.54
AVERAGE	177.82	174.65	191.30	154.96	153.89	152.03	152.58	170.41

Aband. = Abandoned. MW-14 was replaced with MW-14R in August 2021.

ft, AMSL = feet, Above Mean Sea Level

--- = not measured


Time-Series Plot
Groundwater Elevations
MW-8
MW-9
MW-10
MW-11
MW-14
MW-14R
MW-16
MW-17
205.00
195.00
185.00
175.00
165.00
155.00
145.00
Groundwater Elevation (ft, AMSL)
Dec-2000
Dec-2003
Dec-2006
Dec-2009
Dec-2012
Dec-2015
Dec-2018
Dec-2021
Dec-2024
Measurement Date

GROUNDWATER FLOW RATE CALCULATIONS

Porosity (n_e) = 30%

	Minimum	Maximum
Hydraulic Conductivity, K (ft/yr) =	**111**	**1,529**

Groundwater Contour Map	August-2021			
Contour Intervals (dH = 5 ft)	**dL (ft)**	**i (ft/ft)**	**v_x (ft/yr)**	**v_x (ft/yr)**
170 - 165	220	0.023	8	116
170 - 165	351	0.014	5	73
165 - 160	253	0.020	7	101
160 - 155	265	0.019	7	96

dH = change in head
dL = change in distance
ft = feet
ft/ft = feet per foot
ft/yr = feet per year
i = horizontal hydraulic gradient
K = hydraulic conductivity
n_e = porosity
v_x = groundwater flow rate

Appendix B

Groundwater Monitoring Well Network Summary
Geologic Boring Logs and Well Construction Details

Groundwater Monitoring Well Network Summary

Well ID	Installed Date	Northing	Easting	TOC Elevation (ft, AMSL)	Ground Elevation (ft, AMSL)	Depth to Bottom (feet)	Length of Screen Interval (feet)	Well Diameter (inches)
BACKGROUND WELLS								
MW-8	10/21/1988	6979883.73	11779354.81	197.01	194.2	60.71	10	2
MW-9	11/7/1988	6982196.88	11779508.43	244.64	241.64	116.28	10	2
MW-17	5/14/2001	6981337.44	11779828.16	216.35	---	85.13	20	2
COMPLIANCE WELLS								
MW-11	3/6/1990	6982285.47	11778504.02	205.63	203.39	82.24	---	2
MW-14R	8/10/2021	6981726.63	11778569.13	203.69	201.17	103.41	10	2
MW-16	5/14/2002	6981497.26	11778574.35	202.3	---	104.62	30	2
ADDITIONAL WELL								
MW-10	---	6980105.04	11780594.69	213.87	---	66.8	---	---
ABANDONED WELLS								
MW-6	10/26/1988	---	---	190.54	187.9	53.64	10	2
MW-7	10/24/1988	---	---	199.47	196.5	57.37	10	2
MW-12	1/13/1990	---	---	206.26	203.23	78.03	10	2
MW-13	---	---	---	193.32	---	---	---	---
MW-14	---	6981746.36	11778561.94	202.38	---	---	---	2
MW-15	4/22/1999	---	---	204.2	---	---	20	2

--- = not available

ft, AMSL = feet, Above Mean Sea Level

TOC = Top of PVC Casing

Note: Depth to bottom was measured from the TOC.

Observation Well Installation Detail

Project Name UOSA Landfill
Project No. WDC 26094.D1.11
Drilling Contractor EEI
Recorded by T. Szymoniak

Boring/Piezometer No. MW-8
Casing Elevation 197.01 ft.
Location N 418173.01, E 2296367.66
Date 10/21/88

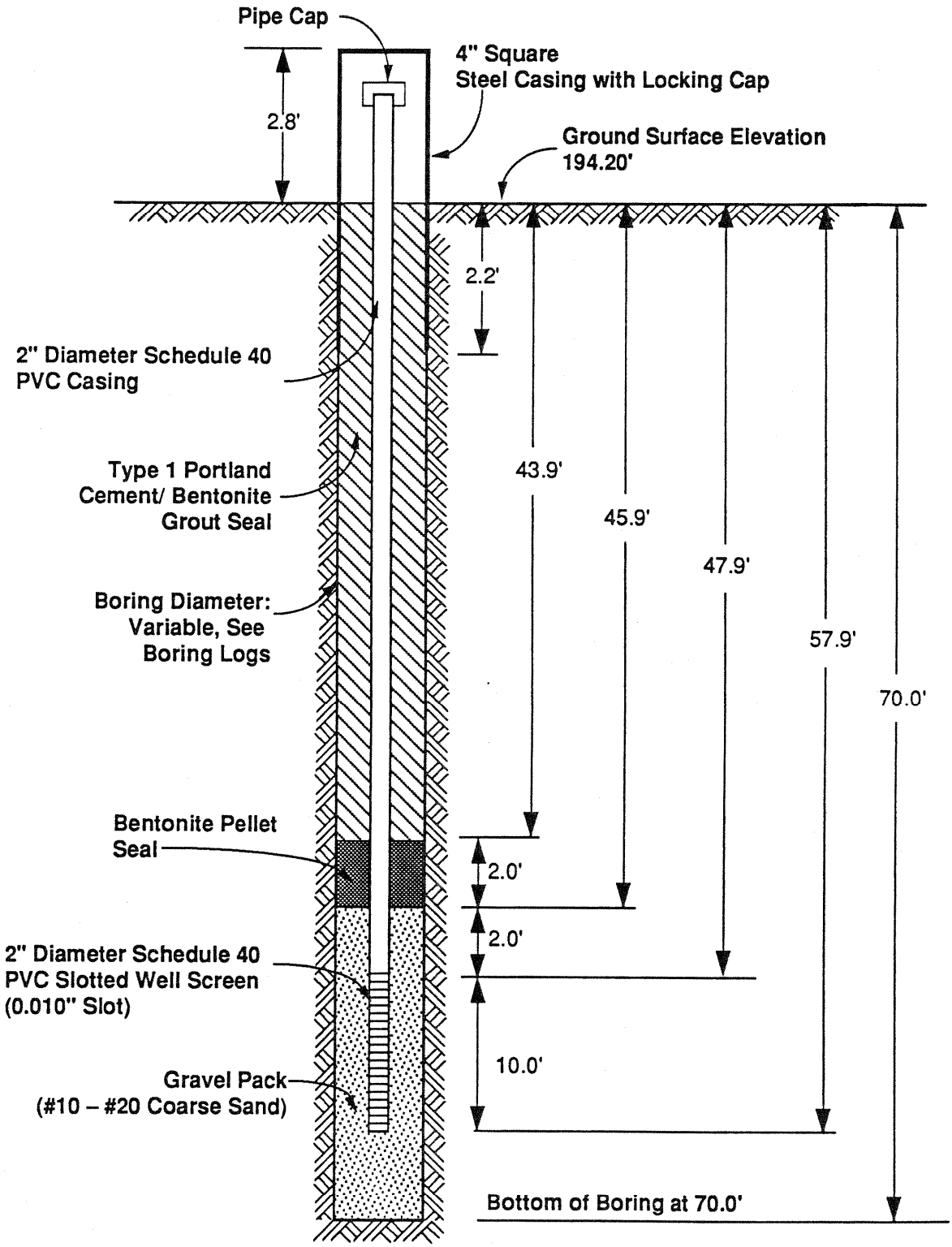


Figure Not to Scale

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 1 OF 7

CH2M HILL

SOIL BORING LOG

PROJECT: UOSA LANDFILL | LOCATION: N418173.012 E2296367.666

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS INC

DRILLING METHOD AND EQUIPMENT: HS AUGER (4.25" ID) MOBIL B-57

WATER LEVEL AND DATE: 38.33 ft, 11/21/88 | START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	DEPTH INTERVAL (ft)	TYPE AND NUMBER	R E C (ft)	STD. PEN. TEST 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SOIL SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TEST AND INSTRUMENTATION
0	0 - 1.5	S-1	0.7 47%	18-10-1 (22)	TOPSOIL < 6.0 INCHES FILL, POORLY GRADED GRAVEL WITH SILT, BROWN AND GRAY, (5YR 6/4), ANGULAR, DRY, DENSE, (GP-GM)		8:35AM 9:30AM, CLEAR, MILD
	2.5 - 3.8	S-2	1.5 115%	23-69-1 (>100)	S-2A LEAN CLAY, LIGHT BROWN, (5YR 5/6), DRY, HARD, NATIVE, (CL) S-2B SILTY CLAY, RED BROWN, (10R 4/6), DRY, HARD, WEATHERED SILTY SHALE, (CL-ML)		COLOR CHANGE AT 3.5ft
5	5.0 - 5.9	S-3	0.9 100%	89-100/4 (>100)	SILTY CLAY, SAME AS S-2, (CL-ML)		5-6' PR=1"/1MIN 10SEC
	7.5 - 7.8	S-4	0.2 67%	100/3"	SILTY CLAY, SAME AS S-2, (CL-ML)		AUGERS DID NOT REACH REFUSAL, CUTTINGS DRY AND COARSE AT COMPLETION OF AUGERING
10					TERMINATED SOIL BORING AT 10.0ft., CONTINUED BORING USING ROCK CORING TECHNIQUES, SEE ROCK CORE LOG SHEET 2 THROUGH 7		

SBLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 2 OF 7

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N418173.012 E2296367.666

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 38.33ft. 11/21/8 | START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN AND REC	R Q D	DISCONTINUITIES: F / R F A T C	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING)	S Y M B O L	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
	9.9						CORE BARREL = 12.9'
10	98%	82%	4	10.0,10.3,10.5&10.7', FRACTURE,2, ROUGH, PLANAR, MnOx STAINED		SILTY SHALE, RED BROWN, (10YR 4/6), FINE GRAINED SEDIMENTS WITH CALCITE INFILLING THROUGHOUT, SLIGHTLY WEATHERED, SOFT, MASSIVE (BULLS BLUFF FORMATION) 11.3 - 11.7 ZONES OF PEBBLES (0.1") INFILLING MATRIX	START 10:30AM, PARTLY CLOUDY MILD
11			2	11.1', FRACTURE, 0, ROUGH, PLANAR, MnOx STAINED			
12			1	12.1& 12.7', FRACTURE, 2, ROUGH, PLANAR, MnOx STAINED			10:57AM
13			1	13.9',VOID INFILLED WITH QUARTZ PEBBLES			
14			2	14.4&14.7, FRACTURE, 5, ROUGH, PLANAR, MnOx STAINED		SILTY SHALE, SAME AS ABOVE	
15			2	15.1',FRACTURES, 0, ROUGH, PLANAR, MnOx STAINED 15.7', 2 FRACTURES INTERSECT AT 60 AND 35, ROUGH, PLANAR,			
16			2	16.5', FRACTURE, 50, ROUGH, STEPPED 16.7', FRACTURE, 45, ROUGH, PLANAR			
17			1	17.1', FRACTURE, 30, ROUGH, PLANAR,			
18			0				12:05PM
19			1	19.2', FRACTURE, 2, SMOOTH, PLANAR, MnOx STAINED			12:20PM
	19.9						
20							

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 3 OF 7

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N418173.012 E2296367.666

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 38.33ft. 11/21/88 START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R A C T	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
	R-2			19.9 - 23.5, CORE COMPLETELY			
	58%	30%	>10	DISJOINTED AND FRACTURED		SILTY SHALE, RED BROWN,	
21						(10YR 4/6), FINE GRAINED	
						SEDIMENTS WITH CALCITE	
			>10			INFILLING THROUGHOUT,	
						SLIGHTLY WEATHERED, SOFT,	
22						MASSIVE, (BALLS BLUFF	
						FORMATION)	
			>10				PULLED CORE BARREL
							BECAUSE OF BLOCKAGE IN
23							WATER COOLING, VERY
							SOFT ROCK CAVED INTO
			1	23.7,FT,2,ROUGH,STEPPED,MnOx			BORING WHICH MADE
				STAINED			DRILLING SLOW WITH POOR
24							RETURN OF CUTTINGS
							SWITCHED TO ROLLER BIT
			0				AFTER CORE BARREL
	24.9						CLOGGED, BIT OD= 3.87"
25				SWITCHED TO ROLLER BIT AFTER			BEGIN ROLLER BIT AT
				CLOGGING CORE BARREL AND BIT			24.9ft, 15:49
26							
							24.9 - 30
							PR=5.1ft/18min.
27							DRILLING FLUID WAS RED
							BROWN, CUTTINGS FROM
							24.9 - 30 WERE FINE AND
							A SAMPLE COULD NOT BE
28							RECOVERED.
29							
30							

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 4 OF 7

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N418173.012 E2296367.666

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 38.33ft. 11/21/88 | START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R / A / C	DISCONTINUITIES: DESCRIPTION — DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
31	TRIP						
32							NO SAMPLES RECOVERED
33							
34							
35							
36							
37							EASY DRILLING, PR=5'/15MIN
38							
39							
40	40.2 R-3 100%	97%	3	40.2,FT,90,ROUGH,PLANAR,HVY Mg STAINED WITH CALCITE INFILLING		SILTY SHALE, RED BROWN (10YR 4/6), CALCITE INFILLING THROUGHOUT, SOFT	SWITCHED TO HW CORE BARREL, START 10/21 8:20AM, COOL LT RAIN

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 5 OF 7

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N148173.012 E2296367.666

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 38.33ft. 11/21/88 START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F/R A C	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
--			1			SILTY SHALE, SAME AS ABOVE	4'6" TOOK 13 MINUTES TO CORE
42 --			---	42.1,FT,0,SMOOTH,PLANAR,MnOx STAINED			
--			1				
43 --			---				
				43.5,FT,0,SMOOTH,PLANAR,MnOx STAINED			
--			2				
				43.8,FT,0,ROUGH,PLANAR,MnOx STAINED			
44 --			---				
				44.3-44.7,1FT,90,ROUGH,STEPPED			
--			1	IRREGULAR,MnOx STAINED			
45 --			---				
--			7				
				45.5-46.2,BROKEN CORE,MnOx STAINED			
46 --			---				EASY DRILLING 5'/15MIN. PR=1"/5[illegible]C
--			2				
				46.6,FT,10,ROUGH,PLANAR			
47 --			---				
				47.2,FT,30,ROUGH,PLANAR			
--			2				
				47.7,FT,5,ROUGH,STEPPED,MnOx			
48 --			---	STAINED			
--			0				
49 --			---				
--			2	49.2-49.5,1FT,90,SMOOTH,PLANAR,MnOx			
	49.8			STAINED			9:20AM
50 --	R-4		---				
	100%	77%				SILTY SHALE, SAME AS ABOVE	
--							
				50.6-50.8,2FT,0,SMOOTH,PLANAR,MnOx			
51 --			---	STAINED			

RCLSYM 06/14/88

CH2M HILL

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: SHEET 6 OF 7

ROCK CORE LOG

PROJECT: UOSA LANDFILL   LOCATION:
ELEVATION: 194.7 ft.   DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.
DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57   ORIENTATION: VERT.
WATER LEVEL AND DATE: 38.7ft. 10/25/88 START: 10/20/88   FINISH: 10/21/88   LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	RQD	F / RAC	DISCONTINUITIES — DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOLIC LOG	LITHOLOGY — ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS — SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				51.5,FT,5,SMOOTH,PLANAR,MnOx		51.8 SILTY SHALE, SIMILAR	
52 --			---	STAINED		TO ABOVE EXCEPT COARSE TO	
				51.9,FT,0,SMOOTH,STEPPED,MnOx		MEDIUM GRAINED	
--			2	STAINED		52.3 SILTY SHALE, SIMILAR	
				52.3,52.5,2FT,30,SMOOTH,PLANAR,MnOx		TO ABOVE EXCEPT FINE	
53 --			---	STAINED		GRAINED	
--			1	53.1,53.4,2FT,0,SMOOTH,PLANAR			
						53.8 SILTY SHALE, SIMILAR	
54 --			---			TO ABOVE WITH COARSE	
						PEBBLES	
--			2	54.3,FT,0,SMOOTH,PLANAR,MnOx		54.4 SILTY SHALE,SIMILAR	
				STAINED		TO ABOVE WITH CALCITE	
55 --			---	54.5,FT,0,SMOOTH,PLANAR,HVY MnOx		VEINLETS INFILLING	
				STAINED		THROUGHOUT	
--			0				
56 --			---				
--			3				
				56,56.7,57.9,FT,SMOOTH,PLANAR,MnOx			
57 --			---	STAINED			
--			1				
58 --			---				
--			0				
59 --			---				
--			0				
	59.9						
60 --	R-5		---				
	100%	80%				SILTY SHALE, SAME AS	10:30AM TOOK SEVERAL
--			0			ABOVE	MINUTES FOR WATER
				60.1,63.3,63.6,65.8,66.1,66.2,66.5,		61.5-62.0 CALCITE VEINLET	RETURN
61 --			---	68.9,69.9,FT,0,SMOOTH,PLANAR,MnOx		1/16" TO 3"	
				STAINED			
--			1				

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-8 | SHEET: 7 OF 7

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION:

ELEVATION: 194.2 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 38.33', 11/21/88 START: 10/20/88 | FINISH: 10/21/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	DISCONTINUITIES F / R A C	DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				SEE SHEET 6 FOR DESCRIPTION OF			
--			1	DISCONTINUITIES			--
63 --			---				--
						63.5-63.8 SILTY SHALE	
--			2			SIMILAR TO ABOVE EXCEPT	--
						WITH CALCITE VEINLETS	
64 --			---			1/16" BY 3"	--
--			2				--
65 --			---				--
--			1				--
66 --			---				--
--			3				--
67 --			---				--
--			2				--
68 --			---				--
--			2				--
69 --			---			69.6-69.9, SILTY SHALE,	--
						SIMILAR TO ABOVE EXCEPT	
--			0			WITH CALCITE VEINLET,	--
	69.9					1/16" - 1/8"BY 5"	11:45AM, COMPLETED
70 --			---				CORING, --
--			---			TERMINATED BORING AT	--
						69.9ft., INSTALLED WATER	USED AIR COMPRESSOR TO
--			---			MONITORING WELL AS SHOWN	BLOW OUT HOLE TO --
						IN APPENDIX C	ESTIMATE LOCATION OF
--			---				GROUNDWATER. --
--			---				--

RCLSYM 06/14/88

Observation Well Installation Detail

Project Name UOSA Landfill
Project No. WDC 26094.D1.11
Drilling Contractor EEI
Recorded by A. Bryda

Boring/Piezometer No. MW-9
Casing Elevation 244.64 ft.
Location N 420486.172, E 2296520.04
Date 11/07/88

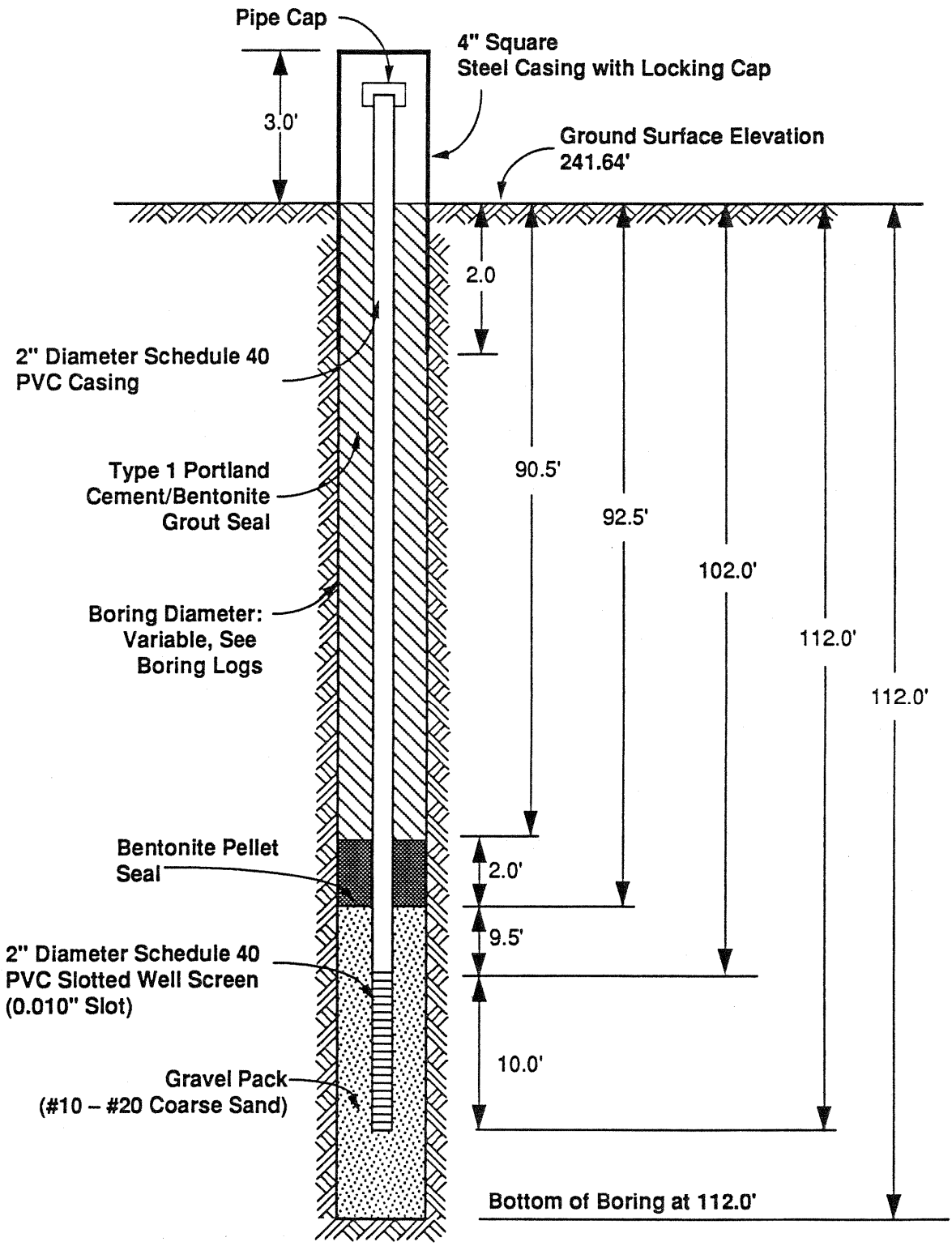


Figure Not to Scale

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 1 OF 12

CH2M HILL

SOIL BORING LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.6 ft. | DRILLING CONTRACTOR: ENVIROMENTAL EXPLORATIONS INC.

DRILLING METHOD AND EQUIPMENT: ROTARY TRI-CONE ROLLER (3.825" ID) MOBIL B-57

WATER LEVEL AND DATE: 87.92 ft., 11/21/88 | START: 10/27/88 | FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	DEPTH INTERVAL (ft)	TYPE AND NUMBER	REC (ft)	STD. PEN. TEST 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TEST AND INSTRUMENTATION
	0.0				TOPSOIL = 4.0 INCHES		
		S-1	0.9	5-6-9	LEAN CLAY, DARK BROWN (5YR 4/4), MOIST,		
	1.5		60%	(15)	STIFF, OCCASIONAL ROOTLET, (CL)		
	2.0						
		U-2	1.5		SILTY CLAY, RED AND BROWN (5YR 4/4), DRY		PP=2.5tsf TV=3.5tsf
			100%		TO MOIST, STIFF, (CL-ML)		
	3.5						
		S-3	1.2	17-46-	SILT, DARK RED (5R 5/4), DRY, VERY STIFF		
			80%	100/3	TO HARD, WEATHERED SHALE, (ML)		
5	5.0			(>100)			
	7.5				WEATHERED SILTY SHALE, DARK RED (5R 5/4),		
	7.8	S-4	0.5	100/3"	SAME AS S-3, (ML)		
			167%				
10	10.0				NO RECOVERY		HAMMER BOUNCING ON SPT
	10.1	S-5	0	100/2"			SAMPLER
					TERMINATED SOIL BORING AT 10.1 ft.,		
					CONTINUED USING ROCK CORING, SEE ROCK		
					CORE LOGS SHEETS 2 THROUGH 12.		

SELSYM 06/14/88

CH2M HILL

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042
ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.
DRILLING METHOD AND EQUIPMENT: HW CORING (4.2") MOBIL B-57 | ORIENTATION: VERT.
WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 | FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	RQD	FRACT	DISCONTINUITIES: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				CONTINUED FROM SOIL BORING			
	10.7		1	10.9,FT,5,PLANAR,SMOOTH,MnOx		10.0 SILTSTONE,BROWN WITH	
11	R-1			STAINED		YELLOW SAND LENSES,(10YR	
	83%	0%				6/6) MICA, FINE GRAINED,	
			7	11.6,BD,5,PLANAR,SMOOTH,CLAY		MODERATELY WEATHERED,	
				INFILLING		HARD	
12				12.1-12.5,BROKEN CORE		10.6 SILTY SHALE, RED	
						BROWN(10YR 4/6),INFILLED	
	12.5		1			WITH LT.YELLOW GREEN	SWITCHED TO ROLLER
						SANDSTONE/SILTSTONE,ZONED,	BIT(3.9"OD) FROM 12.5
13		R				SLIGHTLY WEATHERED	TO 17.0
		O					
		L				12.5-17.0, SAME AS ABOVE	
		L					
14		E					
		R					
		B					
15		I					
		T					
16							C-6 JAR SAMPLE OF
							CUTTINGS
17	17.0			17.0-18.9 ASSUMED CORE LOSS		17.0-21.9	
	R-2					SILTY SHALE WITH	
	61%	51%				INTERBEDDED SANDSTONE,	
18						DARK RED(5R 6/2),GREENISH	
				18.9,FT,0,PLANAR,ROUGH		INCLUSIONS POSSIBLY	
			1			EPIDOTE, ZONED, FINE	
						GRAINED, SLIGHTLY	COLOR CHANGE IN
19						WEATHERED, MATRIX IS SOFT	DRILLING FLUID
						BUT INCLUSIONS ARE HARD	
			1	19.9,FT,0,ROUGH,PLANAR			
20							

CH2M HILL

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 3 OF 12

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R F / A T / C	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				20.5,FT,10,ROUGH,PLANAR,MnOx STAINED			SOFT AT 21.9, BLOCKING
21				20.7,FT,20,ROUGH,PLANAR,MnOx STAINED			BIT WHICH REQUIRED CORE
				21.3,FT,0,ROUGH,PLANAR,MnOx STAINED			BARREL TO BE PULLED
			2	21.6,FT,40,ROUGH,PLANAR,MnOx STAINED			@11:55AM
	21.9					21.9-23.0 SILTY SHALE,	
22	R-3			22.0-23.0,5FT,0,SMOOTH,PLANAR,MnOx		DARK RED (5R 6/2),	
	100%	43%		STAINED		FINE-GRAINED, SOFT,	
			7			SLIGHTLY WEATHERED,	
				23.3,FT,45,ROUGH,PLANAR,MnOx			
23				STAINED, CALCITE INFILLING		23.0-30.3 SILTY SHALE,	
			3	23.9,FT,70,ROUGH,PLANAR,MnOx STAINED		SIMILAR TO ABOVE EXCEPT	
						GREENISH INCLUSIONS	
24						(POSSIBLY EPIDOTE)	
			2				
				25.2,FT,90,ROUGH,STEPPED,MnOx STAINED			
25				25.2-26.0,BROKEN CORE, <2" IN			
			5	LENGTH, FT,0,ROUGH,PLANAR,MnOx			
				STAINED			
26				26.0-27.0,BROKEN CORE,<3" IN LENGTH			
			5				
27							
			2	27.5,FT,0,ROUGH,PLANAR			
28				28.0-28.7,BROKEN CORE,VERTICAL			
	28.7			FRACTURES			STOP DRILLING AT 13:00
	R-4		6				DUE TO BREAKDOWN IN RIG
29	89%	22%		29.0-30.0,5FT,0,ROUGH,PLANAR			START UP AT 15:20
			5				
30				30.0-31.0,BROKEN CORE			
			>10			30.3-31.3 SLATE, GRAY, MICA	
						FINE-GRAINED,FRESH,HARD	

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 4 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION:420486.172 2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R F A C T	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				31.4,BJ,0,SMOOTH,PLANAR		31.3-35.4	
			>10			SILTY SHALE, DARK RED (5R	
				ASSUME CORE LOSS FROM 31.9 TO 32.6		6/2),FINE-GRAINED,SLIGHTLY	
32				SINCE BROKEN AND HIGHLY FRACTURED		WEATHERED,SOFT	
				FROM 31.7-33.7			
			>10				
33							
			>10				
34				34.0-34.6,FT,85,ROUGH,PLANAR,			
				INFILLED WITH BROWN FAT CLAY			
			4	34.6-35.0,BROKEN CORE			
							STOP 16:30 BREAKDOWN
35	35.0						IN DRILL RIG
	R-5			35.2,FT,45,ROUGH,PLANAR,PARTIALLY		35.4-35.9 SILTSTONE	START 12:30 10/29
	89%	44%	2	CLOSED		/SANDSTONE,YELLOW	STOP 13:00 BREAKDOWN IN
	35.9			35.4,FT,0,ROUGH,PLANAR,MnOx STAINED,		GREEN(10Y 6/2), MICA,	DRILL RIG
36	R-6			INFILLED WITH BROWN CLAY		QUARTZ, FINE-GRAINED,	START 13:30 11/1
	91%	51%		36.3,FT,0,ROUGH,PLANAR,INFILLED		FRESH, HARD,THIN	CLOUDY, COOL
			4	WITH BROWN CLAY		35.9-36.9 SLATE, GRAY RED	
				36.6,FT,90,ROUGH,PLANAR,INFILLED		10R 4/2),INCLUSIONS OF	
37				WITH BROWN CLAY		YELLOW SANDSTONE(OR	
				36.8&36.9,FT,0,ROUGH,PLANAR		EPIDOTE), SLIGHTLY WEATHERE	
			3	37.0-37.4,ASSUMED CORE LOSS		HARD INTERLAYERED SILTY	
				37.9,BJ,0,ROUGH,PLANAR		SHALE	
38				38.4,FT,80,ROUGH,PLANAR,BROWN CLAY		38.0 -38.1 SILTSTONE,	
				INFILLING		YELLOW BROWN, MEDIUM,	
			5	38.9,FT,80,ROUGH,PLANAR,BLUE WHITE		SLIGHTLY WEATHERED	
				AND BROWN CLAY INFILLING			
39				39.1-39.5,BROKEN CORE		38.1-44.7 SILTY SHALE,	
						DARK RED, SAME AS ABOVE	
			5				
40				40.5,FT,40,ROUGH,PLANAR,PARTIALLY			
	40.4			OPEN			PULLED CORE BARREL,
	R-7		2				COULD NOT RESTART AFTER
	100%	35%		41.0,FT,20,ROUGH,PLANAR,CALCITE OR			ADDING 5' ROD
41				LT. GRAY CLAY INFILLING			

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 5 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL LOCATION:420486.172 2296520.042

ELEVATION: 244.64 ft. DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	RQD	DISCONTINUITIES F/R	DISCONTINUITIES A/C	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOLOGY	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				4	41.0-41.8,BROKEN CORE			
42					42.0-43.0,5FT,0,ROUGH,PLANAR,MnOx STAINED			
				5				
43					43.0-43.7,5FT,0,ROUGH,PLANAR,MnOx STAINED, CALCITE INFILLED			
				6				
44								
				3				
45							44.7 - 45.3 SIMILAR TO ABOVE EXCEPT YELLOW GREEN INCLUSIONS (SILTSTONE OR EPIDOTE)	
	45.3				45.4,45.5,FT,0,ROUGH,PLANAR,MnOx			PULLED CORE BARREL,
	R-8			4	STAINED			COULD NOT RESTART AFTER
	100%	61%						ADDING 5' ROD
46							45.3-50.5 SILTY SHALE, RED BROWN (10YR 4/6), FINE GRAINED SLIGHTLY WEATHERED, SOFT	
				0				
47					47.2,FT,85,PLANAR,CALCITE INFILLED,1/16" WIDTH			
				1				
48					48.0,48.3,FT,10,ROUGH,PLANAR			
				4	48.6,FT,10,ROUGH,PLANAR,MnOx STAIN, INFILLED WITH GRAY CALCITE OR CLAY		49.0 - 50.5 CALCITE VEINLETS	
49								
				2				
50							50.5 - 51.4 SIMILAR TO ABOVE EXCEPT YELLOW GREEN INCLUSIONS (SILTSTONE OR EPIDOTE), VERY SOFT TO SOFT	
				7				
	50.7				50.9,FT,9,ROUGH,PLANAR,MnOx STAINED			
51	R-9				51.3,2FT INTERSECT, 0&30, ROUGH, PLANAR,INFILLED WITH BROWN&GRAY CALCITE OR CLAY		51.4-55.3 SILT SHALE	PULLED CORE BARRELL, SAME PROBLEM
	100%	31%		6				

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 6 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 | FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	RQD	DISCONTINUITIES: F / R A C	DISCONTINUITIES: F / T	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING)	SYMBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
					51.4,2BJ,25&50,ROUGH,PLANAR,MnOx		52.7 CALCITE VEINLET	
--			7		STAINED			--
					52.0-53.0,7FT,0,ROUGH,PLANAR,MnOx			
53 --			---		STAIN			--
					53,FT,10,ROUGH,STEPPED,CALCITE			
--			4		INFILLING,OPEN		53.76-53.8 CALCITE	--
					53.5,FT,0,SMOOTH,PLANAR,HVY MnOx		VEINLET, 1/8" WIDTH	
54 --			---		STAINING			--
					54.3,54.4,54.7,54.8,54.9,FT,30,			
--			8		SMOOTH,PLANAR,MnOx STAINED,			--
					INFILLED WTIH CALCITE			
55 --			---		54.5,FT,0,ROUGH,PLANAR,MnOx STAINED		55.0-55.7 CALCITE	--
					55.3,FT,15,ROUGH,PLANAR,MnOx		VEINLET	
--			6		STAINED,CALCITE INFILLING		55.3 - 57.5 SILTY SHALE,	--
					55.5-57.0,BROKEN CORE		SIMILAR TO ABOVE EXCEPT	
56 --			---		56.3-57.0,ASSUMED CORE LOSS		VERY SOFT	--
--			>10					56.5 2" DROP IN RODS --
								56.9 2" DROP IN RODS
57 --			---		57.2,2FT,0,SMOOTH,PLANAR,MnOx			--
					STAINED		57.5-59.3	
--			5				SANDSTONE,YELLOW	--
					57.5,2BJ,25&30,SMOOTH,PLANAR		BROWN,FINE-GRAINED,	
58 --			---		57.8,BJ,25,ROUGH,PLANAR		MEDIUM,SLIGHTLY WEATHERED	--
	58.5				58.0,58.2,BJ,2,ROUGH,PLANAR,MnOx			STOP 17:20
--	R-10	3			STAINED			START 7:20AM 11/2, --
	100%	38%			58.8-60.4,BROKEN CORE, HORIZONTAL		59.3-60.3	PARTLY CLOUDY,COOL
59 --			---		AND VERTICAL FRACTURES		SILTY SHALE, RED BROWN,	--
							ZONED INCLUSIONS OF	
--			9				SILTSTONE, SANDSTONE,	--
							PYORITE,MICA,CALCITE,	
60 --			---				SOFT, FINE-GRAINED,	--
					60.6,FT,25,ROUGH,STEPPED,PARTIALLY		SLIGHTLY WEATHERED	
--			4		OPEN		60.3-63.5	--
							SIMILAR TO ABOVE EXCEPT	
61 --			---				NO INFILLING AND VERY	--
					61.1,FT,10,SMOOTH,PLANAR,MnOx		SOFT	
--			3		STAINED, CALCITE INFILLING			--
					61.4,61.6,FT,20,SMOOTH,PLANAR,MnOx			
62 --			---		STAINED,CALCITE INFILLING			--

RCLSYM 06/14/88

CH2M HILL

PROJECT NUMBER: WDC26094.D1	BORING NO.: MW-9	SHEET: 7 OF 12

ROCK CORE LOG

PROJECT: UOSA LANDFILL
LOCATION: N420486.172 E2296520.042
ELEVATION: 244.64 ft.
DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.
DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57
ORIENTATION: VERT.
WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88
LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	RQD	FRACT	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
			6	62.1-65.5, BROKEN CORE, NUMEROUS UNFILLED VOIDS			
63			4			63.5-65.0 SILTY SHALE, DARK RED (10R 4/2), CALCITE SPECKLED WITH SILTSTONE, SANDSTONE INFILLING (POSSIBLY EPIDOTE)	
64	64.9		1	64.2,FT,0,ROUGH, PLANAR			8:10AM
65	R-11 100%	90%	1	65.8,FT,60,PLANAR,CALCITE INFILLING		65.0-72.0 INTERBEDDED SILTSTONE/ SILTY SHALE, DARK RED (10R 4/2)	
66			1				
67			1				
68	68.9		1				9:30, HAD TROUBLE RE-STARTING AFTER ADDING 5'ROD, PULLED CORE BARREL
69	R-12 100%	62%	4	69.5-73.0, BJ, 0, ROUGH, PLANAR, HVY MnOx STAINING, SEEMS TO BREAK AT THE BOTTOM OF THE SANDSTONE LAYERS WHICH ARE APPROXIMATELY 1" IN THICKNESS.		69.5-71.0, CALCITE VEINLETS	
70			6				CONSIDERABLE WOBBLY IN DRILLING RODS AT THIS TIME PROBABLY DUE TO BENT 10'ROD. DRILLER TO CHANGE ON NEXT RUN
71			3				
72			5	72.0-73.0, NUMEROUS UNFILLED VOIDS 72.9,FT,0,SMOOTH,PLANAR,MnOx STAINED		72.0 -73.0 SIMILAR TO ABOVE EXCEPT SOFT	

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 8 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R A C	T	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SYMBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
					73.4,FT,10,SMOOTH,PLANAR,MnOx		73.0-81.9	
			4		STAINED		SIMILAR TO ABOVE EXCEPT	
							RED BROWN (10R 3/4),NO	
74							ZONED INCLUSIONS	
					74.2,FT,30,ROUGH,STEPPED,MnOx		SIMILAR TO ABOVE EXCEPT	
			3		STAINED		ZONED INCLUSIONS OF	
					74.6,FT,20,ROUGH,PLANAR,MnOx		YELLOW GREEN SANDSTONE	
75					STAINED		(EPIDOTE MINERAL)	
	75.4							11:30AM
	R-13		0					
	100%	81%						
76								
			1					
					76.1,FT,40,ROUGH,PLANAR,MnOx			
77					STAINED			
			2					
78								
					77.4,FT,0,ROUGH,PLANAR			
			1					
79								
			4					
80					79.1,FT,0,ROUGH,PLANAR			
					79.6,2FT,5,SMOOTH,PLANAR,MnOx			
			1		STAINED			
					79.8,FT,SMOOTH,PLANAR,MnOx STAINED			
81							81.9 -82.1	
					80.4,FT,0,ROUGH,PLANAR		SANDSTONE,YELLOW BROWN,	
			5				FINE GRAINED,HARD	
							82.1-86.4	
82							SILTY SHALE	
					81.1,FT,0,SMOOTH,PLANAR,MnOx		SAME AS ABOVE	
			1		STAINED			
					81.6,FT,20,SMOOTH,PLANAR,MnOx STAINED			
83					81.9,2FT,0,ROUGH,PLANAR,MnOx STAINED			

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 9 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R A C	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
			2			83.8-84.3,CALCITE	
84				84.0,FT,0,SMOOTH,PLANAR		VEINLETS	
			5				
				84.8-85.7,7FT,15,SMOOTH,PLANAR,			
85				INFILLED WITH CALCITE AND FINE			
	85.4			SAND,OPEN			12:30
	R-14		5				
	100%	72%		85.7,FT,10,ROUGH,PLANAR,MnOx		86.4-86.6 SIMILAR TO	
86				STAINED		ABOVE EXCEPT SILTSTONE/	
						SANDSTONE, LT. YELLOW	
			2			GREEN	
				86.6,FT,0,ROUGH,PLANAR		86.6-89.0	
87				86.8,FT,0,ROUGH,PLANAR		SILTY SHALE,DARK	
				87.2,FT,5,ROUGH,PLANAR,CALCITE		RED,CALCITE INFILLING	
			3	INFILLING		THROUGHOUT, SOFT,	
				87.5-89.0,7FT,0,SMOOTH,PLANAR,MnOx		FINE-GRAINED, SLIGHTLY	
88				STAINED WITH CALCITE INFILLING		WEATHERED	
						87.3-87.9 CALCITE	
			5			VEINLETS	
89						89.0-94.9	
						SIMILAR TO ABOVE EXCEPT	
			1			ZONED INCLUSIONS OF	
						YELLOW GREEN MINERAL	
90				89.8,FT,0,ROUGH,PLANAR,MnOx STAINED		POSSIBLY EPIDOTE	
				90.3-91.0,FT,90,ROUGH,PLANAR			
			2				
91				90.8,FT,60,ROUGH,PLANAR,MnOx			
				STAINED			
			1				
92				91.8,FT,0,SMOOTH,PLANAR,MnOx			
				STAINED			
			1				
93							
				92.8,FT,0,SMOOTH,PLANAR,MnOx			
			1	STAINED			

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 10 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 FINISH: 11/4/88 LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND REC	R Q D	F / R F / A C T	DISCONTINUITIES DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MBOL	LITHOLOGY ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
				93.9,FT,15,SMOOTH,PLANAR			
--			5	94.3,2FT,40&0,ROUGH,PLANAR			
				94.8,FT,40,ROUGH,PLANAR		94.9-95.2	
95 --			---	94.9,BJ,0,ROUGH,PLANAR		SLATE,GRAY,FINE GRAINED,	
	95.4			94.9,-95.1,BROKEN CORE,HORIZONTAL		HARD,SLIGHTLY WEATHERED	STOP 13:10 START 13:50
--	R-15		2	AND VERTICAL FRACTURES			
	98%	50%				95.2-101.0	
96 --			---			SILTY SHALE,DARK RED(5R	
				96.4,FT,0,SMOOTH,PLANAR,MnOx		4/2),MICA, FINE GRAINED,	
--			2	STAINED		SLIGHTLY WEATHERED,SOFT	
97 --			---				
				97.2,FT,70,ROUGH,PLANAR,MnOx			
--			2	STAINED WITH CALCITE INFILLING			
98 --			---				
				98.1,98.6,98.9,FT,0,SMOOTH,PLANAR,MnO			
--			4	STAINED			
99 --			---				
				99.2,FT,5,SMOOTH,PLANAR,MnOx			
--			1	STAINED			
100 --			---				
--			8	100.0-101.6,9FT,0,SMOOTH,PLANAR,MnOx			
				STAINED WITH CALCITE INFILLING			
101 --			---			101.0-101.6, SIMILAR TO	
						ABOVE EXCEPT ZONED	
--			4			INCLUSIONS OF YELLOW	
						GREEN MINERAL POSSIBLY	
102 --			---			EPIDOTE	
						101.6-107.0	
--			3			SILTY SHALE,DARK	
						RED,VARIABLE,SLIGHTLY	
103 --			---	102.5,FT,0,ROUGH,PLANAR		WEATHERED,HARD	
				102.7-103.4,BROKEN CORE,HORIZONTAL			
--	103.6		4	AND VERTICAL FRACTURES			PULLED BARREL AT 15:20,--
	R-16			102.7-103.4,ASSUMED CORE LOSS			BLOCKAGE OF RETURN
104 --	93%	50%	---	103.9,FT,5,SMOOTH,PLANAR,MnOx STAINED			

RCLSYM 06/14/88

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9 | SHEET: 11 OF 12

CH2M HILL

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92', 11/21/88 START: 10/27/88 | FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE	CORE RUN LENGTH AND REC	DISCONTINUITIES R Q D	F/R A C	DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING	SY MB	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	SY OL	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT
			2	104.4,FT,0,SMOOTH,PLANAR,MnOx				
105				STAINED				
				104.7,FT,5,SMOOTH,PLANAR,MnOx				
			5	STAINED				
				105.3,FT,5,SMOOTH,STEPPED				
106				105.4,FT,SMOOTH,STEPPED,MnOx STAINED				
				105.7-107.6,9FT,SMOOTH,PLANAR,MnOx				
			5	STAINED				
107						107.0-113.0		
						SIMILAR TO ABOVE EXCEPT,		
			1	107.6-108.2,BROKEN CORE, ASSUMED		MODERATELY WEATHERED,		
				CORE LOSS AREA		VERY SOFT		
108	108.2							
	R-17							
	61%	0%	>10	108.2-113.6,BROKEN CORE,HORIZONTAL				
				AND VERTICAL FRACTURES, INFILLED				
109				WITH GRAY CLAY, MnOx STAINED				
			>10					
110								
			>10					
111								
			>10					
112								
			>10					
						113.0-122.0		
113						SILTSTONE,PALE RED(5R		
						6/2),MICA,FINE GRAINED,		
	113.6		>10			FRESH,HARD		STOP 17:30 START 11/3,
	R-18							7:50, COOL, CLEAR
114	100%	50%						
				113.7,FT,0,SMOOTH,PLANAR				
				113.9,FT,5,SMOOTH,PLANAR,MnOx STAINED				

RCLSYM 06/14/88

CH2M HILL

PROJECT NUMBER: WDC26094.D1	BORING NO.: MW-9	

ROCK CORE LOG

PROJECT: UOSA LANDFILL | LOCATION: N420486.172 E2296520.042

ELEVATION: 244.64 ft. | DRILLING CONTRACTOR: ENVIRONMENTAL EXPLORATIONS, INC.

DRILLING METHOD AND EQUIPMENT: HW CORING (4.2" OD) MOBIL B-57 | ORIENTATION: VERT.

WATER LEVEL AND DATE: 87.92, 11/21/88 | START: 10/27/88 | FINISH: 11/4/88 | LOGGER: T. SZYMONIAK

DEPTH BELOW SURFACE	CORE RUN LENGTH AND REC	RQD	FRACT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING AND STAINING)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE, CAVING, ROD DROPS, TEST RESULT)
			3	115.1,FT,10,SMOOTH,PLANAR,MnOx STAINED			
116			6	116.0,FT,5,ROUGH,PLANAR 116.2-117.4,1FT,85,SMOOTH,PLANAR,MnOx STAINED			
117			4	117.5,FT,0,ROUGH,PLANAR 117.9,FT,0,ROUGH,PLANAR			120.5, 25% RETURN OF DRILLING FLUID
118	118.6		4	118.4-118.6,1FT,90,SMOOTH,PLANAR,HVY MnOx STAINING 118.7-119.6,6FT,75,SMOOTH,PLANAR,MnOx STAINED			COMPLETED DRILLING AT 11:20AM
119	R-19 100%	17%	6	119.6,FT,0,ROUGH,PLANAR			USED CH2M HILL WELL DEVELOPMENT EQUIPMENT TO PULL DRILLING WATER FROM BORING AND MEASURE RECOVERY OF GROUNDWATER. LET STAND OVERNIGHT, H20 AT 91.0 FEET, SET WELL AS SHOWN IN APPENDIX C, HAD DIFFICULTIES PLACING BENTONITE PELLETS DUE TO BRIDGING AT 67'.
120			3	120.6-122.0,1FT,80,ROUGH,PLANAR,MnOx STAINED			
121			3				
122				TERMINATED ROCK CORING AT 122.0 FT. INSTALLED WATER MONITORING WELL (SEE COMMENTS)			DEVELOPED WELL ON 11/5 FOUND CEMENT IN EXTRACTED WATER, DECIDED TO ABANDON WELL AND RE-DRILL BORING 30 FEET SOUTH AND RE-INSTALL NEW WELL AS SHOWN IN APPENDIX C

CH2M HILL

PROJECT NUMBER: WDC26094.D1 | BORING NO.: MW-9B | SHEET: 1 OF 1

SOIL AND ROCK BORING LOG

PROJECT: UOSA LANDFILL
LOCATION: N420486.172 E2296520.042
ELEVATION: 241.1 ft.
DRILLING CONTRACTOR: ENVIROMENTAL EXPLORATIONS INC.
DRILLING METHOD AND EQUIPMENT: ROTARY TRI-CONE ROLLER (3.825" ID) MOBIL B-57
WATER LEVEL AND DATE: 87.92 ft., 11/21/88 START: 11/1/88 FINISH: 11/4/88 LOGGER: M. Ibison/T. Bryda

DEPTH BELOW SURFACE (ft)	DEPTH INTERVAL (ft)	TYPE AND NUMBER	RECOVERY (ft)	STD. PEN. TEST 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TEST AND INSTRUMENTATION
0					For Soil and Rock Description See Boring MW-9A		
10		C-1					
20		C-2					
30		C-3					
40		C-4					
50		C-5					
60		C-6					
70		C-7					
80		C-8					
90		C-9					
100		C-10					
110		C-11					
120					Terminated Boring at 113.0 ft., Installed Groundwater Observation Well as Shown in Appendix C.		

SBLSYM 06/14/88

Monitoring Well Construction Diagram

Project Name UOSA Landfill
Project No. WDC26094.D3.32
Drilling Contractor Badger Drilling
Recorded by C. Barnett

Boring/Piezometer No. MW-11
PVC Elevation 205.63
Location UOSA -Centreville, VA
Date 3/6/90

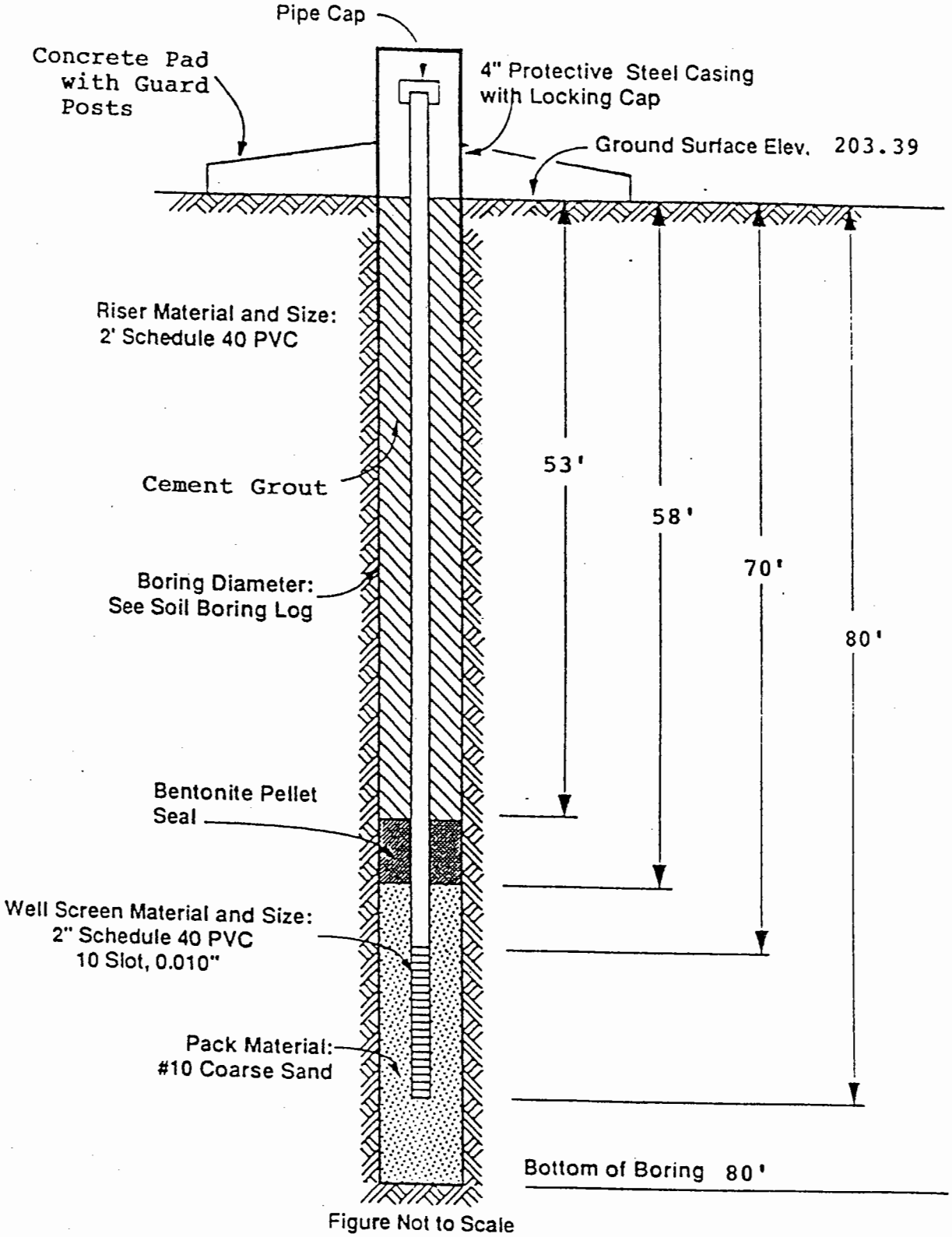


Figure Not to Scale

SCS ENGINEERS
Environmental Consultants
11260 Roger Bacon Drive
Reston, Virginia 20190-5282
703 471-6150 FAX 703 471-6676

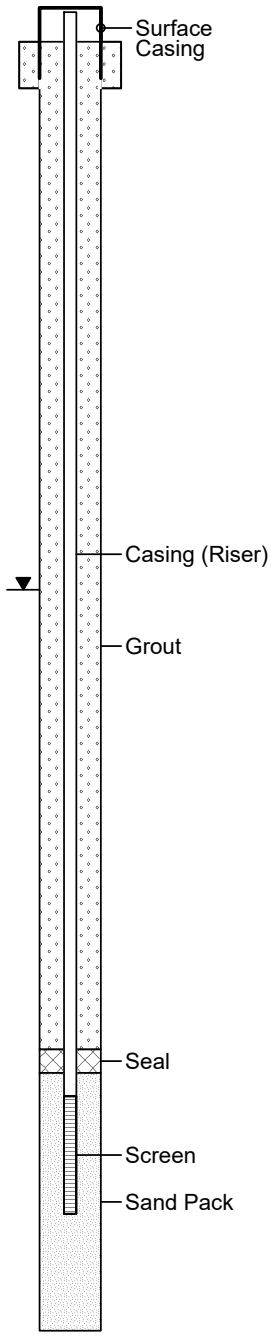
UOSA Landfill
Centerville, Virginia
SCS File No. 02200089.28

DRILLING IFO
Date Start/Complete : 08-09-21 / 08-10-21
Method : Air Rotary
Diameter : 6"
WELL CONSTRUCTION
Material : Flush thread Sch. 40 PVC
Diameter : 2"
Screen Length : 10'
Screen Opening : 0.02" factory-slotted
Filter Pack : #20 quartz

LOG OF BORING MW-14R

Logged By : B. Apolinar, SCS
Drilling Contractor : Groundwater Systems Inc.
Northing : 6981726.625
Easting : 11778569.125
Ground Elevation : 201.165

Well: MW-14R
Elev.: 203.69



Depth in Feet	USCS	GRAPHIC	DESCRIPTION	REMARKS
0			Soil/road gravel	AR = Air Rotary SH = Shale SL = Siltstone 6" bit drilled via AR to 110'. Annular space between the PVC riser and borehole wall was grouted via steel tremmie pipe from 80' to the surface. 5' steel casing cover was placed approximately 3.5' above ground surface over the PVC riser stick-up. A square cement pad was constructed around the well. Damp cuttings were observed at 80'. Drilling paused and the borehole was left to sit for 1hr20min. The borehole was airlifted, no water was produced. Drilling commenced to a depth of 110'. The borehole was left to sit overnight to observe recharge rates and was airlifted via AR on 8/10/2021 to clear any settled sediments, accumulated water, and confirmed water production. Borehole camera was used 8/10/2021 to screen for water bearing fractures'. Cloudy water obscured camera view beneath a depth of 96'. A water bearing fracture was confirmed and observed at 94'. Well development performed on 8/10/2021. Depth to water and bottom measured on 8/10/2021. DTW = 49.31 and DTB = 103.41' from top of PVC casing. END OF BORING 110'
5	SH		SHALE, brown, weathered, dry	
10				
15				
20				
25	SH		SHALE, hard, brownish light red, dry	
30				
35	SL/SH		SHALE/SILTSTONE, red, hard, dry	
40				
45				
50				
55			light red	
60				
65				
70				
75				
80			Fractures at 81'-83'; little water	
85	SH		SHALE, dark red, hard	
90				
95			Fracture with water at 94'-98'	
100				
105			Soft fracture, dry	
110			End of boring (110')	
115				

SCS ENGINEERS
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11260 Roger Bacon Drive
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703 471-6150 FAX 703 471-6676

Upper Occoquan Sewage Authority
Centreville, Virginia
Industrial Landfill #542

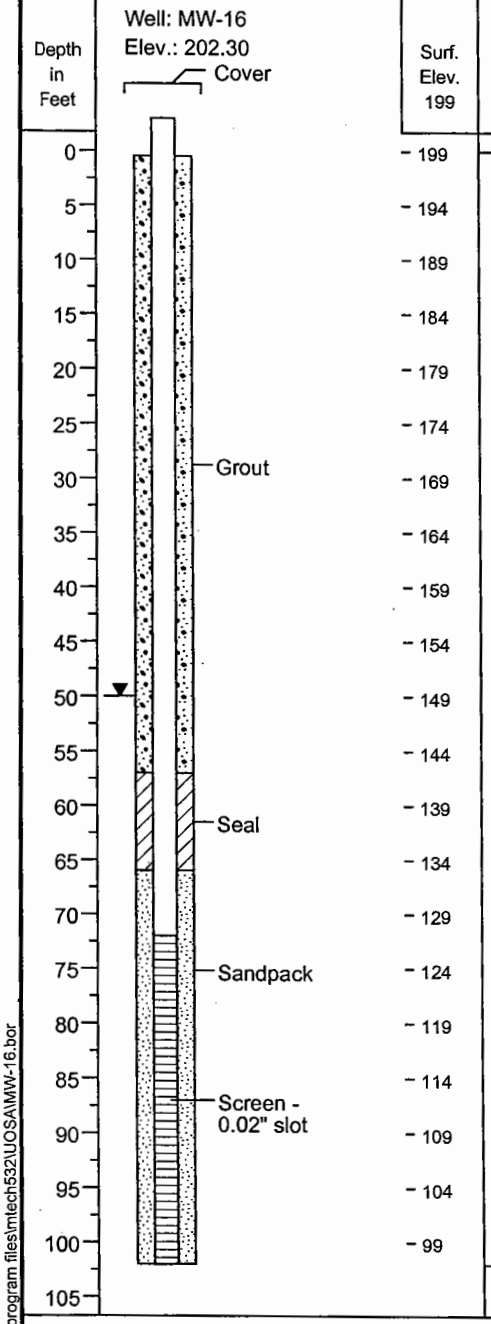
Project No. 02200089.01

WELL CONSTRUCTION
Date Completed : May 14, 2001
Hole Diameter : 6.00 in.
Drilling Method : Air Rotary
Company Rep. : B. Blase

WELL CASING
Material : PVC
Diameter : 2 in.
Joints : threaded

LOG OF BORING MW-16

BORING CONSTRUCTION
Date Completed : May 14, 2001
Hole Diameter : 6.00 in.
Drilling Method : Air Rotary
Sampling Method : Drill Cuttings
Company Rep. : B. Blase



Depth in Feet	Surf. Elev. 199	Samples	Water Levels	GRAPHIC	USCS	DESCRIPTION	REMARKS
0	199					Soil/Weathered rock, reddish brown, dry	soil/weathered rock
5	194						competent bedrock
10	189					SHALE, reddish-brown, dry	
15	184						
20	179				SH		
25	174						
30	169						small fracture zone
35	164						
40	159					SILTSTONE/SHALE, light red, dry, small fractures, very little water	fracture zone w/slight water
45	154						
50	149		▼				
55	144						fracture zone w/same water 56'-60'
60	139					SHALE/SILTSTONE, dark red-brown, dry, some fractures, more water with depth	
65	134						
70	129						
75	124						small fracture zone 75-77
80	119						stop drilling - very little water
85	114						
90	109						same - keep drilling
95	104						soft spot, fracture, more water
100	99						stop drilling, 1 gpm
105							

Driller: Groundwater Systems Inc., Mike and Toby
Drill Rig: Schramm Roto-Drill

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SCS ENGINEERS
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Upper Occoquan Sewage Authority
Centreville, Virginia
Industrial Landfill #542

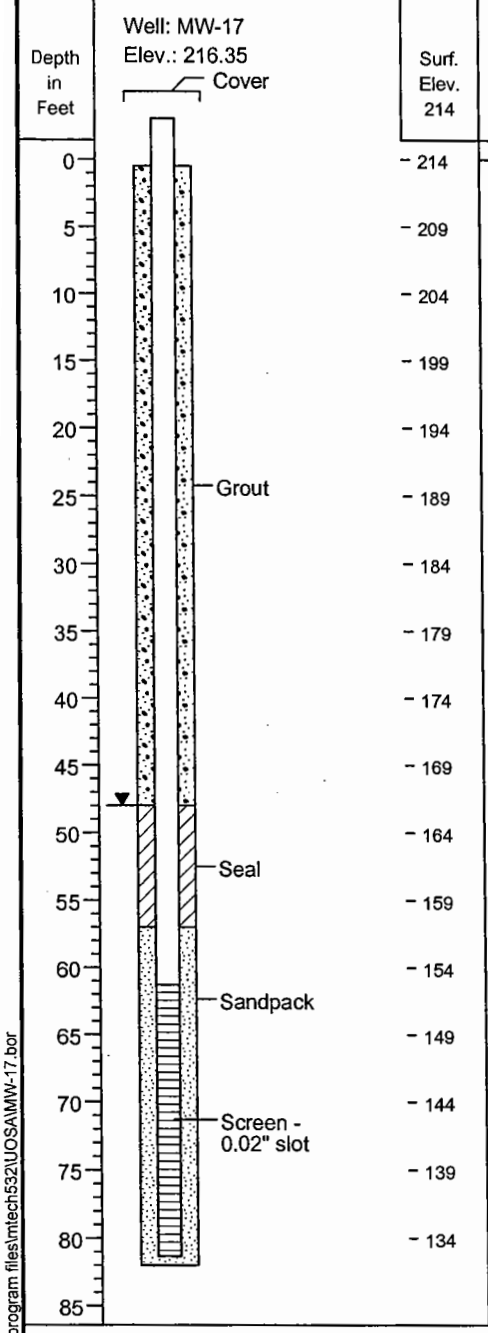
Project No. 02200089.01

WELL CONSTRUCTION
Date Completed : May 14, 2001
Hole Diameter : 6.00 in.
Drilling Method : Air Rotary
Company Rep. : B. Blase

WELL CASING
Material : PVC
Diameter : 2 in.
Joints : threaded

LOG OF BORING MW-17

BORING CONSTRUCTION
Date Completed : May 14, 2001
Hole Diameter : 6.00 in.
Drilling Method : Air Rotary
Sampling Method : Drill Cuttings
Company Rep. : B. Blase



Depth in Feet	Surf. Elev. 214	Samples	Water Levels	GRAPHIC	USCS	DESCRIPTION	REMARKS
0	214					bright red SILTY CLAY, soft, crumbly, dry	soil/weathered rock
5	209					reddish-brown siltstone/mudstone, dry	competent bedrock
10	204						small fracture zone (10'-12'), sl. moist
15	199						
20	194						
25	189						
30	184						
35	179						fracture zone, sl. moist
40	174						larger fracture but no water
45	169						soft zone
50	164						hard, sandstone?
55	159					grayish -brown sandy siltstone, minor fracture zones	grayish silt/sandstone, dry
60	154						still dry, grayish-red cuttings
65	149					reddish-brown sandy siltstone/mudstone	
70	144						fracture zone - some water
75	139						
80	134						fracture zone ends, 2 gpm
85							

Driller: Groundwater Systems Inc., Mike and Toby
Drill Rig: Schramm Roto-Drill

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Appendix C

Table 3.1 Column A Parameters
Table 3.1 Column B Parameters

TABLE 3.1 COLUMN A PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
METALS				
Antimony	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Arsenic	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Barium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Beryllium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Cadmium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Chromium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Cobalt	SW-846 6020	500 mL - plastic	90 days	Nitric Acid
Copper	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Lead	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Nickel	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Selenium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Silver	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Thallium	SW-846 6020	500 mL - plastic	90 days	Nitric Acid
Vanadium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Zinc	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
VOLATILE ORGANIC COMPOUNDS				
1,1,1,2-Tetrachloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,1-Trichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,2,2-Tetrachloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,2-Trichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1-Dichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2,3-Trichloropropane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dibromo-3-chloropropane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dibromoethane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichloropropane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,4-Dichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
2-Butanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
2-Hexanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
4-Methyl 2-pentanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

TABLE 3.1 COLUMN A PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
Acetone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Acrylonitrile	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Benzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromochloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromodichloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromoform	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Carbon disulfide	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Carbon tetrachloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloroform	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
cis-1,2-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
cis-1,3-Dichloropropene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Dibromochloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Dibromomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Ethyl benzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Iodomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Methylene chloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Styrene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Tetrachloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Toluene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
trans-1,2-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

TABLE 3.1 COLUMN A PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
trans-1,3-Dichloropropene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
trans-1,4-Dichloro-2-butene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Trichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Trichlorofluoromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Vinyl acetate	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Vinyl chloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Xylenes	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

HCL= Hydrochloric Acid

LOD = Limit of Detection

LOQ = Limit of Quantitation

mL = milliliters

°C = degrees Celsius

ug/L = micrograms per liter

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
CYANIDE AND SULFIDE				
Cyanide	SW-846 9012B	500 mL - plastic	14 days	NaOH to pH >12; 4°C in the dark
Sulfide	SW-846 9030B/9034	1 L - plastic	7 days	NaOH + ZnAC; 4°C; No head space
HERBICIDES				
2,4,5-T	SW-846 8151	1 L - Glass Amber	7-40 days after extraction	4°C
2,4,5-TP	SW-846 8151	1 L - Glass Amber	7-40 days after extraction	4°C
2,4-D	SW-846 8151	1 L - Glass Amber	7-40 days after extraction	4°C
Dinoseb	SW-846 8151	1 L - Glass Amber	7-40 days after extraction	4°C
Pentachlorophenol	SW-846 8151	1 L - Glass Amber	7-40 days after extraction	4°C
METALS				
Antimony	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Arsenic	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Barium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Beryllium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Cadmium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Chromium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Cobalt	SW-846 6020	500 mL - plastic	90 days	Nitric Acid
Copper	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Lead	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Mercury	SW-846 7470	500 mL - plastic	90 days	Nitric Acid
Nickel	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Selenium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Silver	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Thallium	SW-846 6020	500 mL - plastic	90 days	Nitric Acid
Tin	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Vanadium	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
Zinc	SW-846 6010	500 mL - plastic	90 days	Nitric Acid
POLY-CHLORINATED BIPHENYLS				
Aroclor - 1016	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1221	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1232	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1242	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1248	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1254	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C
Aroclor - 1260	SW-846 8082	1 L - Glass Amber	7-40 days after extraction	4°C

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
PESTICIDES				
4,4-DDD	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
4,4'-DDE	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
4,4'-DDT	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Aldrin	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
alpha-BHC	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
BHC-beta	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Chlordane	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
delta-BHC	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Dieldrin	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Endosulfan I	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Endosulfan II	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Endosulfan sulfate	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Endrin	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Endrin aldehyde	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Heptachlor	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Heptachlor epoxide	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Lindane	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Methoxychlor	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
Toxaphene	SW-846 8081	1 L - Glass Amber	7-40 days after extraction	4°C
SEMI-VOLATILE ORGANIC COMPOUNDS				
1,2,4,5-Tetrachlorobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
sym-Trinitrobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
1,4-Naphthoquinone	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
1-Naphthylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,3,4,6-Tetrachlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,4,5-Trichlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,4,6-Trichlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
2,4-Dichlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,4-Dimethylphenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,4-Dinitrophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,4-Dinitrotoluene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,6-Dichlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2,6-Dinitrotoluene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Acetylaminofluorene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Chloronaphthalene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Chlorophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Methylnaphthalene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Methylphenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Naphthylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Nitroaniline	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
2-Nitrophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
3,3'-Dichlorobenzidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
3,3'-Dimethylbenzidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
3-Methylcholanthrene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
3-Nitroaniline	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4,6-Dinitro-2-methylphenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Aminobiphenyl	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Bromophenyl phenyl ether	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Chloro-3-methylphenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Chloroaniline	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Chlorophenyl phenyl ether	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Nitroaniline	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
4-Nitrophenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
5-Nitro-o-toluidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
7,12-Dimethylbenz(a)anthracene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Acenaphthene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Acenaphthylene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Acetophenone	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Anthracene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzo(a)anthracene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzo(a)pyrene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzo(b)fluoranthene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzo(ghi)perylene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzo(k)fluoranthene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Benzyl alcohol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Bis(2-chloroethoxy)methane	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Bis(2-chloroethyl)ether	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Bis(2-Chloroisopropyl)ether	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
bis(2-Ethylhexyl) phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Butyl benzyl phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Chlorobenzilate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Chrysene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Cresols, Total	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Diallate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Dibenz(a,h)anthracene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Dibenzofuran	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Diethyl phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Dimethoate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Dimethyl phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Di-n-butyl phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Dinitrobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
Di-n-octyl phthalate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Diphenylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Disulfoton	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Ethyl methane sulfonate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Famphur	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Fluoranthene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Fluorene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Hexachlorobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Hexachlorobutadiene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Hexachlorocyclopentadiene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Hexachloroethane	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Hexachloropropene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Indeno(1,2,3-cd)pyrene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Isodrin	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Isophorone	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Isosafrole	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Kepone	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
m,p-Cresols	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Methapyrilene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Methyl methane sulfonate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Nitrobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosodiethylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosodimethylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosodi-n-butylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitroso-Di-n-propylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosodiphenylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosomethyl-ethylamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
N-Nitrosopiperidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
N-Nitrosopyrrolidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
O,O,O-Triethyl phosphorothioate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
o,o-Diethyl o-2-pyrazinyl phosphorothioate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
o-Toluidine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Parathion ethyl	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Parathion methyl	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
p-Dimethylaminoazobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Pentachlorobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Pentachloronitrobenzene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Phenacetin	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Phenanthrene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Phenol	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Phorate	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
p-Phenylenediamine	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Pronamide	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Pyrene	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
Safrole	SW-846 8270	1 L - Glass Amber	7-40 days after extraction	4°C
VOLATILE ORGANIC COMPOUNDS				
1,1,1,2-Tetrachloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,1-Trichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,2,2-Tetrachloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1,2-Trichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1-Dichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,1-Dichloropropene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2,3-Trichloropropane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
1,2,4-Trichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dibromo-3-chloropropane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dibromoethane	SW-846 8011	60 mL (2) - Amber VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,2-Dichloropropane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,3-Dichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,3-Dichloropropane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
1,4-Dichlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
2,2-Dichloropropane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
2-Butanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
2-Hexanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
4-Methyl 2-pentanone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Acetone	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Acetonitrile	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Acrolein	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Acrylonitrile	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Allyl chloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Benzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromochloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromodichloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromoform	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Bromomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Carbon disulfide	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Carbon tetrachloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
Chlorobenzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloroethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloroform	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Chloroprene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
cis-1,2-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
cis-1,3-Dichloropropene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Dibromochloromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Dibromomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Dichlorodifluoromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Ethyl benzene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Ethyl methacrylate	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Iodomethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Isobutyl alcohol	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Methacrylonitrile	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Methyl methacrylate	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Methylene chloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Naphthalene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Propionitrile	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Styrene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Tetrachloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Toluene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
trans-1,2-Dichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
trans-1,3-Dichloropropene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
trans-1,4-Dichloro-2-butene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

TABLE 3.1 COLUMN B PARAMETERS

Parameter	Current SW-846 Method	Sample Size - Container	Maximum Holding Time	Preservation
Trichloroethene	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Trichlorofluoromethane	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Vinyl acetate	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Vinyl chloride	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space
Xylenes	SW-846 8260	40 mL (3) - Clear VOA	14 days	4°C; 6 drops conc. HCL; No head space

HCL= Hydrochloric Acid
L = Liter
LOD = Limit of Detection
LOQ = Limit of Quantitation
mL = milliliters
NaOH = Sodium Hydroxide
°C = degrees Celsius
ug/L = micrograms per liter
ZnAC = Zinc Acetate

Appendix D

Laboratory Analytical/Bottle Kit Request Sheet
Groundwater Level Measurement Log
Sample Label
Daily Field Log
Well Sampling/MicroPurge Log
Custody Seal
Chain-of-Custody Form

Sample Laboratory Analytical/Bottle Kit Request Sheet

Groundwater Monitoring Wells		Parameters
MW-8	MW-14R	Table 3.1 Column A
MW-9	MW-16	Metals
MW-11	MW-17	VOCs 8011 & 8260
QC Samples		**Parameters**
Duplicate Field Blank MS/MSD		Table 3.1 Column A Metals VOCs 8011 & 8260
Trip Blank		Column A VOCs (8011 & 8260)

Leachate Sample	Parameters
Leachate	Table 3.1 Column A Metals VOCs 8011 & 8260
QC Sample	**Parameters**
Trip Blank	Column A VOCs (8011 & 8260)

Groundwater Level Measurement Log

Project Name: Project Number:

Date: Task Number:

Well Number	Time	Depth to Water (ft)	Depth to Bottom (ft)	Water Column Thickness (ft)	Top of Casing Elevation (ft,AMSL)	Groundwater Elevation (ft,AMSL)	Remarks

Field Personnel: _____

Checked By: _____

SAMPLE LABEL

PROJECT NAME

SAMPLE ID	**SAMPLE DATE**
SAMPLED BY	**SAMPLE TIME**
PRESERVATIVE	_____ **GRAB** _____ **COMPOSITE**

ANALYSIS REQUESTED

DAILY FIELD LOG

Project Name:		**Project Number:**	
		Task Number:	**Labor Code:**
Project Manager:		**Field Personnel:**	
Date:	**Vehicle:**	**Miles Billed:**	**Travel Time:**
Weather:			

Labor	Hours	Equipment	Materials

Work Completed:

Prepared By:	**Review By:**

Well Sampling / MicroPurge Log

Project Name:	**Project & Task Number:**
Well Number:	**Date:**
Well Diameter (in):	**1 Well Volume (gal):**
Total Well Depth (ft):	**Purging Time Initiated:**
Depth to Pump (ft):	**Purging Time Completed:**
Depth to Water (ft):	**Total Gallons Purged:**
Water Column Thickness (ft):	

PURGING RECORD

Time	Volume Purged (gallons)	Temperature (°C)	pH (s.u.)	Specific Conductance (uS/cm)	ORP (mV)	D.O (mg/L)	Turbidity (NTU)	Comments (water color, odor, sediment, cloudy, etc.)

SAMPLING RECORD

Sample Number	Collection Time	Parameter	Container	Preservative

Samples Shipped By: _____ Laboratory: _____

Sampler: _____ Checked By: _____

CUSTODY SEAL

CHAIN OF CUSTODY

COMPANY NAME:	INVOICE TO:	PROJECT NAME/Quote #:
CONTACT:	INVOICE CONTACT:	SITE NAME:
ADDRESS:	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #:	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL:		Pretreatment Program:
Is sample for compliance reporting? YES NO	Regulatory State: Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

COMMENTS

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE)								COMMENTS
1)																			
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	**QC Data Package**	**LAB USE ONLY** **Therm ID: _____** **COOLER TEMP _____°C**
RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	Level III ☐	Custody Seals used and intact? (Y / N) Received on ice? (Y / N)
RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	Level IV ☐	

ATTACHMENT C - VARIANCE PETITION

Environmental Consultants

11260 Roger Bacon Drive
Suite 300
Reston, VA 20190-5282

703 471-6150
FAX 703 471-6676
www.scsengineers.com

SCS ENGINEERS

November 8, 2012
File No. 02200089.14

Mr. Larry W. Syverson, C.P.G
Groundwater Remediation Specialist
Virginia Department of Environmental Quality
P.O. Box 1105
Richmond, Virginia 23218

Subject: Upper Occoquan Service Authority Industrial Landfill, Solid Waste Permit #542
Variance Petition

Dear Mr. Syverson:

On behalf of the Upper Occoquan Service Authority (UOSA), SCS Engineers is submitting the attached Variance Petition requesting the Virginia Department of Environmental Quality (VDEQ) approve the removal of the Table 3.1 Column A sampling parameters that are not reasonably expected to be in or derived from the waste as allowed by 9 Virginia Administrative Code (VAC) 20-81-250 C 2 d (1) (b). The parameters requested for removal include the volatile organic compounds listed on Table 3.1 Column A of 9 VAC 20-81-250 E. Therefore, the facility requests the semi-annual groundwater samples only be required to be analyzed for the following inorganic parameters (metals) listed on Table 3.1 Column A: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Selenium, Silver, Thallium, Vanadium, and Zinc.

A copy of the check sent to VDEQ Receipt Control Office for the variance petition fee is also attached. Please contact the undersigned at (703) 471-6150 or Mr. Tom Appleman of UOSA at (703) 830-2200 with questions, concerns, or if additional information is required.

Sincerely,

Kimberley M. Day
Project Professional
SCS ENGINEERS

Jennifer S. Robb
Senior Project Professional
SCS ENGINEERS

KMD/jsr

cc Mr. Richard Doucette, VDEQ-NRO
Geoff Christe, VDEQ-CO
Thomas Appleman, UOSA
File

Enclosure

VARIANCE PETITION

This Variance Petition was prepared in accordance with 9 Virginia Administrative Code (VAC) 20-81-700 and 760.

Applicant's Name and Address:

Upper Occoquan Service Authority
Industrial Landfill
Solid Waste Permit #542
14631 Compton Road
Centreville, Virginia 20121

Statement of Applicant's Interest:

The applicant's interest is to remove the Table 3.1 Column A volatile organic compounds (VOCs) from the semi-annual groundwater sampling parameter list. Therefore, the facility would only being required to analyze the semi-annual groundwater samples for the inorganic parameters listed on Table 3.1 Column A. This request shall also apply to the facility's annual leachate monitoring requirements.

Description of Desired Action:

The applicant would like the Virginia Department of Environmental Quality (VDEQ) to approve the removal of the Table 3.1 Column A sampling parameters that are not reasonably expected to be in or derived from the waste as allowed by 9 VAC 20-81-250 C 2 d (1) (b). The parameters requested for removal include the VOCs listed on Table 3.1 Column A of 9 VAC 20-81-250 E. Therefore, the facility requests the semi-annual groundwater samples only be required to be analyzed for the following inorganic parameters (metals) listed on Table 3.1 Column A.

- **Metals:** Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Selenium, Silver, Thallium, Vanadium, and Zinc.

The proposed parameters will continue to be sampled and reported as total concentrations and will be analyzed using SW-846 methods in accordance with 9 VAC 20-81-250 A 4 b.

Description of Need and Justification:

The Upper Occoquan Service Authority (UOSA) owns and operates a state-of-the-art water reclamation plant in Centreville, Virginia. The water reclamation plant generates lime solids as part of the chemical treatment process. During chemical treatment, secondary effluent is treated with slaked lime [$Ca(OH)_2$] to a pH of 11.3 s.u. to precipitate and coagulate phosphorus and inactivate viruses. The coagulated particles are flocculated and the pH restored to neutral by a two-stage re-carbonation process. The solids are removed from the process and are dewatered to approximately 38% total solids via several large filter presses before being disposed in the on-site, active UOSA Industrial Landfill (Solid Waste Permit #542). No other materials are placed in the UOSA landfill.

In accordance with the facility' Solid Waste Permit, the lime-solids and leachate are sampled on an annual basis and these results are submitted to VDEQ annually. The leachate samples are analyzed for the same list of parameters as the groundwater samples. The lime solids samples are analyzed for toxicity characteristics using the Toxicity Characteristic Leaching Procedure (TCLP). The parameters included in the TCLP analysis that are also included on the Table 3.1 Column A parameter list are shown below.

- **Metals:** Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, and Silver.
- **VOCs:** 1,1-Dichloroethene, 1,2-Dichloroethane, 1,4-Dichlorobenzene, 2-Butanone, Benzene, Carbon Tetrachloride, Chlorobenzene, Chloroform, Tetrachloroethene, Trichloroethene, and Vinyl Chloride

To further characterize the lime solids, SCS Engineers collected lime-solids samples from four discrete locations directly from the working face of the landfill on September 1, 2005. These samples were analyzed for the complete list of Target Analyte List metals, which includes the metals listed on Table 3.1 Column A. A single lime solids sample was also collected by SCS on July 19, 2011 for the analysis of the full list of Table 3.1 Column A parameters.

Table summarizing the Table 3.1 Column A parameters historically detected above the laboratory's limit of detection (LOD) in the lime solids and leachate samples are attached. No VOCs have been detected in the leachate or lime solids samples above the laboratory's limit of quantitation (LOQ) or reporting limit.

The facility is currently implementing a First Determination Monitoring Program in accordance 9 VAC 20-81-250 C 2. A table summarizing the Table 3.1 Column A parameters historically detected above the laboratory's limit of detection (LOD) in the facility's background and compliance groundwater monitoring wells is attached. No verified inter-well exceedances have been identified since implementation of the First Determination Monitoring Program in July 2011. In addition, no VOCs have been detected in the groundwater samples above the laboratory's LOQ.

The reduction of the semi-annual sampling parameter list to include only metals listed on Table 3.1 Column A will allow UOSA to reduce sampling and laboratory analytical costs while remaining protective of human health and the environment.

Duration of the Variance:

During the active life of the facility and the thirty-year post closure care period, the variance will be in effect for the period in which the facility is conducting groundwater monitoring in accordance with the First Determination Monitoring Program.

Potential Impact on Public Health or the Environment:

Based on previous sampling and analysis events, potential human and ecological receptors, and a review of the operational history of the facility, there are currently no substantial threats to public health or the environment. The permitted area has adequate monitoring systems for detecting potential releases to the environment. Therefore, this request will not reduce the ability of the monitoring network to detect a potential release to the environment and remains protective human health and the environment.

Other Information:

Analytical data for the September 2005 and July 2011 lime solids samples, the aforementioned historical summary tables, and other information supporting this request are attached to this document.

Attachment A – Certificates of Analysis & Chain-of-Custody Forms
Attachment B – Historical Laboratory Analytical Results
Attachment C – Site Map/Groundwater Contour Map

Applicant's Signed Statement:

9 VAC 20-81-760 A 1 h: "I certify that I have personally examined and am familiar with the information submitted in this application and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

Name: Mr. Tom Appleman, Regulatory Affairs Coordinator

Signature:

Company: Upper Occoquan Service Authority
Address: 14631 Compton Road
City/State/Zip: Centreville, Virginia 20121
Phone #: (703) 830-2200
Email Address: thomas.appleman@uosa.org

ATTACHMENT A

Certificates of Analysis
Chain-of-Custody Forms

AIR WATER SOIL Laboratories, Inc.

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Case Narrative

RECEIVED
11-9-05

Laboratory I.D. No.: 05090032

Client Name:	SCS Engineers	Date Received:	September 02, 2005
Client Project I.D.:	UOSA Industrial Landfill	Date Issued:	September 16, 2005
Submitted to:	Matt Moore	Date Final Issue:	October 10, 2005

On September 02, 2005, four solid samples were received via courier for analysis per the attached Chain-of-Custody Record. All samples were received with sample containers intact by Karen Seifert (AWS). Upon laboratory receipt, no deviations, discrepancies or irregularities were observed in sample condition, including holding times, temperature, containers or preservatives other than those notated on the chain-of-custody.

The samples were prepared and analyzed per SW846 methodology.

For questions or inquiries please contact Carmela Tombes at (804) 358-8295.

A cross reference of client sample I.D. vs. Laboratory I.D. follows:

Client Sample I.D.	Laboratory I.D.
090105-Sludge#1	05090032-001
090105-Sludge#2	05090032-002
090105-Sludge#3	05090032-003
090105-Sludge#4	05090032-004

Definitions of terms:

BDL = Below Detection Limit

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Certificate of Analysis

Client Name:	SCS Engineers	Date Received:	September 02, 2005
Client Project I.D.:	UOSA Industrial Landfill	Date Issued:	September 16, 2005
Submitted to:	Matt Moore	Date Final Issue:	October 10, 2005

Reference Method: SW-846

Four solid samples were analyzed for the following Target Analyte Metals:

Parameter	090105-Sludge#1 (mg/kg)	090105-Sludge#2 (mg/kg)	090105-Sludge#3 (mg/kg)	090105-Sludge#4 (mg/kg)	Detection Limit (mg/kg)	Method
Aluminum	3300	690	3600	770	250	6010B
Antimony	BDL	BDL	BDL	BDL	5	6010B
Arsenic	0.6	0.6	0.8	0.7	0.5	6010B
Barium	32	23	41	29	0.5	6010B
Beryllium	BDL	BDL	BDL	BDL	0.5	6010B
Cadmium	BDL	BDL	BDL	BDL	0.5	6010B
Calcium	160,000	160,000	160,000	160,000	1250	6010B
Chromium	4.9	1.3	5.4	1.1	0.5	6010B
Cobalt	2.3	BDL	2.0	BDL	0.5	6010B
Copper	9.4	10	17	12	5	6010B
Iron	5300	1200	4200	510	250	6010B
Lead	BDL	BDL	BDL	BDL	0.5	6010B
Magnesium	16,000	18,000	17,000	17,000	50	6010B
Manganese	130	56	99	39	1	6010B
Mercury	BDL	BDL	BDL	BDL	0.008	7470
Nickel	4.5	1.0	3.3	1.1	0.5	6010B
Potassium	820	64	580	80	20	7610
Selenium	BDL	BDL	BDL	BDL	1	6010B
Silver	2.5	2.4	3.3	2.4	0.5	6010B
Sodium	200	140	180	140	0.4	7770
Thallium	BDL	BDL	BDL	BDL	2.5	6010B
Vanadium	7.6	5.8	11	2.1	0.5	6010B
Zinc	82	91	100	91	2.5	6010B

Ted Soyars
Laboratory Manager

05090032

AIR WATER & SOIL Laboratories, Inc.

2119-A NORTH HAMILTON STREET
RICHMOND, VIRGINIA 23230
(804) 358-8295 PHONE
(804) 358-8297 FAX

CHAIN OF CUSTODY

CLIENT NAME: SCS Engineers
CLIENT PROJECT NAME: UOSA Industrial Landfill
CLIENT CONTACT: Matt Moore
CLIENT ADDRESS: 600 Pegasus Court, Suite 102 Winchester, VA 22602
CLIENT PHONE/FAX: (540) 450-2175 (540) 662-8468
CLIENT P.O. No. 02200089.06
Sampler(s) I.D. (print/signature) MINH NGUYEN -

CLIENT SAMPLE I.D.	DATE	TIME	# CONT	MATRIX	GRAB	COMP	ANALYSIS: TAL Metals (4oz - clear glass)
1. 090105-Sludge#1	9/1/2005	9:15	1	Sludge		X	X
2. 090105-Sludge#2	9/1/2005	9:20	1	Sludge		X	X
3. 090105-Sludge#3	9/1/2005	9:25	1	Sludge		X	X
4. 090105-Sludge#4	9/1/2005	9:30	1	Sludge		X	X
5.							
6.							
7.							
8.							
9.							
10.							

COMMENTS

Normal TAT

Data Pack

(Please Note Sample Preservation)

SCS-W
UOSA Industrial Landfill

05090032
DUE: 5 Days
Recd: 09/02/05

RELINQUISHED:	RECEIVED: Karen Serfass	DATE: 9/2/05 TIME: 12:55 PM
RELINQUISHED:	RECEIVED:	DATE: TIME:
RELINQUISHED:	RECEIVED:	DATE: TIME:

LAB USE ONLY
Preservative(s):
Temperature (°C):
Lab I.D. No.:

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Certificate of Analysis

Final Report

Laboratory Order ID 11070271

Client Name:	SCS Engineers-Reston 11260 Roger Bacon Drive Reston, VA 20190	Date Received: Date Issued:	July 20, 2011 September 07, 2011
Submitted To:	Jennifer Robb	Project Number:	02200089.12
Client Site I.D.:	UOSA Industrial Landfill	Purchase Order:	NA

Sample Summary List

Laboratory Sample ID	Sample ID	Sample Date	Receive Date
11070271-001	Lime Solids	07/19/2011	07/20/2011

This Certificate of Analysis is being reissued on September 07, 2011 to include updated results for Arsenic.

Ted Soyars
Laboratory Manager

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a dry weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

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Certificate of Analysis

Final Report

Laboratory Order ID 11070271

Client Name: SCS Engineers-Reston
11260 Roger Bacon Drive
Reston, VA 20190

Date Received: July 20, 2011
Date Issued: September 07, 2011

Submitted To: Jennifer Robb

Project Number: 02200089.12

Client Site I.D.: UOSA Industrial Landfill

Purchase Order: NA

Analytical Results

Sample I.D.: Lime Solids

Laboratory Sample I.D.: 11070271-001

Date/Time Sampled: 07/19/11 09:10

Parameter	Method	Sample Results	Qual	Rep Limit	Samp Prep Date/Time	Analysis Date/Time	Analyst
Antimony	SW6010C	< 5.72 mg/kg		5.72	07/22/2011 14:00	07/25/2011 15:46	MWL
Arsenic	SW6010C	< 0.572 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Barium	SW6010C	58.2 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Beryllium	SW6010C	< 0.572 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Cadmium	SW6010C	< 0.572 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Chromium	SW6010C	2.50 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Cobalt	SW6010C	1.02 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Copper	SW6010C	20.8 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Lead	SW6010C	< 0.572 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Nickel	SW6010C	1.91 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Selenium	SW6010C	< 2.86 mg/kg		2.86	07/22/2011 14:00	07/25/2011 15:46	MWL
Silver	SW6010C	< 0.572 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Thallium	SW6010C	< 2.86 mg/kg		2.86	07/22/2011 14:00	07/25/2011 15:46	MWL
Vanadium	SW6010C	2.14 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Zinc	SW6010C	145 mg/kg		0.572	07/22/2011 14:00	07/25/2011 15:46	MWL
Chloromethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Vinyl chloride	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Bromomethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Trichlorofluoromethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1-Dichloroethylene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Acetone	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
Iodomethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Carbon disulfide	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Methylene chloride	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
trans-1,2-Dichloroethylene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1-Dichloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Vinyl acetate	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
cis-1,2-Dichloroethylene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD

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Certificate of Analysis

Final Report

Laboratory Order ID 11070271

Client Name: SCS Engineers-Reston
11260 Roger Bacon Drive
Reston, VA 20190

Date Received: July 20, 2011
Date Issued: September 07, 2011

Submitted To: Jennifer Robb

Project Number: 02200089.12

Client Site I.D.: UOSA Industrial Landfill

Purchase Order: NA

Analytical Results

Sample I.D.: Lime Solids
Date/Time Sampled: 07/19/11 09:10

Laboratory Sample I.D.: 11070271-001

Parameter	Method	Sample Results	Qual	Rep Limit	Samp Prep Date/Time	Analysis Date/Time	Analyst
2-Butanone (MEK)	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
Bromochloromethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Chloroform	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1,1-Trichloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Carbon tetrachloride	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Benzene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2-Dichloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Trichloroethylene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Acrylonitrile	SW8260B	< 286 ug/kg		286	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2-Dichloropropane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Dibromomethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Bromodichloromethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
cis-1,3-Dichloropropene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
4-Methyl-2-pentanone (MIBK)	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
Toluene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
trans-1,3-Dichloropropene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1,2-Trichloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Tetrachloroethylene (PCE)	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
2-Hexanone (MBK)	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
Dibromochloromethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Chlorobenzene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1,1,2-Tetrachloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Ethylbenzene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Xylenes, Total	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
Styrene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
Bromoform	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
1,1,2,2-Tetrachloroethane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2,3-Trichloropropane	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD

090720111357

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Certificate of Analysis

Final Report

Laboratory Order ID 11070271

Client Name: SCS Engineers-Reston
11260 Roger Bacon Drive
Reston, VA 20190

Date Received: July 20, 2011
Date Issued: September 07, 2011

Submitted To: Jennifer Robb

Project Number: 02200089.12

Client Site I.D.: UOSA Industrial Landfill

Purchase Order: NA

Analytical Results

Sample I.D.: Lime Solids
Date/Time Sampled: 07/19/11 09:10

Laboratory Sample I.D.: 11070271-001

Parameter	Method	Sample Results	Qual	Rep Limit	Samp Prep Date/Time	Analysis Date/Time	Analyst
1,4-Dichlorobenzene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2-Dichlorobenzene	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD
trans-1,4-Dichloro-2-butene	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2-Dibromo-3-chloropropane (DBCP)	SW8260B	< 229 ug/kg		229	07/27/2011 16:47	07/27/2011 16:47	MKD
1,2-Dibromoethane (EDB)	SW8260B	< 57.2 ug/kg		57.2	07/27/2011 16:47	07/27/2011 16:47	MKD

Summary of Analytical QC Batches

QC Batch ID	Method	Sample List
QC110725018	SM18/2540G	11070271-001
QC110726007	SW6010C	11070271-001
QC110728009	SW8260B	11070271-001

AIR WATER & SOIL LABORATORIES, INC.
2109A NORTH HAMILTON STREET
RICHMOND, VIRGINIA 23230
(804) 358-8295 PHONE
(804)358-8297 FAX

CHAIN OF CUSTODY

PAGE 1 OF 1

CLIENT NAME:	SCS Engineers	PROJECT NAME:	UOSA Industrial Landfill
CLIENT CONTACT:	Jennifer Robb	SITE NAME:	UOSA Industrial Landfill
CLIENT ADDRESS:	11260 Roger Bacon Drive, Reston, VA 20190	PROJECT NUMBER:	02200089.12
CLIENT PHONE NUMBER:	(703) 471-6150	P.O. NUMBER:	
CLIENT FAX NUMBER:	(703) 471-6676	REGULATORY AUTHORITY:	

Is sample for compliance reporting? (YES) NO | Is sample from a chlorinated supply? YES (NO) | PWS I.D. #:

SAMPLER NAME (PRINT): MINH NGUYEN | SAMPLER SIGNATURE: [signature] | Turn Around Time: 10 Day(s)

Have ammonia and TKN samples been verified to be dechlorinated at the time of sampling?: YES NO

CLIENT SAMPLE I.D.	Composite Start Date	Composite Start Time	Grab or Composite Stop Date	Grab or Composite Stop Time	Number of Containers	Grab	Composite	Field Filtered (Dissolved Metals)	MATRIX: Ground Water / Surface Water	Waste Water / Storm Water	Drinking Water	Soil	Solids	Other	ANALYSIS: Table 3.1 A VOC's-8260 (HCL)	Table 3.1 A EDB/TCP/DBCP-8011 (HCL)	Table 3.1 A Metals (HNO3)	Total Phosphorus (H2SO4)				COMMENTS
1) LIME SOLIDS			7-19-11	910	1	X							X		X	X	X					Quote I.D.: QT11061301 report results in mg/L NO DATA PACKAGE Cobalt to be analyzed by Low Level ICP Method
2)																						PLEASE NOTE PRESERVATIVE(S) or PUMP RATE (L/min)
3)																						
4)																						
5)																						
6)																						
7)																						
8)																						
9)																						
10)																						

	DATE / TIME	RECEIVED:	DATE / TIME
RELINQUISHED: [signature]	7-19-11 1800	A. McBride	7-20-11 1405
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package: Level I ☐ Level II ☐ Level III ☐ Level IV X (MN)

LAB USE ONLY COOLER TEMP 3.4 °C

11070271

SCS-R
UOSA Industrial Landfill

11070271
DUE: 10 Days
Recd: 07/20/11

ATTACHMENT B

Historical Laboratory Analytical Results

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
METALS									
Antimony	September-2005	---	**1** J	**1** J	ND	ND	ND	1	5
		---	---	---	---	---	ND D	1	5
	July-2011	ND	ND	ND	ND	ND	ND	3	5
		---	---	---	---	ND D	---	3	5
	January-2012	ND	ND	ND	ND	ND	ND	3	5
		---	---	---	---	---	ND D	3	5
	July-2012	ND	ND	ND	ND	ND	ND	5	5
		---	---	ND D	---	---	---	5	5

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Arsenic	July-1992	ND	ND	---	**6**	---	---	---	---
	November-1992	ND	ND	---	ND	---	---	---	---
	January-1993	ND	ND	---	ND	---	---	---	---
	April-1993	ND	ND	---	ND	---	---	---	---
	July-1993	ND	ND	---	**8**	---	---	---	---
	January-1994	ND	ND	---	ND	---	---	---	---
	April-1994	ND	ND	---	ND	---	---	---	---
	July-1994	ND	ND	---	ND	---	---	---	---
	October-1994	ND	ND	---	---	---	---	---	---
	November-1994	---	---	---	ND	---	---	---	---
	January-1995	ND	ND	---	ND	---	---	---	---
	April-1995	ND	ND	---	ND	---	---	---	---
	July-1995	ND	ND	---	ND	---	---	---	---
	January-1996	ND	ND	---	ND	---	---	---	---
	July-1996	ND	ND	---	ND	---	---	---	---
	January-1997	ND	ND	---	ND	---	---	---	---
	July-1997	ND	ND	---	ND	---	---	---	---
	January-1998	**1.4**	**1.2**	---	**1.6**	---	---	---	---
	August-1998	**1.52**	**1.06**	---	**2.05**	---	---	---	---
	January-1999	**1.6**	ND	---	**3**	---	---	---	---
	June-1999	---	---	---	---	**3.4**	---	---	---
	July-1999	---	---	---	---	**1.8**	---	---	---
	November-1999	---	---	---	---	**2.3**	---	---	---
	February-2000	---	---	---	---	**3.1**	---	---	---
	July-2000	---	---	---	**2.1**	**2.7**	---	---	---
	July-2001	---	---	ND	ND	ND	ND	---	---
	September-2001	---	---	**1.6** J	---	---	**3** J	1.6	10
	November-2001	---	---	ND	---	---	**1.8** J	1.6	10
	January-2002	---	---	ND	---	---	ND	1.6	10
	March-2002	---	---	ND	---	---	**2.9** J	1.3	10
	May-2002	---	---	ND	---	---	**2** J	1.3	10
	July-2002	---	---	---	**2** J	**3** J	**1.8** J	1.3	10
	July-2003	---	---	---	**3.7** J	**3.3** J	**2** J	1.3	10
	July-2004	---	---	ND	**1.7** J	**3.5** J	**2.12** J	2.6	10
	September-2005	---	**4** J	ND	**4** J	**5** J	ND	3	10
		---	---	---	---	---	ND D	3	10
	July-2006	---	---	ND	---	**4** J	ND	3	10
	October-2006	---	---	ND	**4** J	ND	ND	3	10
	January-2007	---	---	ND	ND	ND	ND	3	10
	April-2007	---	---	ND	ND	**5** J	ND	3	10
	July-2007	---	---	ND	ND	ND	ND	3	10
	August-2007	**3** J,B	ND	---	---	---	---	3	10
	September-2007	ND	ND	---	---	---	---	3	10
	October-2007 Event #1	ND	ND	---	---	---	---	3	10
	October-2007 Event #2	**4** J	**4** J	---	---	---	---	3	10
	January-2008	ND	ND	ND	ND	ND	ND	3	10
		---	---	ND D	---	---	---	3	10
	July-2008	ND	ND	ND	ND	ND	ND	3	10
		---	ND D	---	---	---	---	3	10
	February-2009	ND	ND	ND	ND	ND	ND	3	10
		---	---	---	ND D	---	---	3	10
	July-2009	ND	ND	ND	**5** J	**8** J	ND	3	10
		---	---	---	---	**5** D,J	---	3	10
	January-2010	ND	ND	ND	ND	ND	ND	9	10
		---	---	---	---	---	ND D	9	10
	July-2010	ND	ND	ND	ND	ND	ND	9	10
		---	---	---	---	---	ND D	9	10
	January-2011	ND	ND	ND	ND	ND	ND	9	10
		---	---	---	ND D	---	---	9	10
	July-2011	ND	ND	ND	ND	ND	ND	9	10
		---	---	---	---	ND D	---	9	10
	January-2012	ND	ND	ND	ND	ND	ND	9	10
		---	---	---	---	---	ND D	9	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Barium	July-1992	**280**	**5**	---	**60**	---	---	---	---
	November-1992	**275**	**4**	---	**45**	---	---	---	---
	January-1993	**295**	***7***	---	**34**	---	---	---	---
	April-1993	**281**	***7***	---	**33**	---	---	---	---
	July-1993	**273**	**8**	---	**166**	---	---	---	---
	January-1994	**264**	ND	---	**31**	---	---	---	---
	April-1994	**255**	**5**	---	**22**	---	---	---	---
	July-1994	**255**	**5**	---	**25**	---	---	---	---
	October-1994	**253**	**5**	---	---	---	---	---	---
	November-1994	---	---	---	**26**	---	---	---	---
	January-1995	**257**	**4**	---	**55**	---	---	---	---
	April-1995	**251**	**4**	---	**23**	---	---	---	---
	July-1995	**239**	ND	---	**23**	---	---	---	---
	January-1996	**241**	ND	---	ND	---	---	---	---
	July-1996	**220**	ND	---	ND	---	---	---	---
	January-1997	**220**	ND	---	**30**	---	---	---	---
	July-1997	**240**	ND	---	**30**	---	---	---	---
	January-1998	**190**	ND	---	ND	---	---	---	---
	August-1998	**187**	ND	---	ND	---	---	---	---
	January-1999	**240**	ND	---	ND	---	---	---	---
	June-1999	---	---	---	---	**180**	---	---	---
	July-1999	---	---	---	---	ND	---	---	---
	November-1999	---	---	---	---	ND	---	---	---
	February-2000	---	---	---	---	**31**	---	---	---
	July-2000	---	---	---	ND	**100**	---	---	---
	July-2001	---	---	ND	ND	ND	ND	---	---
	September-2001	---	---	**40** J	---	---	**100** J	33	1000
	November-2001	---	---	ND	---	---	**100** J	33	1000
	January-2002	---	---	ND	---	---	**100** J	33	1000
	March-2002	---	---	ND	---	---	**70** J	20	1000
	May-2002	---	---	**40** J	---	---	**100** J	20	1000
	July-2002	---	---	---	ND	**92.6** J	**105** J	18.5	1000
	July-2003	---	---	---	ND	ND	ND	0.02	200
	July-2004	---	---	ND	ND	ND	**124** J	*77.1*	1000
	September-2005	---	***7*** J	**23**	**30**	**81**	**160**	2	10
		---		---	---	---	**160** D	2	10
	July-2006	---	---	**21**	**25**	***77***	**130**	2	10
	October-2006	---	---	**23**	**37**	**89**	**176**	2	10
	January-2007	---	---	**24**	**36**	**87**	**192**	2	10
	April-2007	---	---	**23**	**42**	**90**	**198**	2	10
	July-2007	---	---	**24**	**50**	**88**	**184**	2	10
	August-2007	**199**	**17**	---	---	---	---	2	10
	September-2007	**204**	**21**	---	---	---	---	2	10
	October-2007 Event #1	**202**	***7*** J	---	---	---	---	2	10
	October-2007 Event #2	**207**	***7*** J	---	---	---	---	2	10
	January-2008	**198**	**11**	**22**	**52**	**88**	**134**	2	10
		---	---	**22** D	---	---	---	2	10
	July-2008	**189**	**18**	**26**	**31**	**88**	**147**	2	10
		---	**16** D	---	---	---	---	2	10
	February-2009	**170**	**12**	**24**	**28**	**82**	**136**	2	10
		---	---	---	**28** D	---	---	2	10
	July-2009	**193**	**8** J	**28**	**27**	**93**	**218**	2	10
		---	---	---	---	**91** D	---	2	10
	January-2010	**185.4**	**23**	**27.4**	**54.2**	**87.9**	**155.3**	2	10
		---	---	---	---	---	**151** D	2	10
	July-2010	**187.4**	**21.8**	**26.6**	**43.7**	**98.1**	**199.9**	2	10
		---	---	---	---	---	**201** D	2	10
	January-2011	**173.5**	**15.3**	**27.6**	**49.1**	**98.2**	**198.7**	2	10
		---	---	---	**51.4** D	---	---	2	10
	July-2011	**179**	**21.9**	**25.6**	**34.6**	**92.3**	**201**	2	10
		---	---	---	---	**97.6** D	---	2	10
	January-2012	**175.5**	**30.2**	**24.8**	**42.4**	**95.8**	**145.3**	2	10
		---	---	---	---	---	**138.2** D	2	10
	July-2012	**188**	**9.7**	**24.4**	**53.4**	**104**	**135**	*5*	*5*
		---	---	**24** D	---	---	---	*5*	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Chromium	July-1992	ND	ND	---	**8**	---	---	---	---
	September-2005	---	ND	ND	**1** J	ND	ND	1	10
		---	---	---	---	---	ND D	1	10
	July-2006	---	---	ND	**1** J	ND	ND	1	10
	October-2006	---	---	ND	**1** J	ND	ND	1	10
	January-2007	---	---	ND	**1** J	ND	ND	1	10
	April-2007	---	---	ND	**2** J	ND	**1** J	1	10
	July-2007	---	---	ND	ND	ND	ND	1	10
	August-2007	ND	ND	---	---	---	---	1	10
	September-2007	ND	ND	---	---	---	---	1	10
	October-2007 Event #1	ND	ND	---	---	---	---	1	10
	October-2007 Event #2	ND	ND	---	---	---	---	1	10
	January-2008	ND	ND	ND	**1** J	ND	**1** J	1	10
		---	---	ND D	---		---	1	10
	July-2008	ND	ND	ND	**1** J	ND	**1** J	1	10
		---	ND	---	---		---	1	10
	February-2009	ND	ND	ND	ND	ND	**2** J	1	10
		---	---	---	**1** J,D	---	---	1	10
	July-2009	ND	**1** J	ND	**1** J	ND	**2** J	1	10
		---	---	---	---	ND	---	1	10
	January-2010	ND	ND	ND	**1.4** J	ND	**2.5** J	1	10
		---	---	---	---	---	**1.9** J,D	1	10
	July-2010	ND	**1.3** J	ND	ND	ND	ND	1	10
		---	---	---	---	---	**1.3** J,D	1	10
	January-2011	ND	ND	ND	ND	ND	**1.4** J	1	10
		---	---	---	ND D	---	---	1	10
	July-2011	ND	**1.5** J	ND	ND	ND	ND	1	10
		---	---	---	---	ND D	---	1	10
	January-2012	ND	**9** J	ND	**1.3** J	ND	ND	1	10
		---	---	---	---	---	ND D	1	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*
Cobalt	September-2005	---	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2006	---	---	ND	ND	ND	ND	2	10
	October-2006	---	---	ND	ND	ND	ND	2	10
	January-2007	---	---	ND	ND	ND	ND	2	10
	April-2007	---	---	ND	ND	ND	ND	2	10
	July-2007	---	---	ND	ND	ND	ND	2	10
	August-2007	ND	ND	---	---	---	---	2	10
	September-2007	ND	ND	---	---	---	---	2	10
	October-2007 Event #1	ND	ND	---	---	---	---	2	10
	October-2007 Event #2	ND	ND	---	---	---	---	2	10
	January-2008	ND	ND	ND	ND	ND	ND	2	10
		---	---	ND D	---	---	---	2	10
	July-2008	ND	ND	ND	ND	ND	ND	2	10
		---	ND D	---	---	---	---	2	10
	February-2009	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	ND D	---	---	2	10
	July-2009	ND	ND	ND	ND	ND	ND	2	4
		---	---	---	---	ND D	---	2	4
	January-2010	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2010	ND	ND	ND	ND	ND	ND	2	4
		---	---	---	---	---	ND D	2	4
	January-2011	ND	ND	ND	ND	ND	ND	2	4
		---	---	---	ND D	---	---	2	4
	July-2011	ND	ND	ND	ND	ND	ND	2	4
		---	---	---	---	ND D	---	2	4
	January-2012	ND	***2.7*** J	ND	ND	ND	ND	2	4
		---	---	---	---	---	ND D	2	4
	July-2012	ND	ND	ND	ND	ND	ND	0.25	0.5
		---	---	ND D	---	---	---	0.25	0.5

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Copper	September-2005	---	ND	ND	ND	ND	**4** J	3	*5*
		---	---	---	---	---	**4** J,D	3	*5*
	July-2006	---	---	ND	ND	ND	ND	3	10
	October-2006	---	---	ND	ND	ND	ND	3	10
	January-2007	---	---	ND	ND	ND	ND	3	10
	April-2007	---	---	**3** J	**3** J	**4** J	**4** J	3	10
	July-2007	---	---	**3** J	**4** J	**4** J	**3** J	3	10
	August-2007	**3** J	**4** J	---	---	---	---	3	10
	September-2007	ND	**3** J	---	---	---	---	3	10
	October-2007 Event #1	ND	ND	---	---	---	---	3	10
	October-2007 Event #2	ND	ND	---	---	---	---	3	10
	January-2008	ND	ND	ND	ND	ND	ND	3	10
		---	---	ND D	---	---	---	3	10
	July-2008	ND	ND	ND	ND	ND	ND	3	10
		---	ND D	---	---	---	---	3	10
	February-2009	ND	ND	ND	ND	ND	ND	3	10
		---	---	---	**4** J,B,D	---	---	3	10
	July-2009	**4** J,B	**4** J,B	ND	**3** J,B	**3** J,B	**3** J,B	3	10
		---	---	---	---	ND D	---	3	10
	January-2010	ND	ND	ND	ND	ND	ND	3	10
		---	---	---	---	---	ND D	3	10
	July-2010	ND	ND	ND	ND	ND	ND	3	10
		---	---	---	---	---	ND D	3	10
	January-2011	ND	ND	ND	ND	ND	ND	3	10
		---	---	---	ND D	---	---	3	10
	July-2011	**3.8** J	**5.6** J	**4.3** J	ND	ND	**3.1** J	3	10
		---	---	---	---	ND D	---	3	10
	January-2012	ND	**9.5**	ND	ND	ND	ND	3	10
		---	---	---	---	---	ND D	3	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*
Lead	July-1992	ND	ND	---	**6**	---	---	---	---
	September-2005	---	ND	ND	ND	ND	ND	6	10
		---	---	---	---	---	ND D	6	10
	July-2011	ND	ND	ND	ND	ND	ND	6	10
		---	---	---	---	ND D	---	6	10
	January-2012	ND	ND	ND	ND	ND	ND	6	10
		---	---	---	---	---	ND D	6	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Nickel	September-2005	---	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2006	---	---	ND	ND	ND	ND	2	10
	October-2006	---	---	ND	ND	ND	ND	2	10
	January-2007	---	---	ND	ND	ND	ND	2	10
	April-2007	---	---	ND	ND	ND	ND	2	10
	July-2007	---	---	ND	ND	ND	ND	2	10
	August-2007	ND	ND	---	---	---	---	2	10
	September-2007	ND	ND	---	---	---	---	2	10
	October-2007 Event #1	ND	ND	---	---	---	---	2	10
	October-2007 Event #2	ND	ND	---	---	---	---	2	10
	January-2008	ND	ND	ND	ND	ND	ND	2	10
		---	---	ND D	---	---	---	2	10
	July-2008	ND	ND	ND	ND	ND	ND	2	10
		---	ND D	---	---	---	---	2	10
	February-2009	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	ND D	---	---	2	10
	July-2009	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	ND D	---	2	10
	January-2010	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2010	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	January-2011	ND	ND	ND	ND	ND	**2.6** J	2	10
		---	---	---	ND D	---	---	2	10
	July-2011	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	ND D	---	2	10
	January-2012	ND	**4.3** J	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*
Selenium	July-1992	ND	ND	---	ND	---	---	---	---
	September-2005	---	ND	**4** J	**2** J	**2** J	**2** J	1	*5*
		---	---	---	---	---	**2** J,D	1	*5*
	July-2011	ND	ND	ND	ND	ND	ND	8	50
		---	---	---	---	ND D	---	8	50
	January-2012	ND	ND	ND	ND	ND	ND	8	50
		---	---	---	---	---	ND D	8	50
	July-2012	ND	ND	ND	ND	ND	ND	10	10
		---	---	ND D	---	---	---	10	10

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Silver	July-1992	ND	ND	---	ND	---	---	2	10
	September-2005	---	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2006	---	---	ND	ND	ND	ND	2	10
	October-2006	---	---	ND	ND	ND	ND	2	10
	January-2007	---	---	ND	**2** J	ND	ND	2	10
	April-2007	---	---	ND	ND	ND	ND	2	10
	July-2007	---	---	ND	ND	ND	ND	2	10
	August-2007	ND	ND	---	---	---	---	2	10
	September-2007	ND	ND	---	---	---	---	2	10
	October-2007 Event #1	ND	ND	---	---	---	---	2	10
	October-2007 Event #2	ND	ND	---	---	---	---	2	10
	January-2008	ND	ND	ND	ND	ND	ND	2	10
		---	---	ND D	---	---	---	2	10
	July-2008	ND	ND	ND	ND	ND	ND	2	10
		---	ND D	---	---	---	---	2	10
	February-2009	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	ND D	---	---	2	10
	July-2009	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	ND D	---	2	10
	January-2010	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2010	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	January-2011	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	ND D	---	---	2	10
	July-2011	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	ND D	---	2	10
	January-2012	ND	ND	ND	ND	ND	ND	2	10
		---	---	---	---	---	ND D	2	10
	July-2012	ND	ND	ND	ND	ND	ND	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*
Thallium	September-2005	---	ND	ND	ND	ND	ND	2	2
		---	---	---	---	---	ND D	2	2
	July-2011	ND	ND	ND	ND	ND	ND	2	2
		---	---	---	---	ND D	---	2	2
	January-2012	ND	ND	ND	ND	ND	ND	2	2
		---	---	---	---	---	ND D	2	2
	July-2012	ND	ND	**0.05** J,B	ND	ND	ND	0.019	0.1
		---	---	**0.037** J,B,D	---	---	---	0.019	0.1

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
Vanadium	September-2005	---	**6** J	**8** J	**8** J	**7** J	**9** J	2	10
		---	---	---	---	---	**9** J,D	2	10
	July-2006	---	---	**6** J	**8** J	**6** J	**8** J	2	10
	October-2006	---	---	**6** J	**7** J	**7** J	**8** J	2	10
	January-2007	---	---	**6** J	**8** J	**6** J	**8** J	2	10
	April-2007	---	---	**6** J	**8** J	**6** J	**8** J	2	10
	July-2007	---	---	**6** J	**8** J	**5** J	**7** J	2	10
	August-2007	**7** J	**4** J	---	---	---	---	2	10
	September-2007	**10**	**6** J	---	---	---	---	2	10
	October-2007 Event #1	**9** J	**5** J	---	---	---	---	2	10
	October-2007 Event #2	**9** J	**6** J	---	---	---	---	2	10
	January-2008	**10** J1	**6** J	**6** J	**8** J	**7** J	**8** J	2	10
		---	---	**6** J,D	---	---	---	2	10
	July-2008	**10** J1	**6** J	**6** J	**9** J	**7** J	**8** J	2	10
		---	**6** J,D	---	---	---	---	2	10
	February-2009	**9** J	**5** J	**6** J	**9** J	**7** J	**8** J	2	10
		---	---	---	**9** J,D	---	---	2	10
	July-2009	**9** J	**7** J	**6** J	**8** J	**6** J	**8** J	2	10
		---	---	---	---	**6** J,D	---	2	10
	January-2010	**9.9** J	**4** J	**6** J	**8.7** J	**6.8** J	**8.5** J	2	10
		---	---	---	---	---	**8.2** J,D	2	10
	July-2010	**7.7** J	**5.7** J	**5** J	**7.8** J	**5.5** J	**7.7** J	2	10
		---	---	---	---	---	**7.6** J,D	2	10
	January-2011	**9.5** J	**7.6** J	**5.9** J	**8.4** J	**6.7** J	**8.3** J	2	10
		---	---	---	**8.4** J,D	---	---	2	10
	July-2011	**8.8** J	**8.4** J	**5.9** J	**7.9** J	**5.9** J	**8.2** J	2	10
		---	---	---	---	**6.2** J,D	---	2	10
	January-2012	**9** J	**24.9**	**5.6** J	**7.9** J	**5.9** J	**8.6** J	2	10
		---	---	---	---	---	**7.9** J,D	2	10
	July-2012	**7.7**	ND	ND	**6.7**	**5.1**	**6.7**	*5*	*5*
		---	---	ND D	---	---	---	*5*	*5*
Zinc	September-2005	---	**30**	ND	ND	ND	ND	10	20
		---	---	---	---	---	ND D	10	20
	July-2006	---	---	ND	ND	ND	ND	10	10
	October-2006	---	---	ND	ND	ND	ND	10	10
	January-2007	---	---	ND	ND	ND	ND	10	10
	April-2007	---	---	ND	ND	ND	ND	10	10
	July-2007	---	---	**10**	ND	**14**	ND	10	10
	August-2007	ND	**12**	---	---	---	---	10	10
	September-2007	ND	ND	---	---	---	---	10	10
	October-2007 Event #1	ND	ND	---	---	---	---	10	10
	October-2007 Event #2	ND	ND	---	---	ND	---	10	10
	November-2007	---	---	---	---	ND	---	10	10
	December-2007	---	---	---	---	ND	---	10	10
	January-2008	ND	ND	ND	ND	ND	ND	10	10
		---	---	ND D	---	---	---	10	10
	July-2008	ND	ND	ND	ND	ND	ND	10	10
		---	ND D	---	---	---	---	10	10
	February-2009	ND	ND	ND	ND	ND	ND	10	10
		---	---	---	ND D	---	---	10	10
	July-2009	ND	ND	ND	ND	ND	**13**	10	10
		---	---	---	---	ND D	---	10	10
	September-2009	---	---	---	---	---	ND	10	10
	January-2010	ND	ND	ND	ND	ND	ND	10	10
		---	---	---	---	---	ND D	10	10
	July-2010	ND	ND	ND	ND	ND	ND	10	10
		---	---	---	---	---	**10.1** D	10	10
	January-2011	ND	ND	ND	ND	ND	ND	10	10
		---	---	---	ND D	---	---	10	10
	July-2011	ND	ND	ND	ND	ND	**13**	10	10
		---	---	---	---	ND D	---	10	10
	January-2012	ND	**13.3**	ND	ND	ND	ND	10	10
		---	---	---	---	---	ND D	10	10
	July-2012	ND	ND	ND	ND	ND	**10.7**	10	10
		---	---	ND D	---	---	---	10	10

HISTORICAL LABORATORY ANALYTICAL RESULTS SUMMARY
GROUNDWATER MONITORING WELLS

Well Classification		Background			Compliance			LOD (ug/L)	LOQ (ug/L)
Well ID		MW-8	MW-9	MW-17	MW-11	MW-14	MW-16		
Parameter	Monitoring Event	Result (ug/L)							
VOLATILE ORGANIC COMPOUNDS									
Chloroform	September-2005	---	ND	ND	ND	ND	ND	0.2	1
		---	---	---	---	---	ND D	0.2	1
	July-2011	ND	ND	ND	ND	ND	ND	0.2	0.5
		---	---	---	---	ND D	---	0.2	0.5
	January-2012	ND	ND	ND	ND	ND	ND	0.2	0.5
		---	---	---	---	---	ND D	0.2	0.5
	July-2012	**0.14** J	ND	ND	ND	ND	ND	0.14	1
		---	---	ND D	---	---	---	0.14	1
Chloromethane	September-2005	---	ND	ND	ND	ND	ND	0.3	1
		---	---	---	---	---	ND D	0.3	1
	July-2011	ND	ND	ND	ND	ND	ND	0.3	1
		---	---	---	---	ND D	---	0.3	1
	January-2012	ND	ND	ND	ND	ND	ND	0.3	1
		---	---	---	---	---	ND D	0.3	1
	July-2012	ND	**0.13** J	ND	ND	ND	ND	0.11	1
		---	---	ND D	---	---	---	0.11	1
Methylene chloride	September-2005	---	ND	**0.3** J,B	**0.3** J,B	**0.3** J,B	**0.3** J,B	0.3	1
		---	---	---	---	---	**0.4** J,B,D	0.3	1
	July-2011	ND	ND	ND	ND	ND	ND	1	4
		---	---	---	---	ND D	---	1	4
	January-2012	ND	ND	ND	ND	ND	ND	1	4
		---	---	---	---	---	ND D	1	4
	July-2012	ND	ND	ND	ND	ND	ND	0.97	2
		---	---	ND D	---	---	---	0.97	2
Trichlorofluoromethane	September-2005	---	ND	**0.5** J	ND	ND	ND	0.2	1
		---		---	---	---	ND	0.2	1
	July-2011	ND	ND	**0.5** J	ND	ND	ND	0.2	1
		---	---	---	---	ND	---	0.2	1
	January-2012	ND	ND	**0.8** J	ND	ND	**0.9** J	0.2	1
		---	---	---	---	---	**0.8** J,D	0.2	1
	March-2012 SS #1	---	---	**0.7** J	---	---	**0.7** J	0.2	1
	March-2012 SS #2	---	---	ND	---	---	ND	0.2	1
	July-2012	ND	ND	ND	ND	ND	ND	0.2	1
		---	---	ND D	---	---	---	0.2	1

B = Qualifier used is the reported concentration is less than five times that detected in the laboratory blank. Concentration is not considered validated.
--- = not applicable or available
D = Duplicate sample
J = Qualifier used if the reported concentration is less than the LOQ but greater than the LOD. The concentration is considered to be estimated and not validated.

J1 = Qualifier used if the reported concentration has been rounded up to the LOQ due to EPA rounding rules. The concentration is considered to be estimated and not validated.

LOD = Limit of Detection
LOQ = Limit of Quantitation
ND = Not Detected
SS = Split Sample
ug/L = micrograms per liter
Notes:
1. SS #1 was analyzed by Air Water & Soil Laboratories, Inc. SS #2 was analyzed by Pace Analytical Services, Inc.
2. Event #1 sample was collection on October 7, 2007. Event #2 sample was collected on October 29, 2007.

HISTORICAL LABORATORY ANALYTICAL RESULTS
LEACHATE

Parameter	Monitoring Event	Leachate Result (ug/L)		LOD (ug/L)	LOQ (ug/L)
METALS					
Arsenic	July-1994	**32.8**		---	---
	October-1994	**17.4**		---	---
	January-1995	**14.4**		---	---
	April-1995	**12.6**		---	---
	July-1995	ND		---	---
	January-1996	ND		---	---
	April-1996	ND		---	---
	July-1996	ND		---	---
	October-1996	**6.6**		---	---
	January-1997	**5.8**		---	---
	April-1997	ND		---	---
	July-1997	**7.4**		---	---
	October-1997	**7.4**		---	---
	January-1998	**9.2**		---	---
	April-1998	**7.6**		---	---
	August-1998	**4.51**		---	---
	October-1998	**7.4**		---	---
	January-1999	**8.9**		---	---
	July-1999	**4.8**		---	---
	February-2000	**10**		---	---
	July-2000	**4.9**		---	---
	July-2001	ND		---	10
	July-2002	**5.2**	J	1.3	10
	July-2003	**12.1**		---	---
	July-2004	**4.9**	J	2.6	10
	July-2005	**4.8**	J	0.8	10
	July-2006	**3**	J	3	10
	July-2007	ND		3	10
	July-2008	ND		3	10
	July-2009	ND		3	10
	July-2010	ND		9	10
	July-2011	ND		9	10
	July-2012	ND		*5*	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS
LEACHATE

Parameter	Monitoring Event	Leachate Result (ug/L)		LOD (ug/L)	LOQ (ug/L)
Barium	July-1994	**29.9**		---	---
	October-1994	**25**		---	---
	January-1995	**82.5**		---	---
	April-1995	**63.4**		---	---
	July-1995	**79.2**		---	---
	January-1996	ND		---	---
	April-1996	ND		---	---
	July-1996	ND		---	---
	October-1996	**47.7**		---	---
	January-1997	**28.8**		---	---
	April-1997	**25.5**		---	---
	July-1997	**40.9**		---	---
	October-1997	**35**		---	---
	January-1998	ND		---	---
	April-1998	**100**		---	---
	August-1998	ND		---	---
	October-1998	ND		---	---
	January-1999	ND		---	---
	July-1999	ND		---	---
	February-2000	ND		---	---
	July-2000	ND		---	---
	July-2001	ND		---	1000
	July-2002	**36.4**	J	18.5	1000
		23.92	J,D	18.5	1000
	July-2003	ND		0.029	200
	July-2004	ND		77.1	1000
	July-2005	ND		29.3	1000
	July-2006	**34**		2	10
	July-2007	**43**		2	10
	July-2008	**28**		2	10
	July-2009	**39**		2	10
	July-2010	**38.6**		2	10
	July-2011	**46.9**		2	10
	July-2012	**49.6**		5	5
Chromium	July-2006	ND		1	10
	July-2007	**1**	J	1	10
	July-2008	ND		1	10
	July-2009	**2**	J	1	10
	July-2010	**1.9**	J	1	10
	July-2011	ND		1	10
	July-2012	ND		5	5

HISTORICAL LABORATORY ANALYTICAL RESULTS
LEACHATE

Parameter	Monitoring Event	Leachate Result (ug/L)		LOD (ug/L)	LOQ (ug/L)
Cobalt	July-2006	**4**	J	2	10
	July-2007	**6**	J	1	10
	July-2008	**3**	J	1	10
	July-2009	**3.5**	J	2	*4*
	July-2010	**4.4**		2	*4*
	July-2011	**6.4**		2	*4*
	July-2012	**5.7**		0.25	0.5
Copper	July-2006	**41**		3	10
	July-2007	**36**		3	10
	July-2008	**28**		3	10
	July-2009	**32**		3	10
	July-2010	**17.8**		3	10
	July-2011	**43.2**		3	10
	July-2012	**39.5**		*5*	*5*
Nickel	July-2006	**20**		2	10
	July-2007	**35**		2	10
	July-2008	**14**		2	10
	July-2009	**21**		2	10
	July-2010	**22.4**		2	10
	July-2011	**32**		2	10
	July-2012	**35.9**		*5*	*5*
Vanadium	July-2006	**20**		2	10
	July-2007	**15**		2	10
	July-2008	**17**		2	10
	July-2009	**17**		2	10
	July-2010	**12.7**		2	10
	July-2011	**17.7**		2	10
	July-2012	**16.2**		*5*	*5*
Zinc	July-2006	ND		10	10
	July-2007	**10**		10	10
	July-2008	ND		10	10
	July-2009	ND		10	10
	July-2010	ND		10	10
	July-2011	**11.5**		10	10
	July-2012	ND		10	10

HISTORICAL LABORATORY ANALYTICAL RESULTS
LEACHATE

Parameter	Monitoring Event	Leachate Result (ug/L)	LOD (ug/L)	LOQ (ug/L)
VOLATILE ORGANIC COMPOUNDS				
Acetone	July-2011	ND	7	10
	July-2012	**9.9** J,B	2.2	25
Chloromethane	July-2011	**0.3** J	0.3	1
	July-2012	**0.3** J	0.11	1

B = Qualifier used is the reported concentration is less than five times that detected in the laboratory blank. Concentration is not considered validated.
J = Qualifier used when reported concentration is less than the LOQ but greater than the LOD. The concentration is considered to be estimated and not validated.
LOD = Limit of Detection
LOQ = Limit of Quantitation
ND = Not Detected
ug/L = micrograms per liter

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS

Parameter	Monitoring Event		Lime Solids Result (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
METALS					
Arsenic	September-2005	Sample #1	**0.6**	0.5	---
		Sample #2	**0.6**	0.5	---
		Sample #3	**0.8**	0.5	---
		Sample #4	**0.7**	0.5	---
	July-2011		ND	0.572	0.572
Barium	September-2005	Sample #1	**32**	0.5	---
		Sample #2	**23**	0.5	---
		Sample #3	**41**	0.5	---
		Sample #4	**29**	0.5	---
	July-2011		**58.2**	0.572	0.572
Chromium	September-2005	Sample #1	**4.9**	0.5	---
		Sample #2	**1.3**	0.5	---
		Sample #3	**5.4**	0.5	---
		Sample #4	**1.1**	0.5	---
	July-2011		**2.5**	0.572	0.572
Cobalt	September-2005	Sample #1	**2.3**	0.5	---
		Sample #2	ND	0.5	---
		Sample #3	**2**	0.5	---
		Sample #4	ND	0.5	---
	July-2011		**1.02**	0.572	0.572
Copper	September-2005	Sample #1	**9.4**	5	---
		Sample #2	**10**	5	---
		Sample #3	**17**	5	---
		Sample #4	**12**	5	---
	July-2011		**20.8**	0.572	0.572
Nickel	September-2005	Sample #1	**4.5**	0.5	---
		Sample #2	**1**	0.5	---
		Sample #3	**3.3**	0.5	---
		Sample #4	**1.1**	0.5	---
	July-2011		**1.91**	0.572	0.572
Silver	September-2005	Sample #1	**2.5**	0.5	---
		Sample #2	**2.4**	0.5	---
		Sample #3	**3.3**	0.5	---
		Sample #4	**2.4**	0.5	---
	July-2011		ND	0.572	0.572

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS

Parameter	Monitoring Event		Lime Solids Result (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Vanadium	September-2005	Sample #1	**7.6**	0.5	---
		Sample #2	**5.8**	0.5	---
		Sample #3	**11**	0.5	---
		Sample #4	**2.1**	0.5	---
	July-2011		**2.14**	0.572	0.572
Zinc	September-2005	Sample #1	**82**	2.5	---
		Sample #2	**91**	2.5	---
		Sample #3	**100**	2.5	---
		Sample #4	**91**	2.5	---
	July-2011		**145**	0.572	0.572

--- = not available
LOD = Limit of Detection
LOQ = Limit of Quantitation
mg/kg = milligrams per kilogram
ND = Not Detected

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS
Toxicity Characteristic Leaching Procedure (TCLP) Analysis

Parameter	Monitoring Event	Lime Solids Result (ug/L)	LOD (ug/L)	LOQ (ug/L)
METALS				
Arsenic	July-1996	ND	---	100
	July-1997	ND	---	100
	August-1998	ND	---	400
	July-1999	ND	---	2
	July-2000	ND	---	2
	July-2001	**2**	---	---
	July-2002	**8**	---	---
	July-2003	**3**	---	---
	July-2004	**5**	---	---
	August-2006	***75***	---	40
	July-2007	ND	---	30
	July-2008	ND	---	160
	July-2009	**50**	---	30
	July-2010	ND	---	30
	July-2011	ND	---	30
	July-2012	ND	---	30
Barium	July-1996	**600**	---	---
	July-1997	**800**	---	---
	August-1998	***770***	---	---
	July-1999	**140**	---	---
	July-2000	**280**	---	---
	July-2001	**200**	---	---
	July-2002	**95**	---	---
	July-2003	**124**	---	---
	July-2004	**91**	---	---
	August-2006	**189**	---	*5*
	July-2007	**234**	---	*5*
	July-2008	**187**	---	*5*
	July-2009	**395**	---	*5*
	July-2010	**164**	---	*5*
	July-2011	**124**	---	*5*
	July-2012	**116**	---	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS
Toxicity Characteristic Leaching Procedure (TCLP) Analysis

Parameter	Monitoring Event	Lime Solids Result (ug/L)	LOD (ug/L)	LOQ (ug/L)
Cadmium	July-1996	ND	---	*5*
	July-1997	ND	---	*5*
	August-1998	ND	---	20
	July-1999	**0.5**	---	---
	July-2000	ND	---	0.5
	July-2001	ND	---	0.5
	July-2002	ND	---	0.5
	July-2003	ND	---	0.5
	July-2004	**1.1**	---	---
	August-2006	ND	---	*5*
	July-2007	***7***	---	*5*
	July-2008	ND	---	*5*
	July-2009	ND	---	*5*
	July-2010	ND	---	*5*
	July-2011	ND	---	*5*
	July-2012	ND	---	*5*
Chromium	July-1996	ND	---	10
	July-1997	ND	---	10
	August-1998	ND	---	*40*
	July-1999	ND	---	*5*
	July-2000	ND	---	1
	July-2001	ND	---	1
	July-2002	ND	---	1
	July-2003	**1**	---	---
	July-2004	**2**	---	---
	August-2006	**5**	---	*5*
	July-2007	ND	---	10
	July-2008	**14**	---	10
	July-2009	**60**	---	10
	July-2010	ND	---	*5*
	July-2011	**12**	---	*5*
	July-2012	ND	---	*5*

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS
Toxicity Characteristic Leaching Procedure (TCLP) Analysis

Parameter	Monitoring Event	Lime Solids Result (ug/L)	LOD (ug/L)	LOQ (ug/L)
Lead	July-1996	ND	---	50
	July-1997	ND	---	50
	August-1998	ND	---	200
	July-1999	ND	---	5
	July-2000	ND	---	5
	July-2001	ND	---	5
	July-2002	ND	---	5
	July-2003	ND	---	5
	July-2004	ND	---	5
	August-2006	ND	---	10
	July-2007	**38**	---	30
	July-2008	**111**	---	30
	July-2009	ND	---	60
	July-2010	ND	---	15
	July-2011	ND	---	15
	July-2012	ND	---	15
Selenium	July-1996	ND	---	80
	July-1997	ND	---	100
	August-1998	ND	---	400
	July-1999	ND	---	5
	July-2000	ND	---	5
	July-2001	**10**	---	---
	July-2002	***7***	---	---
	July-2003	**5**	---	---
	July-2004	**6**	---	---
	August-2006	**167**	---	60
	July-2007	**102**	---	80
	July-2008	***71***	---	50
	July-2009	**54**	---	50
	July-2010	ND	---	30
	July-2011	ND	---	30
	July-2012	ND	---	90

HISTORICAL LABORATORY ANALYTICAL RESULTS
LIME SOLIDS
Toxicity Characteristic Leaching Procedure (TCLP) Analysis

Parameter	Monitoring Event	Lime Solids Result (ug/L)	LOD (ug/L)	LOQ (ug/L)
Silver	July-1996	ND	---	10
	July-1997	ND	---	10
	August-1998	ND	---	40
	July-1999	ND	---	1
	July-2000	ND	---	1
	July-2001	ND	---	1
	July-2002	ND	---	1
	July-2003	ND	---	1
	July-2004	ND	---	1
	August-2006	ND	---	2
	July-2007	ND	---	5
	July-2008	ND	---	5
	July-2009	ND	---	2
	July-2010	ND	---	5
	July-2011	ND	---	5
	July-2012	**26**	---	5

--- = not available
LOD = Limit of Detection
LOQ = Limit of Quantitation
ND = Not Detected
ug/L = micrograms per liter

ATTACHMENT C

Site Map/Groundwater Contour Map

LEGEND

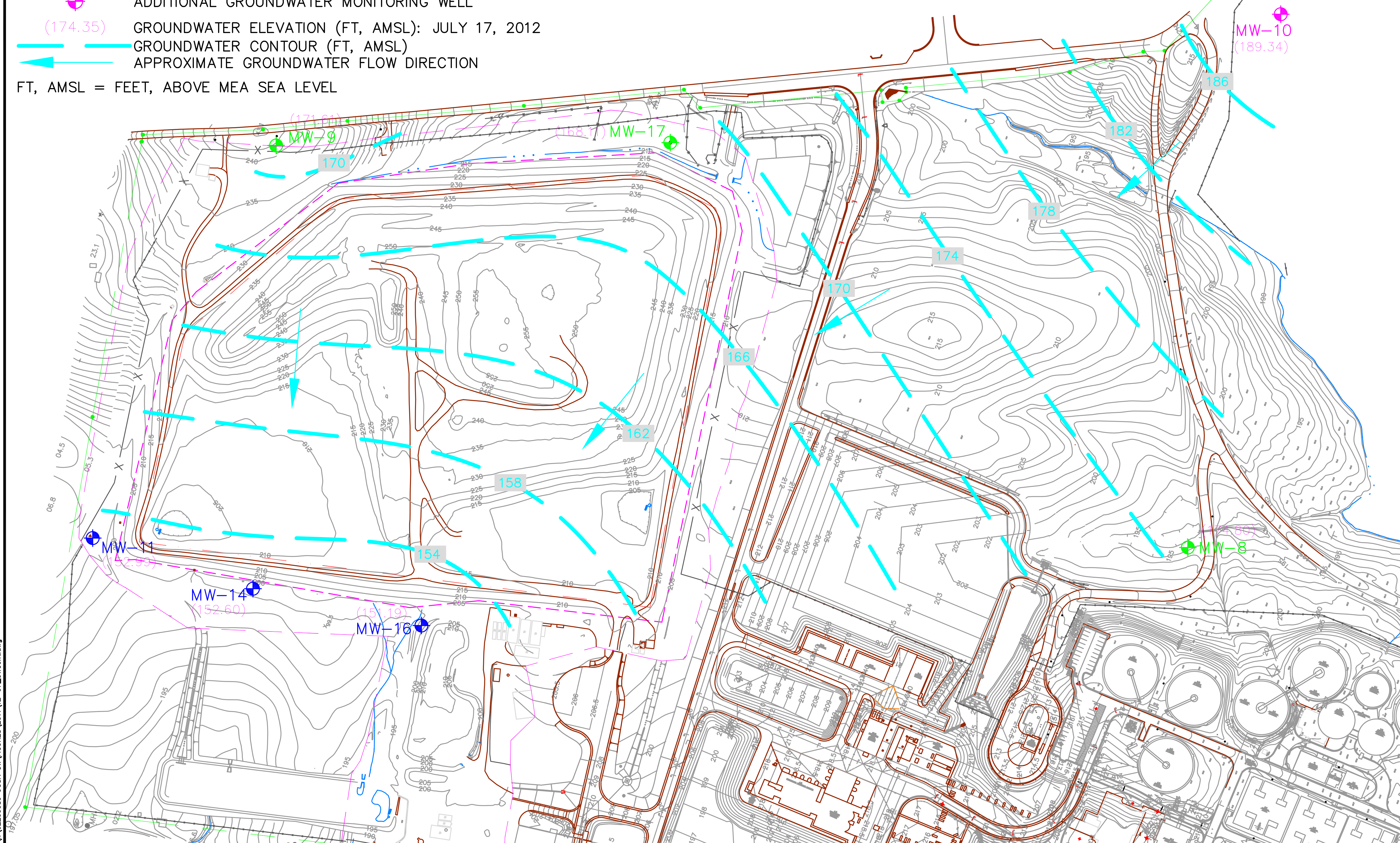
215 TOPOGRAPHIC CONTOUR (FT, AMSL)
FACILITY BOUNDARY
LIMIT OF WASTE
OUTLINE OF 2009 BASE MAP
BACKGROUND GROUNDWATER MONITORING WELL
COMPLIANCE GROUNDWATER MONITORING WELL
ADDITIONAL GROUNDWATER MONITORING WELL
(174.35) GROUNDWATER ELEVATION (FT, AMSL): JULY 17, 2012
GROUNDWATER CONTOUR (FT, AMSL)
APPROXIMATE GROUNDWATER FLOW DIRECTION

FT, AMSL = FEET, ABOVE MEA SEA LEVEL

NOTES:

1. THIS FIGURE IS BASED ON WIDELY SPACED DATA POINTS. WATER LEVELS SHOWN BETWEEN KNOWN DATA HAVE BEEN EXTRAPOLATED AND DRAWN USING PROFESSIONAL JUDGEMENT. THE REPRESENTATION SHOWN MAY NOT REFLECT ACTUAL SITE CONDITIONS.
2. 2009 BASE MAP WAS PREPARED BY AERO-METRIC. THE MAP WAS COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 06-24-09. GRID BASED ON VIRGINIA STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 1983(93). VERTICAL DATUM BASED ON NAVD 1988.

0 200 400
SCALE IN FEET



NO.	REVISION	DATE

SHEET TITLE: SITE MAP/ GROUNDWATER CONTOUR MAP

PROJECT TITLE: VARIANCE PETITION GROUNDWATER

CLIENT: UPPER OCCOQUAN SERVICE AUTHORITY INDUSTRIAL LANDFILL SOLID WASTE PERMIT #542

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
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PROJ. NO. 02200089.14
DWN. BY: KMD
CHK. BY: JSR

CADD FILE: GWCONT
DATE: 11/08/12
SCALE: AS SHOWN
DRAWING NO. 1 of 1

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