CITY OF WORCESTER, MASSACHUSETTS

GREENWOOD STREET LANDFILL

GROUNDWATER REMEDIATION BARRIER CONSTRUCTION

TECHNICAL SPECIFICATIONS

JANUARY 2023

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Division 01 – General Requirements

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. All work shall be performed in accordance with the Order of Conditions issued by the City of Worcester Conservation Commission on August 29, 2022 and included in Appendix A.

1.2 SUMMARY

A. The Project includes installing overburden and bedrock injection wells, hydraulic fracturing of bedrock, and injection of remedial additives to form a groundwater remediation barrier at the western property line of the Project Site. The remedial additives to be injected will reduce concentrations of chlorinated volatile organic compounds (cVOCs) in overburden and bedrock groundwater to prevent further off-site migration of the cVOC plume.

B. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Contractor’s use of site and premises.
4. Work restrictions.
5. Specification conventions.
6. Miscellaneous provisions.

C. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 “Execution” for field engineering and survey and general administrative and procedural requirements governing execution of the Work .

1.3 PROJECT INFORMATION

A. Project Identification: Greenwood Street Landfill Groundwater Remediation Barrier.

1. Project Location: 30 Nippnapp Trail Worcester, MA.

B. Owner: City of Worcester, 20 East Worcester Street, Worcester, Massachusetts 01604

1. Owner's Representative: Jonathan Gervais, Environmental Manager, City of Worcester Department of Public Works & Parks; Phone: 508-929-1300.

C. Engineer: CDM Smith Inc., 75 State Street, Suite 701, Boston, Massachusetts 02109.

1. Engineer's Representative: Nathan Jones, PE, PMP; Phone: 617-452-6563.

D. Licensed Site Professional (LSP): CDM Smith Inc., 75 State Street, Suite 701, Boston, Massachusetts 02109

1. LSP-of-Record: Ernest Ashley, PG, LSP; 617-452-6416

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 SITE DESCRIPTION

A. The Greenwood Street Landfill property is an approximate 100-acre property located at 30 Nippnapp Trail, south of Quinsigamond Village, in the southern part of the City of Worcester.

1. The eastern side of the property consists of an approximate 60-acre capped municipal solid waste (MSW) landfill.
2. The remainder of the site is undeveloped.
3. The western side of the property consists of an approximate 34-acre uncapped area where wastewater sludge from former sludge drying beds was buried; the area is unpaved and covered with grass, trees, and generally dense vegetation.
4. The remainder of the property (approximately 5 acres) is undeveloped land.
5. The limits of work are shown on Figure 1.

B. Massachusetts Contingency Plan (MCP) Response Actions are being conducted at the Project Work Site to address a release of oil and/or hazardous materials (OHM) to the environment; specifically, chlorinated volatile organic compounds (cVOCs) in groundwater.

1. The Massachusetts Department of Environmental Protection (MassDEP) has assigned Release Tracking Number (RTN) 2-18909 to the project site.

C. A portion of the project is located within a small bordering vegetated wetland and its buffer zones located southwest of the site.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Preparation of a comprehensive construction work plan for approval by Engineer detailing all aspects of construction including, but not limited to:

a. Well drilling methods: Identify the methods that will be used to install bedrock and overburden injection wells.

b. Detailed hydraulic fracturing procedures: Describe methods to be used to hydraulically fracture bedrock to simultaneously increase the permeability of the bedrock and emplace remediation amendments.
c. Detailed amendment injection procedures: Provide injection quantities and methods to inject amendments into bedrock and overburden wells.
d. Well location and elevation survey methods: Identify methods to complete a well location and elevation survey of the overburden and injection well locations.
e. Construction management: Provide a detailed staffing plan including primary subcontractors, organizational chart, and resumes of key personnel and their role in construction management, construction quality control, and construction oversight.
f. Construction quality control: Describe protocols and procedures for evaluating and testing products and materials to be installed as part of the work, approach for confirming that all components of the work have been completed in accordance with the Contract Documents, and documentation required for verifying that the appropriate quality control activities have been conducted.
g. Site staging and temporary facilities: Identify staging areas, access roads, temporary sanitary facilities, decontamination facilities, and any other temporary facilities required to complete the work.
h. Permits: Identify permits required to complete the work.
i. Erosion and dust control: Describe the best management practices that will be used to control stormwater runoff and dust generation.
j. Waste management: Describe how liquid and solid wastes will be managed including drilling fluids, development water, drill cuttings, and general refuse.

2. Preparation of a site-specific Health and Safety Plan and Emergency Response Plan in accordance with Section 013529 “Health, Safety, and Emergency Response Procedures”.
3. Establishment of approved stormwater controls and sedimentation and erosion controls in accordance with the Massachusetts Wetlands Protection Act Order of Conditions (Appendix A) and as shown on Figures 2 and 3.
4. Temporary facilities.
5. Improvement of existing gravel access road consisting of installing AASHTO No. 1 crushed stone, geotextile, and dense graded crushed stone over the limits of the existing access road as shown on Figures 2 and 4.
6. Clearing and grubbing necessary to install injection wells.
7. Installation of 22 bedrock injection wells spaced approximately 25 feet apart to supplement 7 existing bedrock barrier wells as shown on Figure 2.
8. Geophysical logging of the newly installed bedrock boreholes.
9. Bedrock borehole straddle packer installation at half of the newly installed wells and collection of groundwater samples for analysis by Engineer.
10. Hydraulic fracturing of bedrock using the 26 bedrock wells (7 existing, minus 3 that were fractured during a pilot study to be conducted by Engineer, plus 22 to be installed as part of this project) to emplace emulsified vegetable oil, microscale ZVI, and sand proppant.
11. Installation of 67 overburden injection points in two rows spaced 10 feet apart, wells spaced 20 feet apart as shown on Figure 2.
12. Well location and elevation survey of the overburden and bedrock injection wells.
13. Injection of amendments including, sodium lactate and emulsified oil based amendment, and bioaugmentation culture into the 67 overburden injection wells.
14. Injection of amendments including, sodium lactate sodium bicarbonate and bioaugmentation culture into the 29 bedrock injection wells.
15. Site restoration and cleanup.
16. All other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access. Do not access without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.8 WORK RESTRICTIONS

A. Time of Year Restriction: Work within the Bordering Vegetated Wetland shall take place during summer months when conditions are dry to minimize the ground disturbance impact of the machinery needed to complete the work.

B. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

C. On-Site Work Hours: Limit work to between 7 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

1.9 SPECIFICATION CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. The Specifications and Figures are intended to describe and illustrate existing conditions in general.

1. Before submitting a bid, inspect and become thoroughly familiar with the existing conditions under which the work will be performed.
2. It is not the intent of the Contract Documents to show all existing conditions.
3. Verify all existing conditions applicable to this project and include in bid all requirements necessary for the completion of the work, based on the existing conditions.
4. No additional compensation will be made for any assumptions, omissions, or errors made as a result of failure to become familiar with the site and the contract documents.

5. Perform all work and supply all materials required to provide complete installation meeting the intent of the Contract Documents, in accordance with the actual site conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012001 - PRICE AND PAYMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unit prices.

1.2 UNIT PRICES

A. Payment of the unit price bid shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary for constructing the Greenwood Street Landfill Groundwater Remediation Barrier complete, as shown and as specified in Divisions 01 through 33.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

C. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 “Schedule of Unit Prices” Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Mobilization/Demobilization.

1. Description: Mobilization/Demobilization includes all insurance bonds, locating any required equipment to the site, providing and complying with a Health and Safety Plan, establishing survey controls, and all other work required by the contract documents not included in other bid items.
2. Unit of Measurement: Lump sum, not to exceed 5 percent of the total bid, excluding this item.

B. Unit Price No. 2: Site Preparation and Clearing.

1. Description: Clearing of vegetation within the limits of work for injection well installation along western property line and within wetland resource areas, timber mats in wetland resource areas, and erosion and sedimentation controls.
2. Unit of Measurement: Lump sum.

C. Unit Price No. 3: Access Road Construction.

1. Field location of all existing and proposed access roads and reconstruction of existing access roads and construction of new access roads, as required, including, but not limited to, any necessary grading and compaction of subgrade; furnishing, placing, and compacting access road materials to the specified thicknesses; any appurtenant work and materials; and all else incidental to the Work.
2. Unit of Measurement: Lump sum.

D. Unit Price No. 4: Bedrock Borehole Injection Well Installation.

1. Description: Installation of bedrock injection wells, as shown, in accordance with Section 331113.13 "Drilling and Well Installation."
2. Unit of Measurement: Number of bedrock injection wells actually installed.

E. Unit Price No. 5: Bedrock Borehole Injection Well Packer Sampling:

1. Description: Bedrock borehole packer groundwater sampling, as shown, in accordance with the Section 331113.13 “Drilling and Well Installation.”
2. Unit of Measurement: Number of bedrock fractures actually sampled/tested.

F. Unite Price No. 6: Bedrock Borehole Geophysical Logging:

1. Description: Bedrock borehole geophysical logging, as shown, in accordance with Section 331113.19 "Borehole Geophysical Logging."
2. Unit of Measurement: Number of bedrock borehole wells actually logged.

G. Unit Price No. 7: Deep Overburden Injection Well Installation.

1. Description: Installation of deep overburden wells, as shown, in accordance with Section 331113.13 "Drilling and Well Installation."
2. Unit of Measurement: Number of deep overburden wells actually installed.

H. Unit Price No. 8: Shallow Overburden Injection Well Installation.

1. Description: Installation of shallow overburden wells, as shown, in accordance with Section 331113.13 "Drilling and Well Installation."
2. Unit of Measurement: Number of shallow overburden wells actually installed.

I. Unit Price No. 9: Off-Site Monitoring Well Clusters.

1. Description: Installation of monitoring well clusters, as shown, in accordance with Section 331113.13 "Drilling and Well Installation."
2. Unit of Measurement: Number of monitoring well clusters actually installed.

J. Unit Price No. 10: Overburden & Bedrock Injection Well Survey

1. Description: Location and elevation survey of newly installed injection and monitoring wells in accordance with Section 017300 “Execution”.
2. Unit of Measurement: Number of injection wells and monitoring well clusters actually surveyed.

K. Unit Price No. 11: Bedrock Barrier Hydraulic Fracturing/Amendment Injections.

1. Description: Hydraulic fracturing of bedrock injection wells (some installed previously and others to be installed as part of this Contract under Unit Price No. 4) in accordance with Section 331113.36 “Hydraulic Fracturing and Emplacement of Remediation Amendments in Bedrock Wells."
2. Unit of Measurement: Number of fractures actually promulgated.

L. Unit Price No.12: Bedrock Barrier Tilt Metering.

1. Description: Tilt metering during bedrock hydraulic fracturing in accordance with Section 331113.36 “Hydraulic Fracturing and Emplacement of Remediation Amendments in Bedrock Wells.”
2. Unit of Measurement: Number of fractures actually tilt metered.

M. Unit Price No. 13: Overburden Barrier Amendment Injections.

1. Description: Amendment injections into overburden injection wells installed as part of the Contract in accordance with Section 331113.49 "Bioremediation Amendment Injection."
2. Unit of Measurement: Number of overburden injection wells that actually received amendment injections as specified.

N. Unit Price No. 14: Bedrock Barrier Amendment Injections.

1. Description: Amendment injections into bedrock injection wells (some installed previously and others to be installed as part of this Contract under Unit Price No. 4) in accordance with Section 331113.49 " Bioremediation Amendment Injection."
2. Unit of Measurement: Number of bedrock injection wells that actually received amendment injections as specified.

END OF SECTION 012200

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title.

1. Substitution Request Form: Use form acceptable to Engineer.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section.

Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of Engineers and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 “Project Management and Coordination” for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Engineer will issue Field Orders authorizing minor changes in the Work, not involving adjustment to the Contract Price or the Contract Time.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Price or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Requests For Proposal (RFP) issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request, or within 10 days after receipt of RFP when not otherwise specified, submit a quotation estimating adjustments to the Contract Price and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Engineer.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Price and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Engineer.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Change Order Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
2. Section 012600 "Contract Change Procedures" for administrative procedures for handling changes to the Contract.
3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Engineer at earliest possible date, but no later than ten days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Owner’s name.

c. Owner’s Project number.
d. Name of Engineer.
e. Engineer's Project number.
f. Contractor's name and address.
g. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

a. Related Specification Section or division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

1) Labor.
2) Materials.
3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment twenty days prior to due date for review by Engineer.

C. Application for Payment Forms: Use form indicated in Owner/Contractor Agreement for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Engineer and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839 “Project Record Documents”. As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by Owner and Engineer for completeness and accuracy.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule.
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule.
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Initial progress report.
10. Report of preconstruction conference.

J. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work proceeding this application, as described in Section 017700 “Closeout Procedures.”

2. Include initial submittal of closeout record drawings in accordance with Section 017839 “Project Record Documents”.
3. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Final submittal of closeout record drawings in accordance with Section 017839 “Project Record Documents”.
5. Updated final statement, accounting for final changes to the Contract Sum.
6. Evidence that claims have been settled.
7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
8. Final liquidated damages settlement statement.
9. Proof that taxes, fees, and similar obligations are paid.
10. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in in temporary field office and in web-based Project software directory. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner’s Project number.
4. Name of Engineer.
5. Engineer’s Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.

1. Attachments shall be electronic files in PDF format.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.

3. Engineer's action on RFIs that may result in a change to the Contract Time, or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Engineer's response was received.

F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's drawings will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion. General Contractor shall be responsible for the full cost for the project team including costs for Owner, Engineer, Contractor, subcontractors and suppliers.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Engineer, Engineer's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.

d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner and Engineer, and Engineer's consultants.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Engineer. Provide data in locked format to prevent further changes.
4. Provide one of the following Project management software packages under their current published licensing agreements:

a. Autodesk; Constructware.
b. Corecon Technologies, Inc.
c. Meridian Systems; Prolog.
d. Newforma, Inc.
e. Procore Technologies, Inc.
f. Viewpoint, Inc.

C. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for RFIs.
    j. Procedures for testing and inspecting.
    k. Procedures for processing Applications for Payment.
    l. Distribution of the Contract Documents.
    m. Submittal procedures.
    n. Preparation of Record Documents.
    o. Use of the premises.
    p. Work restrictions.
    q. Working hours.
    r. Owner's occupancy requirements.
    s. Responsibility for temporary facilities and controls.
    t. Procedures for moisture and mold control.
    u. Procedures for disruptions and shutdowns.
    v. Construction waste management and recycling.
    w. Parking availability.
    x. Office, work, and storage areas.
    y. Equipment deliveries and priorities.
    z. First aid.
    aa. Security.
    bb. Progress cleaning.
    cc. List of major subcontractors and suppliers.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Access.
        6) Site use.
        7) Temporary facilities and controls.
        8) Progress cleaning.
        9) Quality and work standards.
        10) Status of correction of deficient items.
        11) Field observations.
        12) Status of RFIs.
        13) Status of Proposal Requests.
        14) Pending changes.
        15) Status of Change Orders.
        16) Pending claims and disputes.
        17) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 012900 “Payment Procedures” for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Float: The measure of leeway in starting and completing an activity.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

C. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit at weekly intervals.

F. Site Condition Reports: Submit at time of discovery of differing conditions.

G. Unusual Event Reports: Submit at time of unusual event.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Comply with the following:

1. Activity Duration: Define activities so no activity is longer than **20** days, unless specifically allowed by Engineer.
2. Activities to facilitate the Work: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Owner interfaces.
d. Regulatory agency approvals.
e. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents in schedule and show how the sequence of the Work is affected.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

H. Acceptability:

1. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
2. Engineer's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by the Engineer relieve Contractor from responsibility for errors and omissions in the submittals.

3. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.

I. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.

J. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

K. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date, the Engineer’s determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.

L. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Aerial and preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.
5. Preconstruction video recordings.
6. Periodic construction video recordings.
7. Construction webcam.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph.

B. Digital Photographs: Submit image files weekly with daily reports.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time and GPS location data from camera.

D. File Names: Name media files with date, Project area, and sequential numbering suffix.

E. Usage Rights:

1. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

1.5 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag well locations before taking construction photographs.
2. Take a minimum of 20 photographs to show existing conditions before starting the Work.

C. Periodic Construction Photographs: Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs: Take a minimum of 20 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

E. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit within 14 days of date established for commencement of the Work.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Engineer's final release or approval.

1.5 SUBMITTAL FORMATS

A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:

1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
5. EXAMPLE: D-033000.13-008-B.

    a. D = Shop Drawing.
    b. 033000.13 = Section; use only 6 digits for sections that do not include 8 digits.
    c. 008 = the eighth different submittal under this Section.
    d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
5. Category and type of submittal.
6. Submittal purpose and description.
7. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
8. Drawing number and detail references, as appropriate.
9. Indication of full or partial submittal.
10. Location(s) where product is to be installed, as appropriate.
11. Other necessary identification.
12. Remarks.
13. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.

a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 30 days for initial review of each submittal (and 45 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Statement of compliance with specified referenced standards.
    d. Testing by recognized testing agency.
    e. Application of testing agency labels and seals.
    f. Notation of coordination requirements.
    g. Availability and delivery time information.

4. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

D. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Contractor’s Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:

    a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "

3. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

E. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 PROPOSED PRODUCT LIST

A. Within 15 days after date of Notice to Proceed submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Contractor Responsible for:

1. Determination and verification of materials including manufacturer’s catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.
9. Other requirements enumerated in Contract Documents.

C. Contractor's Approval: Indicate Contractor's approval for each submittal. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ENGINEER'S REVIEW

A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Contractor.

B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Engineer will discard submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Engineer without action.

H. Shop drawings will be returned to the Contractor with one of the following codes.

1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
4. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
5. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor’s means and methods of construction work plans, and health and safety plans.

1.11 ELECTRONIC FILES OF PROJECT DRAWINGS

A. Electronic Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.

2. Electronic files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

SECTION 013529 – SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following:

1. Site specific health and safety procedures, including a detailed accident prevention plan are required due to the potentially hazardous conditions at this site. These procedures shall be described in a Safety, Health and Emergency Response Plan (SHERP) prepared by the Contractor. The SHERP shall be submitted to the Engineer and be reviewed by the Engineer and Owner before any Work at the site can be initiated. The Contractor is responsible for the Contractor's workers and subcontractors' health and safety. Implement, maintain, and enforce the SHERP procedures at the appropriate time prior to and during all phases of the Work.
2. Utilize the services of a health and safety professional designated the Health and Safety Manager (HSM) to develop and implement the SHERP, including the air monitoring program, conduct initial site-specific training and provide support for all health and safety activities as needed, including the upgrading or downgrading of the level of personnel protection.

    a. In addition, a Site Safety and Health Officer (SSHO) shall assist and represent the HSM in the continued implementation and enforcement of the SHERP. The SSHO shall be assigned to the site on a full-time basis and shall be either the Contractor's employee or a subcontractor who reports to the Contractor and the HSM in matters pertaining to site safety and health.

1.3 DEFINITIONS

A. Health and Safety Manager (HSM): The employee assigned to develop the SHERP and assume full responsibility for the health and safety program. The HSM shall meet the qualifications of a Certified Industrial Hygienist as defined below.

B. Site Safety and Health Officer (SSHO): The employee assigned to the site on a full-time basis for the duration of the project with functional responsibility for implementation of the SHERP.

C. Monitoring: Indicates the use of field instrumentation to provide information regarding the levels of organic vapors which are being released during remedial action. Monitoring shall be conducted to evaluate employee exposures to toxic materials.

D. Physician: A licensed physician with experience in the practice of occupational medicine.

1.4 INDUSTRIAL HYGIENIST, SITE SAFETY AND HEALTH OFFICER

A. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene (ABIH) shall develop and implement the SHERP, conducting initial site-specific training, providing continued support for all health and safety activities as needed, including upgrading or downgrading of the level of personnel protection as necessary for the duration of the work.

B. The qualifications of the CIH shall include:

1. A minimum of five years working experience in the chemical or hazardous waste disposal industry.
2. Demonstrable expertise in air monitoring techniques and in the development of personal protective equipment programs for working in potentially toxic atmospheres.
3. Working knowledge of Federal and State occupational safety and health regulations.
4. The name, qualifications (education summary and documentation) and work experience of the CIH shall be submitted to the Engineer for review, prior to development of the SHERP.

C. In addition, designate an individual as the Site Safety and Health Officer (SSHO) who shall assist and represent the CIH in the continuous daily implementation and enforcement of the SHERP. The SSHO shall be assigned to the site on a full-time basis and shall report to the Contractor and the CIH in matters pertaining to site safety and health. The SSHO shall be responsible for preparing and maintaining daily SHERP site logs and reports.

1. The qualifications of the SSHO shall include:

a. A minimum of 2 years working experience at hazardous materials or waste sites where Level C personal protective equipment is required.
b. A working knowledge of Federal and State safety and health regulations.
c. Specialized training in personal and respiratory protective equipment program implementation and in the proper use of air monitoring instruments and air sampling methods and procedures.
d. Current certification in first aid and cardio pulmonary resuscitation (CPR) by a recognized approved organization such as the American Red Cross.
e. In addition to 40-hour OSHA training, annual refresher training, and medical monitoring, the SSHO shall also be supervisory trained.

2. The name, the qualifications (education summary and documentation), and the work experience of the SSHO shall be submitted to the Engineer for review, prior to the commencement of work at the site.

1.5 REGULATORY REQUIREMENTS AND APPLICABLE PUBLICATIONS

A. Provide a specific SHERP consistent with the requirements of the following:

1. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926.
2. United States Environmental Protection Agency (USEPA) Standards and Regulations contained in Title 40 Parts.

3. NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Site Activities.

B. SHERP: Provide, but not necessarily be limited to, the following components as required by OSHA 29 CFR 1910.120(i)(2):

1. Names of key personnel and alternates responsible for site safety and health (responsibilities and chain of command).
2. Safety and health hazard assessment and risk analysis for each site task and operation (Accident Prevention Plan).
3. Site Description and Evaluation.
4. Education and Training.
5. Personnel Protective Equipment.
6. Medical Surveillance.
7. Air Monitoring.
8. Standard Operating Procedures, Engineering Controls and Work Practices.
9. Site Control Measures (Work Zones, Communications and Security).
10. Personnel Hygiene and Decontamination.
11. Equipment Decontamination and Record Keeping.
12. Emergency Equipment and First Aid Requirements.
13. Emergency Response Plan and Contingency Procedures.
14. Heat/Cold Stress Monitoring.
15. Logs, Reports and Record Keeping.

C. Six copies of the site specific SHERP shall be submitted to the Engineer within 7 days following the Effective Date of the Agreement and must be approved prior to commencement of any on-site work.

D. Determination of the appropriate level of worker safety equipment and procedures shall be made by the Contractor as a result of initial site survey review of existing data and a continued safety and health monitoring program performed by the SSHO and approved by the Engineer, in accordance with the requirements specified herein. Existing data indicate that all work can be performed in Level D with contingency procedures to move to Level C protection.

E. Standards delineated in this Section are in addition to or an amplification of procedures and requirements of the above referenced regulations and documents.

F. Should any unforeseen or site-specific safety related factor, hazard, or condition become evident during the performance of work at this site, it shall be the Contractor's responsibility to bring such to the attention of the Engineer both verbally and in writing as quickly as possible, for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public and the environment.

G. Should the Contractor seek relief from, or substitution for, any portion or provision of the SHERP, such relief or substitution shall be requested of the Engineer in writing and if approved, be authorized in writing.

H. The SHERP developed by the Contractor shall include provisions for work related to initial site preparation prior to implementation of the facilities described in this Contract. It shall be the responsibility of the Contractor to conduct whatever testing and monitoring is deemed necessary to assure a safe operation during the initial site preparation work.

I. Any temporary facilities or special construction procedures required to construct the Support and Contamination Reduction Zones shall be the responsibility of the Contractor and shall be delineated in the SHERP.

1.6 SITE CONTROL

A. Work Zones:

1. Clearly layout and identify the work Zones in the field and shall limit equipment, operations and personnel in the Zones as required by this Section and described in the EPA Standard Operating Safety Guidelines.
2. The Exclusion Zone shall consist of the injection well site during well construction and injection. The level of personnel protection required in this Zone is expected to be Level D.
3. The Contamination Reduction Zone shall occur at the interface of Exclusion and Support Zones and will provide for the transfer of construction materials from clean to site dedicated equipment, the decontamination of waste transport vehicles prior to entering the Support Zone from the Exclusion Zone, the decontamination of personnel and clothing prior to entering the Support Zone and for the physical segregation of the Support and Exclusion Zones.
4. The Support Zone shall be established on the Site and is defined as the area outside the zone of significant contamination. The Support Zone shall be clearly delineated and shall be secured against active or passive contamination from the work site. The function of the Support Zone is to provide:

    a. An entry area for personnel, material, and equipment to the Exclusion Zone of site operations.
    b. An exit area for decontaminated personnel, materials, and equipment from the Exclusion Zone of site operations.
    c. A location for support area facilities.
    d. A storage area for clean safety and work equipment.

B. Communications:

1. Provide portable two-way radio or portable vehicle telephone communication at the site and emergency numbers, including police, fire, ambulance, hospital, and Owner, shall be prominently posted near the radio or telephone.

C. Security:

1. Provide and maintain security within all fenced areas at the site for the duration of the work in order to restrict unauthorized access to these areas. Lock the fence during off hours when Contractor personnel are not present. Specific components of this security operation are as follows:

    a. Vehicular access to all fenced areas shall be restricted to authorized vehicles only.
    b. Maintain a log of security incidents.
    c. Require visitors having access to all fenced areas to sign-in and sign-out and shall keep a record of all site access.

d. All approved visitors shall be briefed on safety and security and escorted by the Contractor SSHO throughout their visit.
e. The Exclusion Zone shall be posted, "Warning, Hazardous Work Area, Do Not Enter Unless Authorized".

1.7 TRAINING

A. Certify that all personnel assigned to or regularly entering the site for the purpose of performing or supervising work, for health, safety, security, or administrative purposes, for maintenance, or for any other site-related function, have received appropriate safety training in accordance with 29 CFR 1910.120 provided. Training for personnel shall consist of a minimum of 40 hours off-site and 3 days on-site experience. In addition, supervisory personnel shall have a minimum of 8 hours additional specialized training on managing hazardous waste operations. Documentation of all such training shall be submitted to the Engineer before any employees will be allowed in the contaminated area.

B. All personnel assigned to or entering the site shall complete one site specific refresher training session of at least four hours to guarantee that all such personnel are capable of and familiar with the use of safety, health, respiratory and protective equipment and with the safety and security procedures required for this site.

1. The site-specific training session shall be conducted by the SSHO. Follow-up refresher training sessions for new personnel or visitors shall be conducted by the HSM or the SSHO using the training curriculum outlines developed by the HSM. The site-specific training program shall address all elements of the SHERP.

C. All personnel shall receive a minimum of 8 hours per year of retraining while working on the site. Documentation certifying this retraining shall be furnished to the Engineer.

D. Additionally, guarantee that, personnel not successfully completing the required training are not permitted to enter the site to perform work.

1.8 MEDICAL SURVEILLANCE

A. The services of an occupational physician shall be utilized to provide at least minimum medical examinations and surveillance as specified herein. The name of the physician, evidence of examination and written certification of fitness for work and ability to wear required respiratory protection of all personnel shall be provided to the Engineer prior to assigning these personnel to the site. All personnel involved in this project shall be provided with medical surveillance within 30 days prior to commencing work and within 30 days after the conclusion of the work.

B. The entire medical surveillance program shall meet the requirements of OSHA standard 29 CFR 1910.120(f) including the provision by the Contractor to the physician with site-specific information and the physician providing the Contractor with a written medical opinion.

1. The following protocol shall be considered at a minimum:

a. Medical History.
b. General Physical - Examination including evaluation of all major organ systems.

c. Electrocardiogram.
d. Blood Chemistry Screening Profile (e.g., SMAC 20/25).
e. Complete blood count.
f. Urinalysis.
g. Serum Cholinesterase.
h. Methemoglobin.
i. Urine Heavy Metals - (arsenic, cadmium, chromium, and mercury).
j. Pulmonary Function Testing (FEV1.0 and FVC).
k. Chest x-ray. The number of chest x-rays shall be at the direction of the Physician.
l. Serum Lead.
m. Stress Test at the discretion of the physician based on results of EKG/Pulmonary Function Testing.

2. Additional clinical tests may be included at the discretion of the attending occupational physician performing the physical examination.
3. Periodic surveillance examinations shall be performed:

a. Annually for all employees participating in medical surveillance program.
b. Periodic surveillance examinations shall be as specified above for medical surveillance except that the requirement for a chest x-ray and stress test shall be at the discretion of the attending occupational physician performing the physical examination.

4. In addition, a non-scheduled medical examination shall be conducted under the following circumstances:

a. After acute exposure to any toxic or hazardous material.
b. At the discretion of the Contractor's HSM/SSHO or the consulting occupational physician, when an employee has been exposed to dangerous levels of toxic or hazardous materials.
c. At the discretion of the Contractor's HSM/SSHO or the consulting occupational physician, and at the request of an employee with demonstrated symptoms of exposure to toxic or hazardous materials.
d. Non-scheduled medical examinations shall include all items specified above for Periodic Surveillance Examinations, except that the chest x-rays and stress test shall be at the discretion of the attending physician performing the physical examination.

5. Maintain all medical surveillance records in accordance with 29 CFR 1910.20 and make these records available to the Engineer or other regulatory agencies as required.
6. These records shall be maintained for a period of 30 years. One copy of all records shall be turned over to the Owner.

1.9 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

A. Develop contingency plans including evacuation procedures and routes to places of refuge or safe distances from the danger area, for the following potential emergencies: chemical exposure, personal injury, potential or actual fire or explosion, environmental accident (spill or release) and discovery of radioactive material. In the event of any emergency associated with remedial action, without delay: take action to remove or otherwise minimize the cause of the

emergency; alert the Engineer and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to, or resulting in, the emergency.

B. Emergency medical care services shall be prearranged at a nearby medical facility with established emergency routes. The staff at the facility shall be advised of the potential medical emergencies that might result.

C. Establish emergency communications with health and emergency services. The name of this facility, name of contact, emergency routes and emergency communications arrangements shall be provided in the SHERP. In addition, the Contractor shall provide the following equipment:

1. At least one first aid kit shall be provided and maintained fully stocked at a first aid station which is in close proximity to the work, but not inside a hazardous work area. First aid kit locations shall be specially marked and provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds, or lesions.
2. Have at least one certified First Aid Technician on the site at any time there is work being performed. This person may perform other duties but must be immediately available to render first aid when needed. Certification shall be by the American Red Cross or other approved agency and shall be submitted to the Engineer.
3. 2A-10 B:C type dry chemical fire extinguishers shall be provided at the site office.

1.10 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

A. Develop an emergency response and contingency plan for on-site and off-site emergencies, as specified in OSHA 29 CFR 1910.120(l), which shall address at a minimum:

1. Pre-emergency planning.
2. Personnel roles, lines of authority, training, and communication.
3. Emergency recognition and prevention.
4. Safe distances and places of refuge.
5. Site security and control.
6. Evacuation routes and procedures.
7. Decontamination.
8. Emergency medical treatment and first aid.
9. Emergency alerting and response procedures.
10. Critique of response and follow-up.
11. Personal Protection Equipment (PPE) and emergency equipment.

B. In the event of any emergency associated with Response Action, without delay: take action to remove or otherwise minimize the cause of the emergency; alert the Engineer and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to, or resulting in, the emergency.

C. Emergency medical care services shall be prearranged at a nearby medical facility with established emergency routes. The staff at the facility shall be advised of the potential medical emergencies that might result and that the patients clothing and skin might be contaminated.

D. Establish emergency communications with health and emergency services. The name of this facility, name of contact, emergency routes and emergency communications arrangements shall be posted at the site. The posted list shall include the following minimum points:

1. Contractor physician name, address, and telephone number.
2. Ambulance service and fire department telephone numbers.
3. Procedure for prompt notification of Engineer and DER.

E. In the event that an accident for some other safety related incident occurs during the course of the project, the Engineer shall be telephoned immediately and receive a written notification within 24 hours. The report shall include the following items:

1. Name, organization, telephone number, and location of the Contractor.
2. Name and title of the person(s) reporting.
3. Date and time of accident/incident.
4. Location of accident/incident, including site location and facility name.
5. Summary of accident/incident giving pertinent details including type of operation ongoing at time of accident.
6. Cause of accident/incident, if known.
7. Casualties (fatalities, disabling injuries).
8. Details of any existing chemical hazard or contamination.
9. Estimated property damage, if applicable.
10. Nature of damage; effect on contract schedule.
11. Action taken by Contractor to ensure safety and security.
12. Other damage or injuries sustained (public or private).

1.11 PERSONAL PROTECTIVE EQUIPMENT

A. Provide all on-site personnel with appropriate personal safety equipment and protective clothing and ensure that all safety equipment and protective clothing is kept clean and well maintained. The Contractor's HSM shall establish upgrade/downgrade "action levels" from the specified minimum levels of protection based upon air monitoring results and direct contact potential. Protocols formally changing the level of protection and the communication network for doing so shall be described in the SHERP. Any changes to the minimum level of protection shall be approved by the SSHO and the Engineer. At a minimum the following items shall be provided:

1. Protective clothing shall be furnished for on-site personnel, consisting of:

a. Level D: use as appropriate.

1) Coveralls.
2) Gloves appropriate for the task.
3) Boots/shoes, chemical-resistant steel toe and shank.
4) Boots, outer, chemical-resistant (disposable)*.
5) Safety glasses or chemical splash goggles*.
6) Hard hat.
7) Escape mask*.
8) Face shield*.

b. Level C: use as appropriate.

1) Full-face or half-mask, air purifying, canister equipped (NIOSH approved).
2) Hooded chemical-resistant clothing (overalls two-piece chemical-splash suit; disposable chemical-resistant overalls).
3) Coveralls*.
4) Gloves, outer, chemical-resistant.
5) Gloves, inner, chemical-resistant.
6) Boots, outer, chemical-resistant steel toe and shank*.
7) Boot-covers, outer, chemical-resistant (disposable)*.
8) Hard hat.
9) Escape mask*.
10) Two-way radios (worn under outside protective clothing).
11) Face shield*.

*Optional as applicable.

2. All prescription eyeglasses in use on the site shall be safety glasses. Prescription lens inserts shall be provided for full face respirators. Contact lenses are prohibited in the Exclusion and Contamination Reduction Zone.
3. Footwear used on site shall be steel-toed, steel shank safety shoes or boots, with chemical resistant soles.
4. A written respiratory protection program addressing site specific respirator usage shall be developed by the Contractor's HSM and shall be submitted as part of the SHERP. Programs for respiratory protection shall conform to OSHA 1910.134.
5. All on-site personnel shall wear a hard hat when engaging in construction or drilling activities.
6. All personal protective equipment worn on site shall be decontaminated or properly disposed of at the end of the workday. The SSHO is responsible for ensuring all personal protective equipment is decontaminated before being reissued.
7. Each respirator shall be individually assigned and not interchanged between workers without cleaning and sanitizing. Cartridges/canisters and filters shall be changed daily or upon breakthrough, whichever occurs first. A procedure for assuring periodic cleaning, maintenance and changing of filters shall be provided by the Contractor and addressed in the written respiratory protection program.
8. All protective clothing including work clothing and safety boots which have entered the Contamination Reduction and Exclusion Zones shall be properly disposed of or decontaminated at the completion of the workday.
9. Level D shall be the minimum level of protection set for all primary operations performed in the Exclusion Zone, unless an upgrade is required in accordance with the provisions set forth in the Air Monitoring program.

1.12 PERSONAL HYGIENE AND DECONTAMINATION

A. All on-site personnel performing or supervising remedial work within a hazardous work area or exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids shall observe and adhere to the personnel hygiene-related provisions of this paragraph. A detailed description of personnel decontamination protocols to be followed by site workers shall be submitted as part of the SHERP. Personnel found to be disregarding the personal hygiene-

related provisions of the SHERP shall be barred from the site. In addition, the following conditions and procedures shall be followed:

1. Provide and require use by personnel of:

    a. Storage and disposal containers for used disposable outerwear.
    b. Hand washing facilities.
    c. A facility for changing into and out of and storing work clothing separate from street clothing.
    d. A designated lunch and/or break area.
    e. A smoking area.

B. Disposable outerwear shall not be reused, and when removed, shall be placed inside disposal containers provided for this purpose located in the Contamination Reduction Zone.

C. Smoking and chewing shall be prohibited except in a designated Contractor provided smoking area in the Support Zone.

D. Eating and drinking shall be prohibited except in a designated Contractor provided lunch or break area in the Support Zone.

E. All outerwear shall be removed prior to entering the lunch area or smoking area and prior to cleansing hands.

F. Contractor personnel shall be required to thoroughly cleanse their hands and other exposed areas before entering the smoking or lunch area.

1.13 AIR MONITORING

A. General Requirements:

1. The Contractor's HSM shall design, develop, and implement an Air Monitoring Program to detect the release of volatile organic compounds associated with the remedial work.
2. Information gathered during the air monitoring program shall be used to determine appropriate safety and personnel protective measures to be implemented, during the cleanup operations and to document onsite employees' exposures.

B. General Responsibilities:

1. The HSM shall be responsible for establishing air monitoring strategies and protocols using an organic vapor analyzer (OVA) in order to quantify the airborne release of organic vapors during remediation work. These strategies and protocols shall address appropriate air monitoring for volatile organic compounds in the active work zones of the site. This will include, at a minimum, areas in which intrusive activities are being conducted, such as well installation and pipeline trench excavation, the area around the ground water treatment system, and monitor well sampling. The Contractor's HSM shall utilize previous site characterization and sampling data summaries upon which to initially develop the air monitoring protocols.

2. Establish and document baseline (background) air quality conditions prior to commencement of work, for conducting air monitoring during onsite work, and for documenting air quality conditions after completion of site remediation work.
3. All air monitoring equipment required shall be provided by the Contractor and shall be maintained and calibrated according to EPA and NIOSH analytical methods and/or manufacturers' recommendations. Such maintenance and calibration data shall be recorded.
4. All air monitoring equipment shall be operated by personnel trained in their specific use (i.e., SSHO).

C. Action levels developed for the exclusion zone, for the upgrade or downgrade of worker personal protective equipment, shall be based upon information published by ACGIH, OSHA, and USEPA. Action levels shall be based upon established Permissible OSHA Exposure Limit and ACGIH Threshold Limit Values. Action levels shall be established for each work activity and contaminant present. Provide a table for each activity listing the contaminant(s) to be measured, measuring instrument, frequency of measurement, duration of measurement, action level, and required action.

D. Action levels developed for the exclusion zone perimeter, for the implementation of dust suppression measures and other engineering control measures to protect non-40-hour health and safety trained construction workers, the Engineer, and the Owner from the release of airborne contaminants, shall be based upon information published by ACGIH, OSHA, and USEPA. Action levels shall be based upon established Permissible OSHA Exposure Limit and ACGIH Threshold Limit Values. Action levels shall be established for each work activity and contaminant present. Provide a table for each activity listing the contaminant(s) to be measured, measuring instrument, frequency of measurement, duration of measurement, action level and required action.

1. Provide the support necessary for air monitoring during the program, for the interpretation of the analytical results and for the recording and documentation of the results.

1.14 EQUIPMENT DECONTAMINATION

A. All vehicles and equipment used in the Exclusion Zone shall be decontaminated in the Contamination Reduction Zone prior to leaving the site. The procedures for decontamination of vehicles and equipment shall be outlined in the SHERP. Monitoring all vehicle decontamination prior to exiting the site.

1. Personnel engaged in vehicle decontamination shall wear protective equipment including disposable clothing and respiratory protection consistent with the requirements of this specification and the SHERP.
2. All equipment involved in intrusive activities in which exposure to contaminated ground water might occur, such as installation of wells or underground pipes, shall undergo equipment decontamination procedures. As a minimum, this shall include a high-pressure wash area for equipment and vehicles. All equipment being decontaminated by washdown shall be located in the Contamination Reduction Zone prior to maintenance work.
3. All decontamination wastewater shall be managed on site in accordance with local and State regulations.

B. The following EPA Standard Operating Procedures (SOP), as amended, for field application shall be used to wash or decontaminate all equipment that comes in contact with contaminated ground water.

1. Cleaning Procedures for Stainless Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses, subsection B-4, Appendix B, Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia, April 1, 1986.

a. Wash equipment thoroughly with tap water and a phosphate free, laboratory grade detergent using a brush to remove any particle matter or surface film.
b. Rinse equipment thoroughly with tap water.
c. Rinse equipment thoroughly with deionized water.
d. Rinse equipment thoroughly with pesticide grade isopropyl alcohol and allow to air dry. If not enough time is available to air dry, rinse with organic-free water.
e. Wrap equipment completely with aluminum foil to prevent contamination during storage, if necessary.

C. All water used for decontamination, excluding deionized water shall be potable, meeting FDER standards for public potable water supply.

D. Whenever handling decontaminated ("clean") equipment, disposable latex gloves shall be worn. Gloves shall be discarded once used, or at a minimum, between boreholes. Whenever handling or rinsing with isopropyl alcohol, personnel shall wear eye protection, gloves, and neoprene laboratory aprons.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013529

SECTION 013545 - ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Prevention of environmental pollution.
2. Erosion control.
3. Protection of streams and surface waters.
4. Protection of land resources.
5. Protection of air quality.
6. Noise control.

B. Related Requirements:

1. Section 312500 "Erosion and Sedimentation Controls".

1.3 QUALITY CONTROL

A. Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

B. All phases of sedimentation and erosion control shall comply with the Order of Conditions issued be the City of Worcester Conservation Commission on August 29, 2022 (Appendix A). Understand and comply with the requirements of the Conservation Commission Order of Conditions, the Wetland the Wetlands Protection Act, 310 CMR 10.00, and City of Worcester Wetlands Protection Ordinance and Regulations and acknowledge such in writing prior to commencement of the Work.

C. Pre-Construction Conference: Participate in a pre-construction conference with the City of Worcester Conservation Commission or its Agents prior to commencement of the Work. This is in addition to the pre-construction conference described in Section 013100 “Project Management and Coordination”.

D. Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements will notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when

delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EROSION CONTROL

A. Use Erosion control measures, such as siltation basins, hay check dams, mulching, jute netting and other equivalent techniques, as appropriate. All erosion control measures shall be in place in an area prior to construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 312500 "Erosion and Sedimentation Controls".

3.2 PROTECTION OF STREAMS AND SURFACE WATERS

A. Take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment, or other material, or from the manipulation of equipment and/or materials in or near such streams. Do not return water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, to the stream. Divert such waters through a settling basin or filter before being directed into streams or surface waters.

B. Take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, take prompt remedial action in accordance with a contingency action plan approved by the Massachusetts Department of Environmental Protection. Submit two copies of approved contingency plans to the Engineer.

3.3 PROTECTION OF LAND RESOURCES

A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Figure 1.

B. Outside of areas requiring earthwork for the construction of the new facilities, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. Do not fasten or attach any ropes, cables, or guys to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing boards, planks, or poles around them. Protect monuments and markers similarly.

D. Restore as nearly as possible to their original condition trees or other landscape features scarred or damaged by the Contractor's equipment or operations. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.

1. Coat all scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-inch in diameter as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
2. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.

E. The locations of the Contractor's storage and laydown areas required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as approved by the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites. Drawings showing storage facilities shall be submitted for approval of the Engineer.

F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, submit the following for approval at least ten days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations, embankments, and drainage to be constructed within the work area.
2. Details of temporary road construction.
3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer.

H. Dispose all debris and excess material outside wetland or floodplain areas in an environmentally sound manner.

3.4 PROTECTION OF AIR QUALITY

A. Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control - Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

E. Minimize idling of vehicles onsite during construction operations. Do not allow construction vehicles to idle for more than five minutes to comply with the five minute idle law.

3.5 NOISE CONTROL

A. Make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.6 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION 013545

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
2. Section 013545 “Environmental Protection Procedures” for environmental protection requirements.
3. Section 312500 “Erosion and Sedimentation Control” for erosion and sedimentation control requirements.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner, Engineer, regulators, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

1.5 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Engineer’s Field Office: Of sufficient size, but minimum 12-feet by 50-feet, to accommodate needs of Owner, Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections for duration of project. Keep office clean and orderly. Furnish and equip offices as follows:

1. Field office trailer shall have at least two separate spaces for the Engineer and Contractor and two exterior doors.
2. Engineer's field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide steps, platforms, handrails for each exterior door.
3. Converted storage or box containers will not be acceptable.

4. Furnishings:

   a. Provide the following furnishings for the Engineer's temporary field office for the duration of the project. All furnishings shall be in good condition.

      1) Three 60-inch by 30-inch desks with file drawer and 5 drawers, all lockable.
      2) Upholstered swivel type chair with arms for each desk.
      3) One 30-inch by 84-inch conference table.
      4) Eight armless side chairs (stacking type).
      5) One file cabinet, 4 drawer, legal size, Hon No. HN-315C, or equal.
      6) Three wastebaskets.
      7) One lockable storage cabinet, 72-inch high, 36-inch wide, and 18-inch deep.
      8) One electric bottled water dispenser with hot and cold outlets and refrigerator unit. Adequate water bottles shall be provided (and paid for by the Contractor) until Final Completion.
      9) One wall-mounted first aid kit, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, suitable for ten people, McMaster-Carr 9501T1 or equal.
      10) Two smoke detectors, with batteries.
      11) Two dry erase boards, aluminum frame, 36-inch by 60-inch, markers and eraser, Quartet Model No. TS-S 535 or equal.

5. Services:

   a. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.
   b. Field office shall have complete and fully functional electrical and HVAC systems. Provide at least two smoke detectors hard-wired into the electrical system. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.
   c. Electrical System: Provide connection to temporary electric service or generator. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
   d. HVAC System: Provide heating and air conditioning system or window air conditioners with programmable thermostat. System shall be capable of maintaining an interior temperature of 70 degrees F when the exterior temperature is 0 degrees F and an interior temperature of 75 degrees F when exterior temperature is 100 degrees F.
   e. Bottled water service: Provide bottled water service complete with dispenser with hot- and cold-water taps and regular bottle and cup replenishment as directed by the Engineer.
   f. Janitorial service: Provide janitorial services (at least weekly) that include dusting, sweeping, vacuuming, mopping, disinfection, and trash removal.

6. Supplies: Provide the following supplies for the duration of the project: Paper towels, light bulbs, and other consumables as required by the Engineer.

2.3 SANITARY FACILITIES

A. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

1. Supplies: Provide the following supplies for the duration of the project: toilet paper and hand sanitizer.

2.4 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where shown on the Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer’s trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 ENGINEER'S AND CONTRACTORS OFFICE

A. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed and prior to commencement of Work at the site. All systems, furnishings, equipment, and services specified herein shall be furnished, installed, and completely operational for the field office to be considered established.

1. Provide regular office cleaning services for the duration of the project.
2. Provide supplies including, but not limited to restroom supplies (toilet tissue paper, paper towel, and hand sanitizer), as well as light bulbs, air conditioner filters, etc.
3. Supply all fuel for heating and pay all utility bills.

B. Install field office plumb and level.

C. Engineer's trailer shall be removed, and the site shall be cleaned up and restored before Final Completion of the project.

3.4 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service, if approved by Owner.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.

3.5 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.

2. Maintain support facilities until Engineer schedules Final Completion inspection. Remove just before Final Completion.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated. Placement of rip rap, trap rock, or any other permanent or loose fill material for construction or maintenance of temporary access roads shall not be allowed within the Bordering Vegetated Wetland or 30’ buffer zone. Timber matting may be deployed as necessary to minimize impacts of equipment in the wetland.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas accordance with Section 312000 "Earthwork."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary" and Section 013545 "Environmental Protection Procedures."

C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 312500 "Erosion and Sedimentation Control."

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide, install and maintain signage directing occupants to temporary egress.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Clear snow and ice from all drives, walks and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 “Summary” for Contractor requirements related to Owner-furnished products.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 017700 “Closeout Procedures” for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 “Comparable Products” Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that

does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

C. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

D. Substitution: Refer to Section 012500 “Substitution Procedures” for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.

3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution if the product complies with requirements.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 PREINSTALLATION MEETINGS

A. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new and existing wells, review benchmark, control point, and layout requirements. Inform Engineer of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

    a. Contractor's superintendent.
    b. Professional surveyor responsible for performing Project surveying and layout.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

1.5 CLOSEOUT SUBMITTALS

A. Final Survey: Submit two copies signed by land surveyor showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding examine existing conditions for compliance with project requirements and conditions affecting performance. Record observations.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to construct the Work properly..

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on figures, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.

1. Establish benchmarks and control points as needed to locate injection points.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Final Survey: Engage a land surveyor to prepare a final survey showing final well locations. Include on the survey a certification, signed by land surveyor, that well locations are accurately positioned as shown on the survey.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

H. Unnecessary delays or work stoppages will not be tolerated because of equipment failure, which will not be considered a valid reason for extending the length of the Contract. Payment will be withheld for damages with work due to any act of omission, error, or faulty operation or equipment failure. Complete resulting repairs to the satisfaction of the Owner and/or Engineer

or at no additional cost to the Owner and without claim against the Owner and/or Engineer or agents.

3.6 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

D. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

E. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

F. Repair Work previously completed and subsequently damaged during construction period Repair to like-new condition.

G. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

H. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 012900 “Payment Procedures” for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer’s use prior to Engineer’s inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's “punch list”), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, surveys, and similar final record information.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Terminate and remove temporary facilities from Project site.
2. Complete final cleaning requirements.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Engineer.
d. Name of Contractor.
e. Page number.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.

3.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

3.3 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 “Execution” before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 012900 “Payment Procedures” for maintaining and exhibiting project record documents as a prerequisite for progress payments.
2. Section 017300 "Execution" for final property survey.
3. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

B. Record Specifications: Submit annotated PDF electronic file of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Changes made by Change Order or Work Change Directive.
    d. Details not on the original Contract Drawings.
    e. Field records for variable and concealed conditions.
    f. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and Record Drawings where applicable.

B. Format: Submit Record Specifications as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

Division 31 – Earthwork

SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soils: Soil materials and topsoil materials.
2. Aggregates: Coarse aggregate materials and fine aggregate materials.

B. Related Sections:

1. Section 312000 “Earthwork.”
2. Section 312500 “Erosion and Sedimentation Control.”

1.3 ACTION SUBMITTALS

A. Samples - Submit, in 5-gallon air-tight containers, 50 lbs. representative sample of each type of fill to ENGINEER at least 15 days prior to placement of backfill or fill.

B. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

B. Source’s Certificate: Certify materials meet or exceed specified requirements.

C. Material Test Reports: For each soil and aggregate material proposed for fill and backfill as follows:

1. Classification according to ASTM D 487.
2. Gradation according to ASTM C136.
3. Laboratory compaction curve according to ASTM D1557.
4. Test Reports: Submit any test reports required by this Section to the Engineer.

1.5 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3)).
3. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
5. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Commonwealth of Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges, latest edition (SSHB).

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.6 QUALITY ASSURANCE

A. Furnish each material from single source throughout the Work unless an alternate source is approved by the Engineer.

B. Perform Work according to MassDOT SSHB standards.

C. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.

1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

D. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Common Fill: Approved on site excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials, with no stones larger than 6 inches in largest diameter, and a maximum of 75 percent passing the No. 200 sieve, and a maximum dry density of at least 85 pounds per cubic foot (pcf) as determined by ASTM D698. Provide fill with no granite blocks, broken concrete, masonry rubble, or other similar materials and with physical properties such that it can be readily spread and compacted during filling.

2.2 TOPSOIL MATERIALS

A. Topsoil: Fertile, friable, natural topsoil, reasonably free of stumps, roots, stiff clay, stones larger than 1 inch in diameter, noxious weeds, sticks, brush or other litter; conforming to Section M1.07.0 of the MassDOT SSHB.

2.3 AGGREGATE MATERIALS

A. Dense Graded Crushed Stone: combination of crusher run coarse aggregate of crushed stone and fine aggregates of natural sand or stone screening uniformly premixed with a predetermined quantity of water; conforming to Section M.2.01.7 of the MassDOT SSHB.

B. Coarse Aggregate - Crushed Stone: Natural stone free of clay, shale, organic matter; conforming to Section M.2.01.0 of MassDOT SSHB and the gradation requirements for AASHTO No. 1.

1. Coarse Aggregate Designation: No. 1.

2.4 SOURCE QUALITY CONTROL

A. Dense Graded Crushed Stone - Testing and Analysis: Perform according to ASTM D1557 and ASTM C136.

B. When tests indicate materials do not meet specified requirements, change material and retest.

C. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 STOCKPILING

A. Stockpile materials on site at locations designated by Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.

D. Stockpile topsoil 8 feet high maximum.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

F. Stockpile unsuitable or hazardous materials on impervious liner and cover to prevent erosion and leaching, until disposed of.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 310515

SECTION 310519.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonwoven geotextile material.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for fill and grading materials.
2. Section 312000 “Earthwork” for excavation and backfilling procedures.
3. Section 312500 “Erosion and Sedimentation Controls” for erosion and sedimentation control devices.

1.3 ACTION SUBMITTALS

A. Product Data: Submit certified test results from the manufacturer including tensile strength, elongation, thickness, UV resistance, and other material properties.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures and quality control and quality assurance.

1.5 QUALITY ASSURANCE

A. Perform Work according to applicable standards and the recommendations of the Manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging that identifies the manufacturer/supplier’s name, style, and roll number. Inspect for damage.

B. Comply with ASTM D4873.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture, dust, chemicals, UV radiation or other environmental conditions that might damage the geotextile by storing at least 3 inches off the ground in a clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace geotextile related products that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS - NONWOVEN GEOTEXTILES

A. Description:

1. Non-biodegradable, non-reactive (for pH of three to eleven), UV-resistant, insect/rodent-resistant nonwoven needle punched material consisting of filaments formed into a stable network.
2. Edges: Selvaged or finished to prevent separation of outer material.
3. Nonwoven geotextile shall be 8 oz unless otherwise indicated.

B. Performance and Design Criteria:

1. When tested in accordance with ASTM D4759, test results from any sampled roll in the lot shall meet or exceed the values listed in Table 1. Strength values are in the weaker principal direction.

TABLE 1: NONWOVEN GEOTEXTILE MINIMUM AVERAGE ROLL VALUES

PROPERTIES	TEST METHOD	UNIT	6 oz	8 oz	10 oz
Mass per Unit Area	ASTM D5261	oz/yd2 (g/sm)	6 (203)	8 (271)	10 (339)
Thickness	ASTM D5199	mils (mm)	75 (1.90)	90 (2.29)	108 (2.74)
Grab Strength	ASTM D4632	lbs (kg)	160 (73)	220 (100)	260 (118)
Grab Elongation	ASTM D4632	percent	50	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (kg)	60 (27)	80 (36)	100 (45)
Puncture Strength	ASTM D4833/ D6241	lbs (kg)	90 (41)	120 (54)	165 (175)
Water Flow Rate	ASTM D4491	gpm/ft2 (lpm/m2)	110	95	75
Permittivity	ASTM D4491	sec-1	1.5	1.2	1.0
Apparent Opening Size (Max)	ASTM D4751	inch (mm) US Std. Sieve	0.008 (0.212) 70	0.007 (0.180) 80	0.006 (0.150) 100
UV Resistance	ASTM D4355	percent strength retained	70	70	70

2.2 MATERIALS - ACCESSORIES

A. Use products to secure geotextile fabrics as recommended by geotextile manufacturer.

2.3 SOURCE QUALITY CONTROL

A. If requested by the Owner, provide materials for Quality Assurance Laboratory (QAL) testing by an independent GRI accredited laboratory to confirm conformance testing results.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. The Engineer shall inspect subgrade to verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material and that subgrade has been properly prepared.

B. Subgrade Material and Compaction Requirements: As specified in Section 312000 “Earthwork”.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published installation instructions. Do not install damaged materials.

B. Geotextile Material:

1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.
2. Ensure that material is in direct contact with subgrade.
3. Minimum Unseamed Joints Overlap: 18 inches.

C. Securement Pins or Staples:

1. Insert through geotextile midway between edges of overlaps and minimum 6 inches from free edges.
2. Minimum Spacing:

    a. Slopes Steeper than 3 Horizontal on 1 Vertical: 24 inches o.c.
    b. Slopes 3 Horizontal on 1 Vertical to 4 Horizontal on 1 Vertical: 3 feet o.c.
    c. Slopes Flatter than 4 Horizontal on 1 Vertical: 5 feet o.c.

3. Ensure that washer bears against geotextile.

D. Field Seams:

1. Minimum Seamed Joints Overlap: 12 inches at longitudinal and transverse joints.
2. Seams across Slope: Lap upper panel over lower panel.

E. Penetrations: As recommended by geotextile manufacturer.

F. Repairing Damaged Geotextiles:

1. Repair torn or damaged geotextile by placing patch of same type of geotextile over damaged area minimum of 12 inches beyond edge of damaged area and fasten as recommended by geotextile manufacturer.
2. Remove and replace geotextile rolls which cannot be repaired.

G. Fill and Cover:

1. Place fill to prevent tensile stress or wrinkles in geotextile.
2. Place fill from bottom of side-slopes upward.
3. Do not drop fill from height greater than 3 feet.

3.3 FIELD QUALITY CONTROL

A. Acceptance:

1. The Engineer will inspect installation and identify repairs or modifications necessary to perform as specified.

2. Make final adjustments and repairs under direction of The Engineer or manufacturer's representative.

3.4 PROTECTION

A. Ballast: Adequate to prevent uplift of material by wind.

B. UV Exposure: Do not leave material uncovered for more than 14 days after installation.

C. Do not use staples or pins to hold geotextiles in place where located adjacent to other geosynthetic layers that could be damaged.

D. Do not operate equipment directly on top of geotextile.

END OF SECTION 310519.13

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.

B. Related Requirements:

1. Section 312500 “Erosion and Sedimentation Controls” for temporary protection of erosion and sedimentation.

1.3 DEFINITIONS

A. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.3 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other project work.

END OF SECTION 311000

SECTION 312000 – EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation, and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.

B. Work includes, but is not necessarily limited to, excavation for grading for access road installation as shown on Figures 2 and 3 and related work.

C. Examine site prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.

D. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for fill materials.
2. Section 310519 “Geotextiles for Earthwork” for geotextile materials.
3. Section 311000 "Site Clearing" for site preparation work.
4. Section 312500 “Erosion and Sedimentation Controls” for temporary stated work.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor's work not in compliance with Contract Documents, which will be performed without additional compensation.
3. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.

E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.

F. In-the-Dry: An excavation subgrade where groundwater level: has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.

G. Objectionable Material: Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

H. Optimum Moisture Content: Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D1557.

I. Overexcavation: Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.

J. Percent Compaction: Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D1557.

K. Structures: Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.

L. Subgrade: Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.

M. Unsuitable Soil: Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.

N. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

O. Zone of Influence: A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.

P. The Engineer: The Engineer or designated representative hired by Owner.

1. Approval given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Submit copies of field daily reports by soil technician at the end of each work day that earthwork and grading operations occur.

B. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.

C. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation.

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.5 QUALITY ASSURANCE

A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of OSHA excavation safety standards, 29 CFR Part 1926 Subpart P, the Massachusetts Department of Labor and Workforce Development, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations" (Chapter 454 CMR 10.00 et seq)., and State and local authorities having jurisdiction. Where conflict between OSHA, State and local regulations exists, apply most stringent requirements.

B. At least three working days prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to www.call 811.com.

C. Quality Control Testing for Off-site Borrow Materials:

1. Chemical testing will not be required where site characterization of off-site borrow sources indicates that soils are acceptable for use. If site characterization data or materials are suspected of being contaminated, perform chemical testing as directed by The Engineer with no additional compensation.
2. Chemical Test Data: Test each material source requiring testing by a person experienced in sample collection who is a registered Professional Engineer or geologist, or certified groundwater or environmental professional registered in the Commonwealth of

Massachusetts. Submit samples of each proposed material to a chemical analytical laboratory, certified by the governing agency, for following analyses:

a. Volatile Organic Compounds: EPA 8240 plus Hazardous Substance List (HSL) Parameters.
b. Acid and Base Neutral Extractable Organic Compounds: EPA 8270.
c. Pesticides and PCBs: EPA 8080.
d. Total Petroleum Hydrocarbons: Infrared Method, EPA 9071/418.1.
e. Thirteen Priority Pollutant Metals: EPA 7000 Series.
f. Total Cyanide: EPA 9012.

3. Obtain and test off-site borrow samples in accordance with criteria established by the Engineer. Submit results for review and approval prior to use on site.

1.6 FIELD CONDITIONS

A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.

B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer registered in Commonwealth of Massachusetts, experienced and skilled in construction layout and staking requirements.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Utility Locator Service: Notify "Call Before You Dig” for area where Project is located before beginning earthwork operations.

E. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill materials designated for use in this Section are specified in Section 310515 “Soils and Aggregates for Earthwork.”

B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.

C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.

B. Prior to and During Earthwork Operations:

1. Protect and maintain erosion and sedimentation controls; coordinate with Section 312500 “Erosion and Sedimentation Controls.”

C. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned access road and in areas requiring excavation or filling of organic material and debris.

D. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

E. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

3.2 EXCAVATION

A. Include material of every description and of whatever substance encountered as an unclassified excavation.

B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.

C. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.

D. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.

E. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.

F. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by the Engineer, refill with dense graded crushed stone satisfactory to the Engineer without additional compensation.

G. When excavation has reached prescribed depths, notify the Engineer who will observe the conditions. If materials and conditions are not satisfactory, the Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.

H. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of the Engineer, remove existing soil and replaced with dense graded crushed stone as acceptable to the Engineer at Contractor's expense.

I. Exposed subgrades in large open areas shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 10 ton. Conduct proof-rolling in presence of the Engineer. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proof-rolling.

1. Confined Areas: Proof-roll with hand operated vibratory equipment that is approved by the Engineer.

J. Perform overexcavation at the Engineer’s request to remove unsuitable soil, objectionable material, or other materials as determined by the Engineer and to such depth and width as directed. Replace with suitable material as directed by the Engineer.

1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

K. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify soils testing laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.

1. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
2. Notify the Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

L. Replace overexcavation beyond the limits and depths required by Contract Documents using dense graded crushed stone satisfactory to the Engineer without additional compensation.

3.3 SUBGRADE PREPARATION

A. Notify Engineer when excavations have reached required subgrade.

B. Maintain excavated subgrade in-the-dry condition.

C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

D. For subgrades consisting of granular soils, proof roll the final subgrade using at least four coverages of a vibrator plate compactor.

E. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat.

F. Remove and replace soft subgrades or unusable material with dense graded crushed stone satisfactory to the Engineer.

G. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by the Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, pea gravel, crushed rock, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.

1. If additional overexcavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.

H. Notify the Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.

1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

3.4 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Protect from precipitation.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.5 FILL PLACEMENT AND COMPACTION PROCEDURES

A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.

B. Do not place or compact fill and backfill when materials are too wet to properly compact.

1. In-place Soil Moisture Content: Maximum of three percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.

C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.

D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.

E. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches.

F. Compact filled slopes by slope rolling and trimming or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.

G. Do not allow fill lifts to contain stones with a dimension larger than 2/3 the specified loose measure lift thickness.

H. Perform compaction in open areas using compaction equipment by any of the following methods:

1. Fully loaded ten-wheel trucks or front-end loaders.
2. Tractor dozers weighing minimum of 30,000 pounds.
3. Heavy vibratory rollers.

I. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers.

1. Do not exceed lift thickness of 6 inches or ½ the specified lift thickness (whichever is less), measured before compaction, when using hand operated equipment.

J. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to the Engineer in-place moisture conditioning methods can achieve the required moisture content.

K. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D1557, unless otherwise specified.

3.6 COMPACTION REQUIREMENTS

A. Perform in-place testing of compacted fill lifts to measure in-place density and water content according to ASTM D6938 and ASTM D1557.

B. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways and earth dam structures. Compact each fill or backfill layer to:

1. Maximum Dry Density: Minimum of 90 percent for ASTM D1557.
2. Moisture Content: At or near its optimum moisture content of minus 1 percent to plus 4 percent.

C. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D1557.
2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

3.7 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be permanently stockpiled in an area designated by the Owner. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.

3.8 GRADING

A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.

B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.

C. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by the Engineer.

3.9 FIELD QUALITY CONTROL

A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.

B. General Testing Requirements:

1. Backfill and Fill: Prior to and during the placement of backfill and fill perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.

    a. Provide minimum 48 hours' notice prior to placement of backfill and fill.

2. Subgrade: Do not cover with fill without observation, testing, and approval Engineer.

    a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.

C. Test materials by a certified independent laboratory, engaged by Contractor and acceptable to the Engineer, demonstrating conformance with project requirements. Deliver test reports and material certifications to the Engineer before using any material in the work.

D. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of the Engineer without additional compensation.

E. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.

F. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.

G. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer may designate areas to be tested. Notify the Engineer at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction, but in no instance, shall less than those listed:

1. Structures and Embankments: At least one density and moisture content test for each 2,500 square feet of surface area for each lift of fill at embankment, structure, and manhole locations.
2. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 50 feet intervals for each lift of fill placed or as directed by the Engineer.
3. The Engineer may designate supplemental areas to be tested at additional compensation.

H. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by the Engineer, notwithstanding results of previous testing.

I. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.

3.10 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All work shall be performed in accordance with all erosion and sediment control measures required by the Order of Conditions issued by the Worcester Conservation Commission and included in the Appendix

1.2 SUMMARY

A. Section Includes:

1. Sediment Fences.
2. Construction Entrances.
3. Filter Bags.
4. Straw Wattle.

B. Related Sections:

1. Section 310515 “Soils and Aggregates for Earthwork”.
2. Section 311000 “Site Clearing”.

1.3 ACTION SUBMITTALS

A. Submit, within 10 days after award of Contract, technical product literature for all commercial products.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Silt fence filter fabric shall be a woven, polypropylene, ultraviolent resistant meeting minimum requirements below:

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D4632/ D4632M
Elongation at Failure (percent)	20	ASTM D4632/ D4632M
Mullen Burst Strength	300 psi	ASTM D3786/ D3796M
Puncture Strength (lbs)	60	ASTM D4833/ D4833M
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D4533/ D4533M
Flow through Rate (gal/min/sf)	25	ASTM D4491/ D4491M
Equivalent Opening Size	40 – 80	US Std Sieve ASTM D4751
Minimum UV Residual (percent)	70	ASTM D4355/ D4355M

B. Products: Provide one of the following:

1. "Mirafi FW402," by TenCate Geosynthetics
2. "Carthage 15%," by Carthage Mills
3. "HSP2." by ACF Environmental, Inc.
4. Or equal.

C. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as "Envirofence" by Mirafi Inc., Charlotte, NC or equal.

D. Posts: Constructed of hardwood with minimum diameter thickness of 1.5 inches.

E. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or 1/32 inch diameter soft aluminum wire.

2.2 STRAW WATTLE

A. Straw Wattle: Prefabricated commercial product with outside casing made up of organic hessian.

1. Effective Height: 12 inches plus or minus 1 inch.
2. Effective Circumference: 38 inches.

B. Product: Provide products by Phase II Stormwater Products Wrentham MA or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

3.2 SILT FENCE

A. Position sediment fences to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.

B. Dig trench approximately 6 inches wide and 6 inches deep along proposed fence lines.

C. Drive stakes, 10 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.

D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

E. Backfill trench with excavated material and tamp.

F. Install pre-fabricated silt fence according to manufacturer's instructions.

3.3 CONSTRUCTION ENTRANCE

A. Construct entrance with minimum of 6 inch (150 mm) of course aggregate at all points of ingress/egress.

B. Width: Minimum 20 feet, increased as needed for typical construction vehicles.

C. Minimum Length: 50 feet (where soils are coarse grained); 100 feet (30.5 m) (where soils are fine grained – clay/silt)].

D. Install filter fabric below aggregate.

E. Maintain entrance throughout construction, adding more aggregate or increasing length as needed.

3.4 STRAW WATTLE

A. Position straw waddles as necessary to prevent off site movement of sediment produced by construction activities as directed by the Engineer.

B. Drive wooden stakes, 5 feet on center (maximum) at back edge of waddle. Drive stakes 2 feet (minimum) into ground.

C. Install pre-fabricated straw waddle according to manufacturer’s instructions.

3.5 SITE STABILIZATION

A. Incorporate erosion control devices at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 8 feet. Slope stockpile sides at 2: 1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.

1. During non-germinating periods, apply mulch at recommended rates.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.6 FIELD QUALITY CONTROL

A. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

3.7 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately one-half channel depth.

END OF SECTION 312500

Division 33 – Utilities

SECTION 331113.13 – DRILLING AND WELL INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes overburden and bedrock injection well drilling and installation. This section also includes groundwater monitoring well drilling and installation. The overburden and bedrock injection wells are being installed for the purpose of conducting injections to treat the groundwater in the form of a groundwater remediation barrier at the western property line of the Site. The remedial additives to be injected will reduce concentrations of chlorinated volatile organic compounds (cVOCs) in overburden and bedrock groundwater to prevent further off-site migration of the cVOC plume. The overburden and bedrock groundwater monitoring wells are being installed for the purpose of monitoring groundwater conditions downgradient of the barrier at an off-site property.

B. Work includes, but is not limited to:

Install sixty-seven (67) deep overburden injection wells, ten (10) shallow overburden injection wells, twenty-two (22) bedrock injection wells and three (3) groundwater monitoring well clusters (1 shallow overburden well, 1 deep overburden well and 1 bedrock well) with an all-terrain vehicle (ATV) track-mounted drill rig. The drilling access route and staging location is shown on Figure 1. The injection well and groundwater monitoring well locations are shown on Figure 2. Details of well construction are provided below and attached Figures 5 through 8.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-Installation Conference: At a minimum, conduct a pre-construction meeting with the drilling Contractor after the bid is awarded.

1.4 ACTION SUBMITTALS

A. The Contractor shall submit a work plan for well drilling and installation methods including well development.

B. The Contractor shall submit detailed product data including safety data sheets (SDS) for well installation materials including polyvinyl chloride (PVC) materials, steel casing, protective steel casing, silica sand, neat cement, cement bentonite grout and bentonite.

C. The Contractor shall submit well completion reports to MassDEP pursuant to 310 CMR 46.00 (Certification of Well Drillers and Filing of Well Completion Reports).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For drilling Contractor supervisor and drilling Contractor operator, include number of years of experience and the scope of three similar projects completed within the past five years.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that has completed three projects of similar scope and magnitude within the past five years and that employs installers and supervisors who are trained to perform installation of overburden and bedrock borehole injection wells. Competency determination of the supervisor and well drilling operators are at the discretion of the Engineer.

B. Employ a certified environmental well driller, licensed by the Commonwealth of Massachusetts pursuant to 310 CMR 46.00 Certification of Well Drillers and Filing of Well Completion Reports.

1.7 EXISTING CONDITIONS

A. Information regarding sub-surface conditions including the attached boring/well construction logs is intended to assist in establishing a price for the work. The Owner does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling of the wells.

B. Confirm all local conditions affecting the project work by personal investigation. No information on local geology, maps or plans, or information from the Owner or their agents or employees relieves any responsibility for fulfilling all terms and requirements of the Contract Documents.

C. Be advised and be aware of difficult drilling conditions and problems that may be encountered during the drilling, construction, and testing of the wells. Typical examples may include, but are not limited to, lost circulation, fractured zones and flowing artesian conditions in the bedrock formation. Take these and other pertinent factors into consideration in planning and executing the work. There will be no additional compensation for unforeseen conditions.

PART 2 - PRODUCTS

2.1 WATER SUPPLY

A. The Contractor shall be responsible for determining a source of water supply and transport subject to the Engineer’s approval, at no additional cost to the Owner. Obtain, transport, and/or haul water for drilling wells as required for drilling, flushing/jetting activities, and dust control (if needed). Transport the water from the point of supply and supply appurtenances needed for connection to the water supply. A fire hydrant exists at the entrance to the site, however flow and pressure at the hydrant are not known. A hydrant use permit must be obtained through the City of Worcester if the hydrant is used as a water supply source. In any case, use only potable water for drilling. Provide, install, and maintain, water-supply connections, necessary pumps,

piping, and piping road crossings for construction use. Upon completion, all temporary connections and piping installed shall be removed.

2.2 PVC WELL CONSTRUCTION MATERIALS

A. The overburden injection and groundwater monitoring well screens shall be flush joint threaded 2.0-inch inside diameter, PVC (0.010-inch slot), and threaded with a bottom cap. Up to 10 feet of screen will be installed at each of the seventy-seven (77) overburden injection well locations and three off-site (3) groundwater monitoring well cluster locations. It is anticipated that the PVC well screen shall not exceed 10 feet in length and the final installation depths will be determined by the Engineer. There shall be no grease, oil, film, or other foreign substance on the outside or inside of any well screen, sump, or bottom cap. All PVC well sections shall be connected by dry threading of the joints. No glue, solvents, or lubricating compound shall be used to make up the connections.

2.3 PERMANENT STEEL CASING MATERIALS

A. The permanent steel casing for the bedrock injection wells shall be 4.0-inch inside diameter, Schedule 40 steel, following AWWA C200 material standard for steel water well casings (MassDEP Private Well Guidelines, 2008). An estimated 40 feet of steel casing is required for each well installation. The final quantity will dependent upon field conditions (depth to bedrock) and will be determined by the Engineer. There shall be no grease, oil, film, or other foreign substance on the outside or inside of any pipe, or pipe appurtenance. No glue shall be used.

2.4 CEMENT GROUT

A. Neat cement grout shall be mixed according to the following ratio:

1. 5 to 6 gallons potable quality water.
2. 94 lbs. Type I/II Portland Cement.

2.5 SILICA SAND

A. Silica sand for the screen pack shall be a commercially processed silica sand having a gradation range of 0.60 – 0.85 mm (20-30 mesh) and a uniformity coefficient of approximately 2.0. Sand shall extend a minimum of 2 feet above the well screen, or as directed by the Engineer.

2.6 BENTONITE

A. Bentonite for installing a clay seal 2 feet above the silica sand shall be untreated, premium grade, sodium montmorillonite conforming to the applicable standards of the American Petroleum Institute (API).

2.7 CEMENT BENTONITE GROUT

A. Cement bentonite grout shall be mixed according to the following ratio:

1. 5 to 6-gallons potable quality water.
2. 94 lbs. Type I/II Portland cement.
3. 4 to 5 lbs. Wyoming bentonite.
4. 1/2 to near teaspoon aluminum hydroxide.

2.8 CONCRETE

A. Concrete to be installed from the bentonite seal to ground surface shall consist of an appropriate mixture of Portland cement, aggregate, and potable water, subject to approval of the Engineer.

2.9 PROTECTIVE STEEL CASING AND ROADBOX

A. For bedrock injection wells, permanent steel casing to extend from 2 feet above grade and up to 5 feet below the top of competent bedrock. A bedrock injection well will not be considered complete until it has protective locking 4-inch steel cover and is secured to the satisfaction of the Engineer. For overburden injection wells, a protective steel casing with a locking cover (5 feet in length) shall be installed from 2 feet above the ground surface to 3 feet below the ground surface. For overburden and bedrock groundwater monitoring wells, a steel 8-inch diameter roadbox shall be installed from the ground surface (flush mounted) to 1 foot below the ground surface.

PART 3 - EXECUTION

3.1 GENERAL

A. Obtain necessary local, state, and agency permits associated with the well installation, construction and fluid management. Contractor to follow the Order of Conditions (attached) from the City of Worcester Conservation Commission for the Greenwood St. Landfill project (CC-2022-061 & DEP#349-1334) for installation of overburden and bedrock wells within the wetland resource areas.

B. Drill rigs shall be all-terrain vehicle (ATV) track-mounted drill rigs.

C. Overburden drilling/well installation is to be completed using hollow stem auger drilling methods and bedrock drilling/well installation is to be completed using air hammer drilling methods unless otherwise approved by the Engineer.

D. Provide sufficient equipment to drill borings to a depth of 30 feet below ground surface (BGS) in overburden and to a depth of 70 feet BGS in bedrock.

E. Decontamination of the drill rig and all downhole equipment shall be the responsibility of the Contractor prior to site mobilization. Decontamination of downhole equipment between drilling locations shall be conducted at the Engineer's direction. Contractor to provide equipment for on-site decontamination.

F. Provide a clean pipes/tubing, submersible pumps, power supply (including fuel and maintenance), and other necessary appurtenances and supplies for well installation and development.

G. All well installations must meet Massachusetts Department of Environmental Protection (MassDEP) Policy WSC# 93-310 Standard Reference for Monitoring Wells (April 1991) and WSC# 93-310 Supplement: Standard Reference for Monitoring Wells (January 1999) and MassDEP Private Well Guidelines (October 1989, Revised 2000, 2004, Updated 2008). Work shall be performed by a certified environmental well driller, licensed by the state of Massachusetts pursuant to 310 CMR 46.00 (Certification of Well Drillers and Filing of Well Completion Reports).

H. During the course of the work, keep the site of the operation in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of work, remove and haul away any surplus excavation, equipment, temporary structures, and any other refuse remaining from the drilling operations and shall leave the entire site of the work in a neat and orderly condition.

I. The volume of soil cuttings and development water are expected to be small at each well installation location. It is anticipated that drill cuttings will be disposed of by raking into the ground surface. It is anticipated that well development test water will be discharged to the ground surface. In the event that soil cuttings and development water must be containerized at the site, contain the materials in 55-gallon steel drums and move them to an on-site location designated by the Engineer.

J. Be solely responsible for site security and equipment. Take reasonable precautions to protect the ground surface, grading, and other existing site features at each work location and restore any damage to its original condition upon completion of the work.

K. Protect all equipment, parts, and materials against damage during a prolonged period at the site. Remove any equipment, parts, or materials damaged or deemed unacceptable by the Engineer from the site and replace with new equipment, parts, or materials at no additional cost. All equipment, parts, and materials shall be clean and free of oils, grease, and other foreign substances prior to being used and as approved by the Engineer.

L. Use only thread lubricant/pipe dope especially formulated for monitoring wells or other material approved by the Engineer. All materials used for well installation shall be free of ingredients that could introduce hydrocarbon contamination or any other contaminants including per- and polyfluoroalkyl substances (PFAS).

3.2 OVERBURDEN INJECTION WELL DRILLING AND INSTALLATION

A. Drill injection wells at approximate locations shown on Figure 2. A total of sixty-seven (67) deep overburden injection wells will be installed across the length of the groundwater remediation barrier. A total of ten (10) shallow overburden injection wells will be installed next to deep overburden injection wells (well couplets) in the central area of the groundwater remediation barrier area. The shallow overburden injection well construction diagram is presented on Figure 5 and the deep overburden injection well construction diagram is presented on Figure 6.

B. Collect two (2) foot long, two (2) inch diameter split spoon soil samples every 5 feet or as directed by the Engineer from the ground surface through the overburden until bedrock is reached. Upon retrieval from the borehole, open each split spoon sample and immediately transfer to the Engineer for the collection of soil samples and logging of soil/rock types. Ensure that the material to be sampled is not disturbed by the drilling operation. The final overburden well screen installation depth and well construction materials will be determined by the Engineer following review of the soil cuttings and split spoon samples.

C. For shallow overburden injection wells, conduct drilling from the ground surface through the overburden using a hollow stem auger (4.25 inch inside diameter) to a maximum depth of 20 feet BGS. Shallow overburden injection wells will be installed next to deep overburden injection wells at up to 10 locations (well couplets) in the central area of the groundwater remediation barrier area as shown on Figure 2. Typical well construction for shallow overburden wells shall be as follows and is shown on Figure 5:

1. Install a 10-foot (2-inch diameter) 0.01-inch slot Schedule 40 PVC screen from approximately 10 to 20 feet BGS and 2-inch Schedule 40 PVC riser from 2 feet above the ground surface to 10 feet BGS.
2. Backfill the annular space with #1 silica sand from 8-20 feet BGS.
3. Backfill with medium bentonite chips from 3-8 feet BGS and backfill with concrete from the ground surface to 3 feet BGS.
4. Complete the well with a 4-inch diameter protective steel casing with locking cap and conduct well development after installation.
5. The Engineer will select the final well installation locations based upon technical prioritization, and access concerns.
6. Dispose of drill cuttings by raking into the ground surface and dispose of any excess drilling water by discharging to the ground surface.
7. Develop injection wells via surge and purge methods with a submersible pump as directed by the Engineer.

D. For deep overburden injection wells, conduct drilling from the ground surface through the overburden using hollow stem auger (4.25 inch inside diameter) to a maximum depth of 30 feet BGS. Typical well construction for deep overburden injection wells shall be as follows and is shown on Figure 6:

1. Install a 10-foot (2-inch diameter) 0.01-inch slot Schedule 40 PVC screen from approximately 20 to 30 feet BGS and 2-inch Schedule 40 PVC riser from 2 feet above the ground surface to 20 feet BGS.
2. Backfill the annular space with #1 silica sand from 18-30 feet BGS.
3. Backfill with medium bentonite chips from 16-18 feet BGS and grout from the ground surface to 16 feet BGS.
4. Complete the well with a 4-inch diameter protective steel casing with locking cap and conduct well development after installation.
5. The Engineer will select the final well installation locations based upon technical prioritization, and access concerns.
6. Dispose of drill cuttings by raking into the ground surface and dispose of any excess drilling water by discharging to the ground surface.
7. Develop injection wells via surge and purge methods with a submersible pump as directed by the Engineer.

E. Advance the borings to the depth proposed, unless otherwise directed by the Engineer. All drilling activities shall be performed under the direction of the Engineer.

F. Construct the well such that the borehole deviation from plumbness is 1 degree or less per 50 feet of depth (Manual of Water Well Construction Practices (U.S. EPA, 1975).

G. Injection well PVC casing and 0.01-inch slot PVC screen shall be installed in the borehole and the annular space backfilled, as specified for the designated well type. A minimum 10-foot length of well screen shall be installed at the bottom of each well. Final screen length shall be directed by the Engineer. The remaining assembly shall be composed of PVC casing. The well tip must be fitted with a threaded plug, unless otherwise directed by the Engineer. All PVC well sections shall be connected by dry threading of the joints. No glue, solvents, or lubricating compound shall be used to make up the connections.

H. Install a sand filter pack around the well screen to at least 2 feet above the screen. Sand filter pack shall be poured into the borehole between the casing and the riser pipe in increments of 6 to 12 inches, retracting the augers after each increment. In shallow groundwater conditions where installation of sand 2 feet above the screen is not feasible, then a lesser amount may be installed with Engineer approval. The sand filter pack must extend above the top of the well screen.

I. Install a bentonite clay seal (2-foot minimum thickness) above the sand filter pack. In shallow groundwater conditions where installation of a 2-foot thick bentonite clay seal is not feasible, the thickness of the clay seal may be reduced to six inches with Engineer approval.

J. Fill the remaining annular space around the PVC well with neat cement grout for the deep overburden injection wells. Wells shall be square cut to the well pipe stick-up at a minimum of 2 feet above grade. Use concrete as a surface seal and to hold the pipe in place. Secure the wells from vandalism or the introduction of foreign materials throughout the duration of the work.

3.3 BEDROCK INJECTION WELL DRILLING AND INSTALLATION

A. Drill bedrock injection wells at approximate locations shown on Figure 2. The Engineer will select the final well installation location based upon technical prioritization, and access concerns. The bedrock injection well construction diagram is presented on Figure 7.

B. Conduct drilling from the ground surface through the overburden to bedrock using hollow stem auger (6.25 inch inside diameter) drilling methods. Collect 2-foot long, 2-inch diameter split spoon soil samples at 5-foot intervals from the ground surface through the overburden until bedrock is reached. Upon retrieval from the borehole, open each split spoon sample and immediately transfer to the Engineer for the collection of soil samples and logging of soil/rock types. Ensure that the material to be sampled is not disturbed by the drilling operation. Permanent steel casing depth seating will be determined by review of soil cuttings and split spoon soil samples.

C. Once bedrock is encountered (bedrock approximately 30 feet BGS), telescope/advance air hammer drill bit (5.785-inch diameter) 3 to 5 feet into bedrock and install 4-inch diameter permanent steel casing into competent bedrock to a total depth of approximately 33-35 feet BGS with 2 feet sticking above the ground surface. Provide sufficient 4-inch permanent steel

casing to drill to depths of 35-40 feet BGS. The final permanent casing depth installed into bedrock shall be determined by the Engineer.

D. Following permanent casing installation, install neat cement grout in the annular space via tremie pressure grouting with 1-inch diameter PVC along the entire casing length from the bottom of the borehole to ground surface with a positive displacement pump.

E. After the neat cement grout has properly set in accordance with manufacturers recommendations, conduct bedrock drilling using a 3.785 inch diameter air hammer drill bit to a depth of 30 to 35 feet past the bottom of the 4-inch permanent steel casing (anticipated total maximum depth is approximately 70 feet BGS). Construct the well such that the borehole deviation from plumbness is 1 degree or less per 50 feet of depth (Manual of Water Well Construction Practices (U.S. EPA, 1975).

F. Advance borings to the depth proposed, unless otherwise directed by the Engineer. All drilling activities shall be performed under the direction of the Engineer.

G. Complete the bedrock borehole well with a protective locking steel cover and conduct well development via jetting or other method approved by the Engineer.

H. Disposed of drill cuttings by raking into the ground surface. The drilling water shall be re-circulated using a weir (wash tub). At completion of each well installation location, discharge excess drilling water to the ground surface.

I. Following bedrock injection well installation and borehole geophysics at the twenty-two bedrock injections wells, perform packer groundwater sampling at two zones per bedrock well (11 bedrock wells total) at intervals identified by the Engineer. The Contractor shall furnish all mechanical equipment necessary for packer sampling including but not limited to air tanks, straddle packers, pumping equipment, etc. The packer sampling would be completed as a separate field mobilization following completion and review of the borehole geophysical data.

3.4 GROUNDWATER MONITORING WELL INSTALLATION

A. Drill and install three (3) groundwater monitoring well clusters (1 shallow overburden, 1 deep overburden and 1 bedrock) as shown on Figure 2. The Engineer will select the final well installation location based upon technical prioritization, and access concerns.

B. The overburden monitoring wells will be installed with the same methods, depths and materials as the injection monitoring wells. The overburden well construction diagrams are presented on Figure 5 and Figure 6.

C. For the bedrock groundwater monitoring wells, drilling shall be conducted from the ground surface through the overburden, to bedrock using hollow stem auger (4.25 inch inside diameter) drilling methods. The bedrock groundwater monitoring well construction diagram is presented on Figure 8.

D. Split spoon samples shall be collected every 5 feet or as directed by the Engineer in the field. Once bedrock is encountered (bedrock ~40 feet BGS), conduct bedrock drilling using a 4-inch (3.785 inch) diameter air hammer drill bit to a maximum depth of 20 feet past the bottom of the 4-inch permanent steel casing (anticipated total maximum depth is approximately 60 feet BGS).

The bedrock monitoring well shall be installed to approximate depths of 60 feet BGS. Bedrock well construction shall be as follows:

1. Install a 10 foot (2-inch) .01-inch slot schedule 40 PVC screen from approximately 50 to 60 feet BGS into the bedrock and 2-inch schedule 40 PVC riser from ground surface to 50 feet BGS.
2. Backfill the annular space with #1 silica sand from 48-60 feet BGS, backfill with medium bentonite chips from 44-46 feet BGS, grout seal from 1.0 foot to 44 feet BGS and a concrete seal from ground surface to 1-foot BGS.
3. Complete the well with a protective steel 8-inch road box and conduct well development after installation.
4. All drill cuttings and drilling fluids shall be placed in 55-gallon steel drums for drilling work conducted off-site. Each drum shall be Massachusetts Department of Transportation (MassDOT) approved and shall include a safety nut for inside and outside of the cover bolt.

3.5 OBSTRUCTIONS DURING DRILLING

A. Abandoning a borehole to drill another borehole adjacent to the original borehole requires Engineer's approval. The Contractor will be paid for footage drilled to the point of refusal provided that the boring has been advanced to a minimum depth of five (5) feet below the ground surface.

B. The Contractor shall assume the risk and responsibility for carrying borings through or past boulders, old masonry, concrete foundations, and any other obstructions that may be encountered.

C. Blasting will not be permitted for any of the work specified in this specification. The Contractor shall make every reasonable effort to penetrate boulders, cobbles, or other obstructions by chopping, rock coring, or other acceptable methods.

3.6 PRACTICAL REFUSAL

A. Practical refusal may not be accepted as the termination of a borehole above the highest bottom elevation as specified or stated elsewhere. The Engineer will determine whether the boring shall be relocated and re-drilled to the specified bottom elevation. The Engineer may direct other methods to advance the drilling (if needed).

3.7 WELL PROTECTION

A. Protect each well from entry of foreign materials at all times and, upon completion, secure with a lockable protective locking casing pipe.

B. Protective locking Casing Pipe:

1. Secure wells upon completion with a lockable protective casing pipe fabricated of steel and conforming to ASTM A120.
2. Bottom of the protective casing pipe shall be cemented 2 to 3 feet below grade.

3. Protective casing pipe shall be painted to inhibit rust formation and increase visibility. Paint the well number in one-inch block numerals of a contrasting color.
4. Protective casing pipe shall be free of cutting oil or other residue.

3.8 BACKFILLING BORINGS AND SURFACE RESTORATION

A. Backfill boreholes in accordance with state and local requirements. It is anticipated that drill cuttings, drilling water, and well development water will be discharged to the ground surface unless otherwise specified by the Engineer. Soil may not be stockpiled at any location.

B. If at any time prior to the completion of the backfilling operation the borehole is left unattended, it shall be suitably capped and protected

C. The ground surface shall be restored to match the existing elevation at no increase in Contract Price or in the Period of Performance.

D. During the course of the work, keep the site of operations in a neat and clean condition and dispose of all residue resulting from the drilling and well installation work at a location designated by the Engineer. At the conclusion of the work, remove and haul away any surplus materials and refuse and leave the entire site in a neat and orderly condition. The Contractor is responsible for repair of any property damage incurred during the course of his work.

3.9 BORING AND WELL ACCEPTANCE CRITERIA

A. The details drafted for this project attempt to minimize the deficiencies that could result in an unacceptable well installation and boring completion. Acceptability of a well generally is based on its ability to meet its intended use. Boring acceptance criteria are limited to the successful completion as outlined in this specification.

B. Failure of a well or boring to meet the acceptance criteria will constitute cause to cancel any and all payments that would otherwise be paid for the installation and completion of the well or boring in question.

C. No payment for the well will be made if the Contractor fails to meet all of the criteria in this specification, unless otherwise approved in writing by the Engineer.

D. Maintain a daily work log that summarizes the work performed for the day and submit to the Engineer at the end of each workday. Compare quantities logged with those logged by the Engineer. Report any difference not resolved by discussion in the field to the Engineer within seven days from the date the work was performed.

3.10 BORING OR WELL ABANDONMENT

A. Should the Contractor abandon a boring or well because of loss of tools, cemented well screens or gravel packs, casing collapse, or any other causes, abandonment shall be completed by grouting. The boring or well shall be grouted to surface with neat cement grout or cement-bentonite grout; native materials may not be used to backfill the hole.

B. The Contractor shall receive no payment for time, materials, or work for well abandonment and shall receive no compensation for the abandoned well.

C. The Contractor shall replace the abandoned well at the same cost to install.

D. If a boring and or well is decommissioned, well decommissioning reports will be completed and submitted to MassDEP.

3.11 RECORD KEEPING

A. Provide daily drilling reports to the Engineer describing the activities performed during the reference period. Logs shall include the following. information:

1. Complete description of equipment used.
2. Geologic materials and depths encountered
3. Number of feet drilled.
4. Depths of lost circulation zones and methods of regaining circulation.
5. Drilling rates.
6. Time, depth and description of any unusual occurrences or problems during drilling.
7. Diameters and lengths of casing installed.
8. Fluid and water-level changes and the depths at which they occurred.
9. Hours of pumping.
10. Number of hours on the job.
11. Repair/shutdown time and other such pertinent data as may be required by the Engineer.

B. Submit one copy of each daily log to the Engineer on a daily basis. Provide a tabulation of all quantities for pay items and a description of all decisions made.

C. File all records and reports with the proper agencies required by federal, state, and local codes or regulations.

END OF SECTION 331113.13

SECTION 331113.19 – BOREHOLE GEOPHYSICAL LOGGING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes borehole geophysical logging to be conducted following installation of the twenty-two (22) bedrock borehole injection wells. The bedrock borehole geophysical logging is being conducted for the purpose of determining bedrock fracture locations in the borehole injection wells to identify depths to conduct to hydraulic fracturing and remedial additive injections. The bedrock borehole geophysical logs will also aid the determination of depths to conduct packer test groundwater sampling.

B. Work includes, but is not limited to:

1. Conduct borehole geophysical logging at up to twenty (22) new bedrock borehole well locations to depths of approximately 60-70 feet below ground surface. The bedrock borehole injection wells are shown on Figure 2. Most of the bedrock borehole wells will be drive up accessible to conduct the field work from a logging van. Bedrock borehole wells located within the wetland resource areas (see Figure 2) may require an all-terrain vehicle (ATV) access. The bedrock borehole geophysical logs from previous site investigations are attached.

1.3 PRE-INSTALLATION MEETINGS

A. Preinstallation Conference: At a minimum, conduct a pre-construction meeting with the geophysical Contractor after the bid is awarded.

1.4 ACTION SUBMITTALS

A. The Contractor shall submit a work plan and geophysical borehole example log format for review and approval by the Engineer.

B. The Contractor shall submit preliminary electronic copies of the borehole geophysical well logs to the Engineer at the end of each day of logging.

C. The Contractor shall submit the final deliverable report within thirty (30) days of completion of the borehole geophysical logging at the twenty (22) bedrock borehole wells. The geophysical final deliverbale report shall include the following:

1. Integrated borehole geophysical logs for the logged boreholes. The borehole geophysical logs shall be similar to the attached logs for existing wells at the site;
2. Statistics plots of the orientations of bedrock structures detected in the boreholes;
3. Tables with the depths and orientations of bedrock structures detected in the boreholes;
4. Interpretation of the logging data and text describing the procedures used and limitations of the borehole geophysical methods;
5. Spatial horizontal and vertical data shall reference North American Datum of 1983 (NAD 83) Stateplane Massachusetts (Mainland) and National Geodectic Vertical Datum of 1929 (NGVD29).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For geophysical supervisor and geophysical equipment operator, include number of years of experience and the scope of three similar projects completed within the past five years.

1.6 QUALITY ASSURANCE

A. Geophysical Contractor Qualifications: An entity that has completed three projects of similar scope and magnitude within the past five years and that employs operators and supervisors who are trained to perform borehole geophysical logging of bedrock injection wells. Competency determination of the supervisor and well geophysical equipment operators are at the discretion of the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

A. The geophysical log depths shall reference the top of steel casing or ground surface as specified by the Engineer. Equip geophysical logging and survey tools with a continuous depth recorder that displays on the log output.

B. Calibrate geophysical logs per manufacturer’s recommendations. Provide calibration records at request of the Engineer.

C. Furnish all labor, materials, equipment, and all other facilities and incidentals necessary to geophysically log twenty-two (22) bedrock borehole wells combined with complete heat pulse flow measurements (HPFM). The greatest anticipated depth of the wells is 70 feet with an open bedrock borehole length of approximately 30 feet. The geophysical logs to be run over the course of construction and testing on each well in the following order include:

1. Fluid Temperature.
2. Fluid Conductivity/Resistivity.

3. Caliper Probe.
4. Optical Televiewer (OTV).
5. Acoustic Televiewer (ATV).
6. Heat Pulse Flowmeter (ambient and pumping conditions) up to two locations in each bedrock borehole.

D. Provide submersible pumps, hoses/tubing for HPFM logging and flow control, and flowmeter to measure flow during geophysical logging. Contractor to provide and pumps capable of adequately stressing aquifer up to a rate of one (1) gallon per minute (gpm) during ambient and stressed conditions with a HPFM.

E. Presentation: Provide integrated borehole geophysical logs similar to the attached logs at a scale of one (1) inch to two (2) feet with horizontal scale as approved by the Engineer. Changes to these requirements may be made if approved by the Engineer.

PART 3 - EXECUTION

3.1 BOREHOLE GEOPHYSICAL LOGGING

A. Conduct geophysical logging a minimum of twenty-four (24) hours after borehole well development with logging interval at the total depth of hole, or as determined by the Engineer. Provide twenty-four (24) hour advance notice to the Engineer prior to running all geophysical logs. Run geophysical logs in the presence of Engineer, unless Engineer waives requirement. Each log must be run and recorded in a continuous fashion to qualify as an acceptable log. A combination of partial logging trips for a given stage of logging is not acceptable.

B. Log borehole wells in the order as identified in Section 2.1(C). Engineer shall have access to logger vehicle at all times. Logging areas will be witnessed at Engineer's discretion.

C. Perform borehole geophysical logging by lowering sensing devices attached to a wireline into borehole and recording various physical properties of borehole. Verify geophysical logging program implemented during construction and testing collects information on hydrogeology of penetrated bedrock formations, data on borehole geometry, and determining packer test sampling intervals and bedrock fracture/injection intervals.

D. Assist Engineer during geophysical logging and data collection and interpretation, as needed.

E. Perform HPFM logging at pre-determined borehole fracture zones when pumping is introduced at a rate of up to one (1) gpm and the aquifer is stressed. The HPFM intervals will be determined based on the results of the preliminary borehole logs. Do not install pump until HPFM logging tools are installed and centralized within wells. Be prepared to install and pull pump for each HPFM logging tool test to provide most accurate logging by having logging tools centralized and not pushed to one side of wells.

F. Verify equipment, logging data, and log interpretation is in conformance with ASTM D5753: Standard Guide for Planning and Conducting Borehole Geophysical Logging.

G. In the event that a logging tool becomes stuck or is lost in the borehole/wells, the Contractor is responsible for all costs associated with tool retrieval or replacement and the clearance of the borehole/wells.

H. No payment will be made for borehole geophysical logs which are unusable or not representative of downhole conditions due to poor performance of the logging equipment as determined by the Engineer in the field.

3.2 TEMPERATURE LOG

A. Run a differential and gradient temperature log from top of casing to total depth of the borehole under ambient conditions. The temperature logs are useful for identifying water bearing fractures and identifying ambient vertical flow between zones of differing hydraulic head. Run log continuously from top of wells to bottom to record water temperature with depth in the borehole. Follow suggested guidelines in ASTM D5753-18 - Standard Guide for Planning and Conducting Borehole Geophysical Logging.

3.3 FLUID CONDUCTIVITY/RESISTIVITY LOG

A. Obtain a fluid resistivity log to measure borehole fluid resistance to electronic conductance. Changes in fluid resistivity indicate in the concentrations of dissolved solids in water or potential contaminants flowing from fracture zones. Fluid resistivity logs can be useful for identifying water bearing fractures and contaminants in the borehole. Run log continuously from top of well casing to the bottom of the borehole. Follow suggested guidelines in ASTM D5753-18 - Standard Guide for Planning and Conducting Borehole Geophysical Logging.

3.4 CALIPER PROBE LOG

A. Obtain x-y caliper measurements of the borehole. Changes in borehole diameter are related to borehole well construction and natural borehole fractures. The caliper log can be useful to understand water bearing fracture zones as observed with increase in borehole diameter. Calculate volumetric of borehole with x-y caliper measurement and follow suggested guidelines in ASTM D6167-19 - Standard Guide for Conducting Borehole Geophysical Logging: Mechanical Caliper.

3.5 OPTICAL TELEVIEWER LOG (OTV)

A. Obtain an optical televiewer log, which provides a high-resolution optical borehole imagery to obtain a complete fracture analysis including fracture orientation. Boreholes with suspended sediment or that are murky can severely affect the optical televiewer data. The optical televiewer can be acquired in both air and water filled portions of the borehole. Ensure that wells and borehole fluid is of sufficient clarity as determined by Engineer to allow an OTV survey to be conducted. Contractor to repeat OTV survey at own cost if water quality is inadequate or borehole is not properly conditioned, as evaluated by the Engineer. Follow suggested guidelines in ASTM D5753-18 - Standard Guide for Planning and Conducting Borehole Geophysical Logging.

3.6 ACOUSTIC TELEVIEWER LOG (ATV)

A. Obtain an acoustic televiewer log which measures the acoustic impedance of the borehole wall and the two-way travel time of the transmitted signals. The ATV Logs provide the corrected orientation and shape of the borehole's features, which are used to calculate the dip direction and dip angle of imaged planar features. Discontinuities imaged with the ATV log include fractures, foliation, mineralization, weathered zone, and rock fabric. Acoustic caliper can only be acquired in the water filled portions of the borehole. Follow suggested guidelines in ASTM D5753-18 - Standard Guide for Planning and Conducting Borehole Geophysical Logging.

3.7 HEAT PULSE FLOW METER (HPFM) LOG

A. Obtain ambient and stressed condition flow meter logs of open borehole wells. The HPFM will be completed at up to three pre-determined intervals in each borehole well after review of the preliminary borehole logging data. The tool contains a thermistor for generating a pulse of heat into the water and two temperature sensors for measuring the direction and magnitude of the pulse of heated water in the borehole. The HPFM measures the direction and rate of induced low vertical flow in the borehole. The HPFM probe shall be calibrated to measure flows from approximately 0.02 to 1 gpm. Fully interpret results of the HPFM logs by geophysical logger and explain on-site to the Engineer. Follow suggested guidelines in ASTM D5753-18 - Standard Guide for Planning and Conducting Borehole Geophysical Logging.

END OF SECTION 331113.19

SECTION 331113.36 – HYDRAULIC FRACTURING AND EMPLACEMENT OF REMEDIATION AMENDMENTS IN BEDROCK WELLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hydraulic fracturing of bedrock borehole injection wells configured as a bio-barrier to facilitate the injection of bioremediation and chemical reduction amendments to remediate chlorinated volatile organic compound (cVOC) contamination in bedrock groundwater. The hydraulic fracturing and amendment injections will be conducted at existing natural fracture locations identified by borehole geophysical logging within the open borehole of each bedrock injection well. Tiltmeter mapping of amendment fracture emplacement is required to demonstrate treatment zone coverage and performance of fracturing amendment emplacement.

B. Work includes but is not limited to hydraulic fracturing and amendment injections at up to three (3) locations per bedrock borehole (total of 26 bedrock boreholes and 78 fracturing locations), tilt metering at up to thirty-nine (39) locations in up to thirteen boreholes (13) and submittal of a fracturing report including tilt meter results. The access route to the bedrock boreholes and staging area location is shown on Figure 1. The bedrock borehole fracturing and injection well locations are shown on Figure 2. Details of bedrock injection well construction are provided on the attached Figure 7. The bedrock borehole geophysical logs for the existing bedrock borehole wells are attached.

C. Related Requirements:

1. Section 331113.49 “Bioremediation Amendment Injection in Overburden and Bedrock Wells.”
2. Section 331113.13 “Drilling and Well Installation”
3. Section 331113.19 “Geophysical Logging”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: At a minimum, conduct a pre-construction meeting with the remediation Contractor after the bid is awarded.

1.4 ACTION SUBMITTALS

A. The Contractor shall submit a work plan for the hydraulic fracturing and amendment injection including but not limited to materials to be used, material quantities, equipment, methods, documentation and reporting.

B. The Contractor shall submit detailed product data including safety data sheets (SDS) for well hydraulic fracturing and amendment injection materials including but not limited to emulsified vegetable (EVO), zero valent iron (ZVI), sand proppant, and guar gum.

C. The Contractor shall submit a draft report to the Engineer electronically within 45 business days after completion of the field work, and shall include documentation of field activities, quantities of amendment injected, fracture pressure and flow versus time plots and tiltmeter geophysics analysis results and associated 3-D fracture models, and all other monitoring data. The Contractor shall incorporate any comments from the Engineer and provide a final report in hard copy and electronic file format within 10 business days after receipt of comments.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For remediation Contractor supervisor and remediation Contractor operator, include number of years of experience and the scope of three similar projects completed within the past five years.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that has completed three projects of similar scope and magnitude within the past five years and that employs installers and supervisors who are trained to perform hydraulic fracturing and amendment injections of installed bedrock borehole injection wells.

1.7 EXISTING CONDITIONS

A. Information regarding sub-surface conditions including the attached boring/well construction logs and borehole geophysical logs are intended to assist in establishing a price for the work. The Owner does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling of the wells.

B. Confirm all local conditions affecting the project work by personal investigation. No information on local geology, maps or plans, or information from the Owner or their agents or employees relieves any responsibility for fulfilling all terms and requirements of the Contract Documents.

C. Be advised and be aware of difficult borehole conditions and problems that may be encountered during the hydraulic fracturing and amendment injection of the bedrock wells. Typical examples may include but are not limited to fractured zones and flowing artesian conditions in the bedrock formation. Take these and other pertinent factors into consideration in planning and executing the work. There will be no additional compensation for unforeseen conditions.

PART 2 - PRODUCTS

2.1 WATER SUPPLY

A. The Contractor shall be responsible for determining a source of water supply and transport subject to the Engineer's approval, at no additional cost to the Owner. Obtain, transport, and/or haul water for hydraulic fracturing as required for fracturing/amendment injections and dust control (if needed). Transport the water from the point of supply and supply appurtenances needed for connection to the water supply. A fire hydrant exists at the entrance to the site, however flow and pressure at the hydrant are not known. A hydrant use permit must be obtained through the City of Worcester if the hydrant is used as a water supply source. In any case, use only potable water for drilling. Provide, install, and maintain, water-supply connections, necessary pumps, piping, and piping road crossings for construction use. Upon completion, all temporary connections and piping installed shall be removed.

2.2 REMEDIATION AMENDMENTS

A. The remediation amendments to be emplaced during bedrock hydraulic fracturing shall include Emulsified Vegetable Oil (EVO), Microscale Zero Valent Iron (ZVI), Sand Proppant; Guar Gum, and other chemicals/additives required for development of injection carrier slurries. The Contractor is responsible for procuring, receiving, handling, and storing all materials, including the remediation amendments. The Contractor is responsible for securing and protecting equipment and supplies from vandalism during non-working hours. All items shall be brought to the site clean and in like new condition and kept clean and in satisfactory condition throughout the duration of the contract. Damaged materials, torn bags, etc., shall be replaced as directed by the Engineer.

2.3 FRACTURING AND TILTMETER EQUIPMENT

A. Provide self-contained hydraulic fracturing unit equipped with mixing tanks and pumps, capable of safely and efficiently mixing and delivering high-density fracture slurries containing ZVI, EVO and sand. All equipment shall be resistant to ZVI, EVO, sand proppant and all other materials planned to be used. Equipment shall be capable of delivering sufficient pressures to hydraulically fracture existing bedrock fractures.

B. Provide hoist rig or telehandler for lowering/handling straddle packer assembly into the bedrock borehole for the purpose of isolating existing bedrock fracture intervals. Provide all required downhole fracturing tooling to conduct hydraulic fracturing and amendment slurry injections.

C. The Contractor shall provide a high-pressure packer assembly suitable for conducting hydraulic fracturing/amendment injections and associated equipment required to isolate and pressurize the zones to be fractured. Provide an appropriate size packer assembly to fit inside a 3.785-inch diameter open bedrock borehole. Note that the steel casing grouted into the bedrock is 4.0-inch inside diameter. Provide more than one packer assembly such that one can be left in place at a previous borehole while in-situ bedrock fracturing pressure dissipates, and a second packer assembly can be used at a subsequent bedrock borehole.

D. Provide auxiliary vehicles (pickup truck, skid steer, flatbed trucks, crane, etc.) as necessary for hauling tools, maintaining equipment, decontamination, or retrieving supplies.

E. Provide amendment handling equipment required to unload, transport, handle, and mix all amendments and material.

F. Provide all necessary equipment to collect tiltmeter data for analysis of hydraulic fracture injections. The Contractor shall provide up to fifteen (15) tiltmeters to set up around a single bedrock borehole during hydraulic fracturing and injections.

PART 3 - EXECUTION

3.1 GENERAL

A. Obtain necessary local, state, and agency permits associated with hydraulic fracturing and amendment injections. Contractor to follow the Order of Conditions (attached) from the City of Worcester Conservation Commission for the Greenwood St. Landfill project (CC-2022-061 & DEP#349-1334) for conducting environmental remediation construction work within the wetland resource areas.

B. The Contractor shall provide all remedial injection amendments, water, sand, as well as all other chemicals/additives required for development of injection carrier slurries to deliver remedial amendments into the bedrock subsurface. The Contractor shall stage all injection materials near the injection points or at a location approved by the Engineer;

C. Provide sufficient equipment and tooling and to advance bedrock borehole fracturing equipment to 70 feet below ground surface in bedrock.

D. Decontamination of the downhole equipment shall be the responsibility of the Contractor prior to site mobilization. Decontamination of downhole equipment between borehole locations shall be conducted at the Engineer’s direction. Contractor to provide equipment for on-site decontamination.

E. During the course of the work, keep the site of the operation in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of work, remove and haul away any surplus excavation, equipment, temporary structures, and any other refuse remaining from the drilling operations and shall leave the entire site of the work in a neat and orderly condition.

F. Contractor shall temporarily containerize all fluids, personal protective equipment (PPE), and other disposable sampling equipment and will dispose of these materials as directed by the Engineer. It is currently anticipated that fluids can be discharged to the ground. All efforts should be made to minimize the quantity of unused fracture slurry water. If any is leftover, it should be containerized in either 55-gallon drums or 5-gallon buckets and be re-used.

G. Be solely responsible for site security and equipment. Take reasonable precautions to protect the ground surface, grading, and other existing site features at each work location and restore any damage to its original condition upon completion of the work.

H. Protect all equipment, parts, and materials against damage during a prolonged period at the site. Remove any equipment, parts, or materials damaged or deemed unacceptable by the Engineer from the site and replace with new equipment, parts, or materials at no additional cost. All equipment, parts, and materials shall be clean and free of oils, grease, and other foreign substances prior to being used and as approved by the Engineer.

I. Use only thread lubricant/pipe dope especially formulated for environmental remediation activities or other material approved by the Engineer. All materials used for hydraulic fracturing and amendment injections shall be free of ingredients that could introduce hydrocarbon contamination or any other contaminants including per- and polyfluoroalkyl substances (PFAS).

3.2 HYDRAULIC FRACTURING AND AMENDMENT SLURRY INJECTIONS

A. Contractor shall provide all remedial injection amendments (e.g. ZVI and EVO), water, sand, guar gum as well as all other chemicals/additives required for development of injection carrier slurries to deliver remedial amendments into the bedrock borehole fractures.

B. Contractor shall transport equipment, materials, supplies, and personnel to the site. The Contractor shall stage all injection materials near the injection points or at a location approved by the Engineer. The access route to the bedrock boreholes, staging area, hydrant location, etc. is shown on Figure 1. The bedrock borehole hydraulic fracturing and amendment injections locations are shown on Figure 2.

C. Prepare/stage remediation amendments, sand proppant, and other materials required for fracturing (e.g., guar gum, thickeners, and crosslinkers); required volumes and concentrations of remediation amendments are shown in Table 1.

D. Engineer will confirm which boreholes will require tiltmeter monitoring prior to fracturing mobilization. Assume tilt metering will be conducted up to three (3) bedrock fractures at up to thirteen (13) bedrock borehole locations. Set up the tiltmeter array deploying up to fifteen (15) tilt meters around a single well where borehole tiltmeter monitoring is to be performed. The tiltmeter sensors will be placed in two (2) to three (3) concentric circular arrays around each borehole.

E. Conduct hydraulic fracturing and amendment slurry injections at up to three depth intervals (existing natural fractures) per bedrock borehole. Engineer shall provide target depths prior to fracturing mobilization. Hydraulic fracturing and injection depths will be determined based on the bedrock borehole geophysical logging to be performed on boreholes that will be installed as a part of bio-barrier construction.

F. Deploy high pressure straddle packer assembly and fracturing tooling to target depths starting with the deepest fracture (depths will be provided by Engineer prior to fracturing mobilization). Provide more than one straddle packer assembly such that one can be left in place at a previous borehole while in-situ bedrock fracturing pressure dissipates, and a second packer assembly can be used at a subsequent bedrock borehole.

G. Create fracturing amendment slurry by preparing the sand proppant and remediation amendment mixture. A fracturing fluid containing ZVI at approximately 3.5 pounds per gallon of fracture slurry, sand at approximately 3.5 lbs/gallon of fracture slurry, and EVO at 0.5 lbs/gallon is

anticipated to be used at each single fracturing/amendment injection location. The target amendment concentrations and volumes are provided in Table 1. The Contractor can propose higher loadings if achievable. The actual composition of the fracturing fluid will be determined upon procurement of amendment materials and the vendor-provided mixing test.

H. Prior to the start of hydraulic fracturing/amendment injection, begin baseline tiltmeter data collection if tiltmeter monitoring is performed at a given bedrock borehole location. Initiate fracturing at target depths; adjust pressure/injection flowrate as needed to propagate fractures containing sand and remediation amendments. Continuously monitor and record pressure and flowrate during fracture propagation. Record tiltmeter data, as appropriate.

I. Carefully monitor the ground surface area around each borehole being fractured and watch for surfacing of amendment adjacent to the borehole and adjacent bedrock borehole injection wells. If significant amendment surfacing occurs at the wellhead, the injection will immediately stop, and the packer system will be depressurized. Any surfaced amendment will be contained and re-used. The injection packer system tooling will be advanced to the next fracture initiation depth to continue fracturing at a different depth than the one where surfacing occurred.

J. If no surfacing occurs, continue injecting until target volumes of material have been achieved. If conditions develop such that the target volume cannot be achieved, or if fracturing cannot be initiated at a given depth, injections may be stopped, as directed by the Engineer. To compensate for fractures where the target volume cannot be achieved, additional amendment volume may be injected into other nearby boreholes/fractures, as directed by the Engineer. Additional amendment volumes beyond the target volume for a given fracture may not require sand proppant as part of the amendment formulation. The Engineer will provide direction regarding whether to include sand in these instances.

K. Following completion or abandonment of bedrock hydraulic fracturing/amendment injection location, deflate packers and raise packer assembly and fracturing tooling to the next target depth and repeat fracturing/tiltmeter monitoring process, as appropriate. If in-situ pressures remain high such that the packer assembly cannot be readily deflated, leave packer assembly in place and proceed to next borehole by deploying the additional packer assembly.

L. If hydraulic fracturing and amendment injection is occurring in a secure location, equipment can be left in place overnight. If injection is occurring in unsecured areas, then pack and secure equipment each evening before leaving the site.

M. Field conditions may influence completion of amendment injection, and the Engineer reserves the right to modify the number of borings, placement of fracturing locations, number of intervals per boring during injections and total number of batch slurry volumes to be injected at each fracture location.

3.3 RECORD KEEPING

A. Provide daily reports to the Engineer describing the activities performed at each bedrock borehole and each bedrock fracture during the reference period. Daily reports shall include the following information:

1. Date and time work is performed.

2. Weather conditions.
3. Workers names.
4. Reference point for depth measurements.
5. The proppant type and amount pumped (lbs).
6. The amendment type(s) and amount pumped (lbs).
7. The amount of slurry pumped (gal).
8. The amount of potable water used (gal).
9. The amendment and proppant loading (lbs/gal).
10. The type and quantity of any loss (gal).
11. Pressure data: peak, average, and break (psi).
12. Flow data: peak, average, and break (gal/min).

B. Submit one copy of each daily log to the Engineer on a daily basis. Provide a tabulation of all quantities for pay items and a description of all decisions made.

C. File all records and reports with the proper agencies required by federal, state, and local codes or regulations.

END OF SECTION 331113.36

SECTION 331113.49 – BIOREMEDIATION AMENDMENT INJECTION IN OVERBURDEN AND BEDROCK WELLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes amendment injections into overburden and bedrock injection wells configured as a bio-barrier to facilitate the injection of bioremediation and chemical reduction amendments to remediate chlorinated volatile organic compound (cVOC) contamination in overburden and bedrock groundwater.

B. Work includes but is not limited to overburden amendment injections at up to sixty-seven (67) deep overburden injection wells, ten (10) shallow overburden injection wells and twenty-nine (29) bedrock injection wells. The access route to the injection wells and staging area location is shown on Figure 1. The injection well locations are shown on Figure 2. Details of overburden well construction are provided on the attached Figures 5 and 6. Details of bedrock well construction are provided on the attached Figure 7. The boring and well construction logs for the existing overburden and bedrock wells are attached.

C. Related Requirements:

1. Section 331113.13 “Drilling and Well Installation”.
2. Section 331113.36 “Hydraulic Fracturing for Emplacement of Remediation Amendments in Bedrock Wells”.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: At a minimum, conduct a pre-construction meeting with the remediation Contractor after the bid is awarded.

1.4 ACTION SUBMITTALS

A. The Contractor shall submit a work plan for the overburden and bedrock well amendment injections including but not limited to materials to be used, material quantities, equipment, methods, documentation and reporting.

B. The Contractor shall submit detailed product data including safety data sheets (SDS) for amendment injection materials including but not limited to emulsified vegetable oil, sodium lactate, sodium bicarbonate and bioaugmentation culture.

C. The Contractor shall submit a draft report to the Engineer electronically within 45 business days after completion of the injection work, and shall include documentation of field activities, quantities of amendment injected, flow versus time plots and all other monitoring data. The Contractor shall incorporate any comments from the Engineer and provide a final report in hard copy and electronic file format within 10 business days after receipt of comments.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For remediation Contractor supervisor and remediation Contractor operator, include number of years of experience and the scope of three similar projects completed within the past five years.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that has completed three projects of similar scope and magnitude within the past five years and that employs installers and supervisors who are trained and experienced in remediation amendment injections of installed overburden and bedrock injection wells.

1.7 EXISTING CONDITIONS

A. Information regarding sub-surface conditions including the attached boring/well construction logs is intended to assist in establishing a price for the work. The Owner does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling of the wells.

B. Confirm all local conditions affecting the project work by personal investigation. No information on local geology, maps or plans, or information from the Owner or their agents or employees relieves any responsibility for fulfilling all terms and requirements of the Contract Documents.

C. Be advised and be aware of difficult conditions and problems that may be encountered during the amendment injection of the overburden and bedrock wells. Typical examples may include but are not limited to low permeability overburden materials and low transmissivity fractures which may affect injection rates. Take these and other pertinent factors into consideration in planning and executing the work. There will be no additional compensation for unforeseen conditions.

PART 2 - PRODUCTS

2.1 WATER SUPPLY

A. The Contractor shall be responsible for determining a source of water supply and transport subject to the Engineer’s approval, at no additional cost to the Owner. Obtain, transport, and/or haul water for amendment batch mixing as required for well amendment injections and dust control (if needed). Transport the water from the point of supply and supply appurtenances needed for connection to the water supply. A fire hydrant exists at the entrance to the site, however flow and pressure at the hydrant are not known. A hydrant use permit must be obtained through the City of Worcester if the hydrant is used as a water supply source. In any case, use only potable water for

mixing amendments. Provide, install, and maintain, water-supply connections, necessary pumps, piping, and piping road crossings for construction use. Upon completion, all temporary connections and piping installed shall be removed.

2.2 REMEDIATION AMENDMENTS

A. The remediation amendments to be emplaced during overburden well amendment injections shall include emulsified vegetable oil, sodium lactate, sodium bicarbonate, and bioaugmentation culture. The remediation amendments to be emplaced during bedrock well amendment injections shall include sodium lactate, sodium bicarbonate and bioaugmentation culture. The Contractor is responsible for procuring, receiving, handling, and storing all materials, including the remediation amendments. The Contractor is responsible for securing and protecting equipment and supplies from vandalism during non-working hours. All items shall be brought to the site clean and in like new condition and kept clean and in satisfactory condition throughout the duration of the contract. Damaged materials, torn bags, etc., shall be replaced as directed by the Engineer.

2.3 REMEDIATION AMENDMENT INJECTION EQUIPMENT

A. Provide an injection manifold unit with piping, connections, mixing tanks, pumps capable of safely and efficiently mixing and delivering amendment solutions containing emulsified vegetable oil, sodium lactate, sodium bicarbonate and bioaugmentation culture. The injection manifold unit shall be capable of injecting amendment up to twenty (20) overburden wells simultaneously and up to two (2) bedrock wells simultaneously. All equipment shall be resistant to emulsified vegetable oil, sodium lactate, sodium bicarbonate and all other materials planned to be used.

B. Provide a minimum five thousand (5,000) gallon mixing tank and amendment batch mixing and injection equipment including but not limited to circulation pumps, drum pumps, connection hoses, totalizing flowmeters, proportional flow/in-line mixers, well head attachments, flow control valves and pressure gauges.

C. Provide drill rig or hoist rig for lowering/handling inflatable packers (as needed) into the bedrock borehole for the purpose of sealing off the bedrock borehole during amendment injections.

D. The Contractor shall provide inflatable packers suitable for conducting amendment injections into the bedrock boreholes. Provide appropriate size inflatable packers to fit inside a 3.785-inch diameter open bedrock borehole. Note that the steel casing grouted into the bedrock is 4.0-inch inside diameter. Provide more than one packer assembly such that one can be left in place at a previous borehole while injection pressure dissipates, and a second packer assembly can be used at a subsequent bedrock borehole.

E. Provide general supporting equipment including injection trailer, amendment mixing tanks, generators, hoses (transport amendment from the injection manifold to the individual injection wells) and miscellaneous fittings (connect the various manifold components, hoses, wellheads).

F. Provide auxiliary vehicles (pickup truck, skid steer, flatbed trucks, crane, etc.) as necessary for hauling tools, maintaining equipment, decontamination, or retrieving supplies.

G. Provide amendment handling equipment required to unload, transport, handle, and mix all amendments and material.

PART 3 - EXECUTION

3.1 GENERAL

A. Obtain necessary local, state, and agency permits associated with amendment injections. Contractor to follow the Order of Conditions (attached) from the City of Worcester Conservation Commission for the Greenwood St. Landfill project (CC-2022-061 & DEP#349-1334) for conducting environmental remediation construction work within the wetland resource areas.

B. The Contractor shall provide all remedial amendments, water, as well as all other chemicals/additives required for development of amendment solutions to deliver remedial amendments into the overburden and bedrock injection wells. The Contractor shall stage all injection materials near the injection points or at a location approved by the Engineer.

C. During the course of the work, keep the site of the operation in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of work, remove and haul away any surplus excavation, equipment, temporary structures, and any other refuse remaining from the injection operations and shall leave the entire site of the work in a neat and orderly condition.

D. Contractor shall temporarily containerize all fluids, personal protective equipment (PPE), and other disposable sampling equipment and will dispose of these materials as directed by the Engineer. All efforts should be made to minimize the quantity of unused amendment slurry water. If any is leftover, it should be containerized in either 55-gallon drums or 5-gallon buckets and be re-used.

E. Contractor shall be solely responsible for site security and equipment. Take reasonable precautions to protect the ground surface, grading, and other existing site features at each work location and restore any damage to its original condition upon completion of the work.

F. Protect all equipment, parts, and materials against damage during a prolonged period at the site. Remove any equipment, parts, or materials damaged or deemed unacceptable by the Engineer from the site and replace with new equipment, parts, or materials at no additional cost. All equipment, parts, and materials shall be clean and free of oils, grease, and other foreign substances prior to being used and as approved by the Engineer.

G. Use only thread lubricant/pipe dope especially formulated for environmental remediation activities or other material approved by the Engineer. All materials used for amendment injections shall be free of ingredients that could introduce hydrocarbon contamination or any other contaminants including per- and polyfluoroalkyl substances (PFAS).

3.2 OVERBURDEN AMENDMENT INJECTIONS

A. Contractor shall provide all remedial injection amendments including emulsified vegetable oil, sodium lactate, sodium bicarbonate, bioaugmentation culture, potable water, as well as all other chemicals/additives required to deliver remedial amendments into the overburden injection wells.

B. Contractor to transport equipment, materials, supplies, and personnel to the site. The Contractor shall stage all injection materials near the injection points or at a location approved by the Engineer. The access route to the overburden injection wells, staging area, hydrant location, etc. is shown on Figure 1. The overburden amendment injection well locations are shown on Figure 2.

C. Create amendment solution by preparing the remediation amendment mixture. An amendment mixture containing a total injection volume per well of approximately 1,250 gallons including emulsified vegetable oil at approximately 12.5 gallons, sodium lactate at 35 gallons, sodium bicarbonate at 53 pounds, bioaugmentation culture at 3 liters, and approximately 1,203 gallons of potable water is anticipated to be used at each single overburden injection well location. The target amendment concentrations and volumes are provided in Table 2. The actual composition of the amendment mixture will be determined upon procurement of amendment materials.

D. Perform injections by mixing and injecting discrete batches. Fill mixing tank with potable makeup water. Prepare and inject bioaugmentation culture in a manner than prevents exposure to oxygen and aerobic makeup water. Clearly label each well and hosing line with the corresponding injection well identification. Open injection well casings and well gripper plugs as needed and connect hoses/fittings from manifold to all injection wells planned for simultaneous injection.

E. Stagger well injections to avoid injecting immediately adjacent wells (if a limited number of wells are targeted for injection, then simultaneous injection in nearby wells can be permitted for efficiency).

F. Perform injections by mixing and injecting discrete batches as identified below:

1. Add appropriate amount of amendment to the tank of potable makeup water and mix thoroughly to create desired concentration and volume of amendment (See Table 2).
2. Slowly turn on each injection line to allow purging of air out of the well casing by initially injecting water only.
3. Once wells intended for injection are purged, manually record initial totalizer reading using the injection logging sheet.
4. Use a field sheet to record totalizer values prior to transferring data into computer as a cautionary step.
5. Begin injecting amendment from the tank with amendment mixture that was prepared above.
6. Check hoses/assemblies/fittings for leaks and address them appropriately;
7. Adjust actual dosing of amendment as necessary once injections are underway and can be measured.

G. The target pressure for overburden injections will range from two (2) to four (4) pounds per square inch (psi). The target injection rates for overburden injections will range from two (2) to four (4) gallons per minute (gpm). The final overburden injection pressure ranges (psi) and flow rate (gpm) may slightly differ at each overburden injection well and will be determined by the

Engineer during injections. If injection flowrates are less than 1.0 gpm, which would make it impractical to achieve the target volumes in Table 2, inject as much amendment as possible in two days at a given injection well. Report the actual volume achieved to Engineer. Inject additional amendment above the target volume in surrounding wells as appropriate to compensate for wells that receive less than the target volume.

H. Inject into each well until target injection volumes are achieved. Notify Engineer immediately if target volumes cannot be achieved. Carefully monitor the ground surface area around each injection well and watch for surfacing of amendment. If significant amendment surfacing occurs at the wellhead, the injection will immediately stop, and the system will be depressurized. Any surface amendment will be contained and re-used. The injection system connections will be mobilized to the next injection well to continue overburden amendment injections other than the one where surfacing occurred.

I. Record time, flow rate, individual well and cumulative total flow, manifold and individual well pressure, and any qualitative observations for wells being injected on an Injection Flow Measurement Form provided by the Engineer (see attached) approximately every 10 minutes and during significant changes.

J. Record time, volume remaining in amendment/substrate tote/tank, cumulative flow total, and any qualitative observations on an Amendment Tracking Sheet provided by the Engineer (see attached) approximately every 10 minutes and during significant changes. Calculate dosage based on volume of substrate consumed and verify that proportional flow/inline mixer is operating at the desired set point (as appropriate).

K. Perform bioaugmentation during amendment injection in accordance with vendor recommendations. Ensure bioaugmentation culture is not exposed to oxygen or aerobic makeup water.

L. To clean out injection hoses and injection well screen to avoid fouling, flush approximately fifty (50) gallons of potable make-up water into each injection well after target amendment volume has been injected.

M. At the end of each day after final readings have been recorded, stop injecting amendment and flush injection lines with water for 25-30 minutes. Once water flushing is completed, turn off valve upstream of injection lines and allow injection lines to depressurize.

N. Pack up injection equipment as applicable. If injection is occurring in a secure location, equipment can be left in place overnight. If injection is occurring in an unsecured area, pack equipment and secure each evening before leaving site.

O. Field conditions may influence completion of amendment injection, and the Engineer reserves the right to modify the number of injection wells, total volume of amendment slurry to be injected at each well and final pressure and flow rates.

3.3 BEDROCK AMENDMENT INJECTIONS

A. Contractor shall provide all remedial injection amendments including sodium lactate, sodium bicarbonate, bioaugmentation culture, potable water, as well as all other chemicals/additives required to deliver remedial amendments into the bedrock borehole injection wells (note that no emulsified vegetable oil is included in the bedrock amendment formulation).

B. Contractor to transport equipment, materials, supplies, and personnel to the site. The Contractor shall stage all injection materials near the injection points or at a location approved by the Engineer. The access route to the bedrock injection wells, staging area, hydrant location, etc. is shown on Figure 1. The bedrock amendment injection well locations are shown on Figure 2.

C. Deploy an inflatable single packer and associated tooling to target depths within the steel casing above the open bedrock portion of the borehole (depths will be provided by Engineer prior to mobilization). Provide more than one inflatable packer such that one can be left in place at a previous bedrock borehole well while in-situ bedrock amendment injection pressure dissipates, and a second packer assembly can be used at a subsequent bedrock borehole.

D. Create amendment solution by preparing the remediation amendment mixture. An amendment mixture containing a total injection volume per well of approximately 1,000 gallons including sodium lactate at approximately 40 gallons, sodium bicarbonate at 40 pounds, bioaugmentation culture at 6 liters, and approximately 960 gallons of potable water is anticipated to be used at each single bedrock injection well location. The target amendment concentrations and volumes are provided in Table 3. The actual composition of the amendment mixture will be determined upon procurement of amendment materials.

E. Perform injections by mixing and injecting discrete batches. Fill mixing tank with potable makeup water. Prepare and inject bioaugmentation culture in a manner than prevents exposure to oxygen and aerobic makeup water. Clearly label each well and hosing line with the corresponding injection well identification. Open injection well casings and well gripper plugs as needed and connect hoses/fittings from manifold to all injection wells planned for simultaneous injection.

F. Stagger well injections to avoid injecting immediately adjacent wells (if a limited number of wells are targeted for injection, then simultaneous injection in nearby wells can be permitted for efficiency).

G. Perform injections by mixing and injecting discrete batches as identified below:

1. Add appropriate amount of amendment to the tank of potable makeup water and mix thoroughly to create desired concentration and volume of amendment (See Table 3).
2. Slowly turn on each injection line to allow purging of air out of the well casing by initially injecting water only.
3. Once wells intended for injection are purged, manually record initial totalizer reading using the injection logging sheet.
4. Use a field sheet to record totalizer values prior to transferring data into computer as a cautionary step.
5. Begin injecting amendment from the tank with amendment mixture that was prepared above.

6. Check hoses/assemblies/fittings/inflatable packers for leaks and address them appropriately.
7. Adjust actual dosing of amendment as necessary once injections are underway and can be measured.

H. The target pressure for bedrock injections will range from ten (10) to thirty (30) pounds per square inch (psi). The target injection rates for bedrock injections will range from two (2) to ten (10) gallons per minute (gpm). The final bedrock injection pressure ranges (psi) and flow rate (gpm) may slightly differ at each bedrock injection well and will be determined by the Engineer during injections. If injection flowrates are less than 1.0 gpm, which would make it impractical to achieve the target volumes in Table 3, inject as much amendment as possible in two days at a given injection well. Report the actual volume achieved to Engineer. Inject additional amendment above the target volume in surrounding wells as appropriate to compensate for wells that receive less than the target volume.

I. Inject into each well until target injection volumes are achieved. Notify Engineer immediately if target volumes cannot be achieved. Carefully monitor the ground surface area around each injection well and watch for surfacing of amendment. If significant amendment surfacing occurs at the wellhead, the injection will immediately stop, and the system will be depressurized. Any surface amendment will be contained and re-used. The injection system connections will be mobilized to the next injection well to continue bedrock amendment injections other than the one where surfacing occurred.

J. Record time, flow rate, individual well and cumulative total flow, manifold and individual well pressure, packer system pressure, and any qualitative observations for wells being injected on an Injection Flow Measurement Form provided by the Engineer (see attached) approximately every 10 minutes and during significant changes.

K. Record time, volume remaining in amendment/substrate tote/tank, cumulative flow total, and any qualitative observations on an Amendment Tracking Sheet provided by the Engineer (see attached) approximately every 10 minutes and during significant changes. Calculate dosage based on volume of substrate consumed and verify that proportional flow/inline mixer is operating at the desired set point (as appropriate).

L. Perform bioaugmentation during amendment injection in accordance with vendor recommendations. Ensure bioaugmentation culture is not exposed to oxygen or aerobic makeup water.

M. To clean out injection hoses and injection wells to avoid fouling, flush approximately fifty (50) gallons of potable make-up water into each injection well after target amendment volume has been injected.

N. At the end of each day after final readings have been recorded, stop injecting amendment and flush injection lines with water for 25-30 minutes. Once water flushing is completed, turn off valve upstream of injection lines and allow injection lines to depressurize.

O. Pack up injection equipment as applicable. If injection is occurring in a secure location, equipment can be left in place overnight. If injection is occurring in an unsecured area, pack equipment and secure each evening before leaving site.

P. Field conditions may influence completion of amendment injection, and the Engineer reserves the right to modify the number of injection wells, total volume of amendment slurry to be injected at each well and final pressure and flow rates.

Q. RECORD KEEPING

A. Provide daily reports to the Engineer describing the activities performed at each overburden injection well during the reference period. Daily reports shall include the following information:

1. Weather conditions.
2. Workers names.
3. Reference point for depth measurements.
4. The amendment type(s) and amount pumped (lbs).
5. The amount of amendment pumped (gal).
6. The amount of potable water used (gal).
7. The amendment concentration (mg/L or percent).
8. The type and quantity of any loss (gal).
9. Pressure data: peak, average (psi).
10. Flow data: peak, average(gal/min).

B. Submit one copy of each daily log to the Engineer on a daily basis. Provide a tabulation of all quantities for pay items and a description of all decisions made.

C. File all records and reports with the proper agencies required by federal, state, and local codes or regulations.

END OF SECTION 331113.49

Greenwood St Landfill
Daily Injection Well Flow Measurement Form

Injection Well =

Date	Time (start)	Time (end)	Injection Time	Individual Flow Meter Reading (start)	Individual Flow Meter Reading (end)	Injected Volume in Interval	Average Injection Rate	Manifold Pressure	Wellhead Pressure	Comments	Cumulative Donor Solution for the Day	Cumulative Donor Solution ITD
--	Military	Military	(min)	(gal)	(gal)	(gal)	(gpm)	(psi)	(psi)	--	(gal)	(gal)

Greenwood St Landfill
Amendment Tracking Sheet

Date	Time	Total Inches of Amendment Used from Tote	Incremental Inches of Amendment Used from Tote	Total Gallons of Amendment Used from Tote	Incremental Gallons of Amendment Used from Tote	Solution Totalizer Reading (gal)	Average Injection Rate (gpm)	Current Amendment Dose Rate (Approximate)	Running Average Amendment Dose Rate (Approximate)	Comments (i.e., switched to next tote, visual observations)

Figures

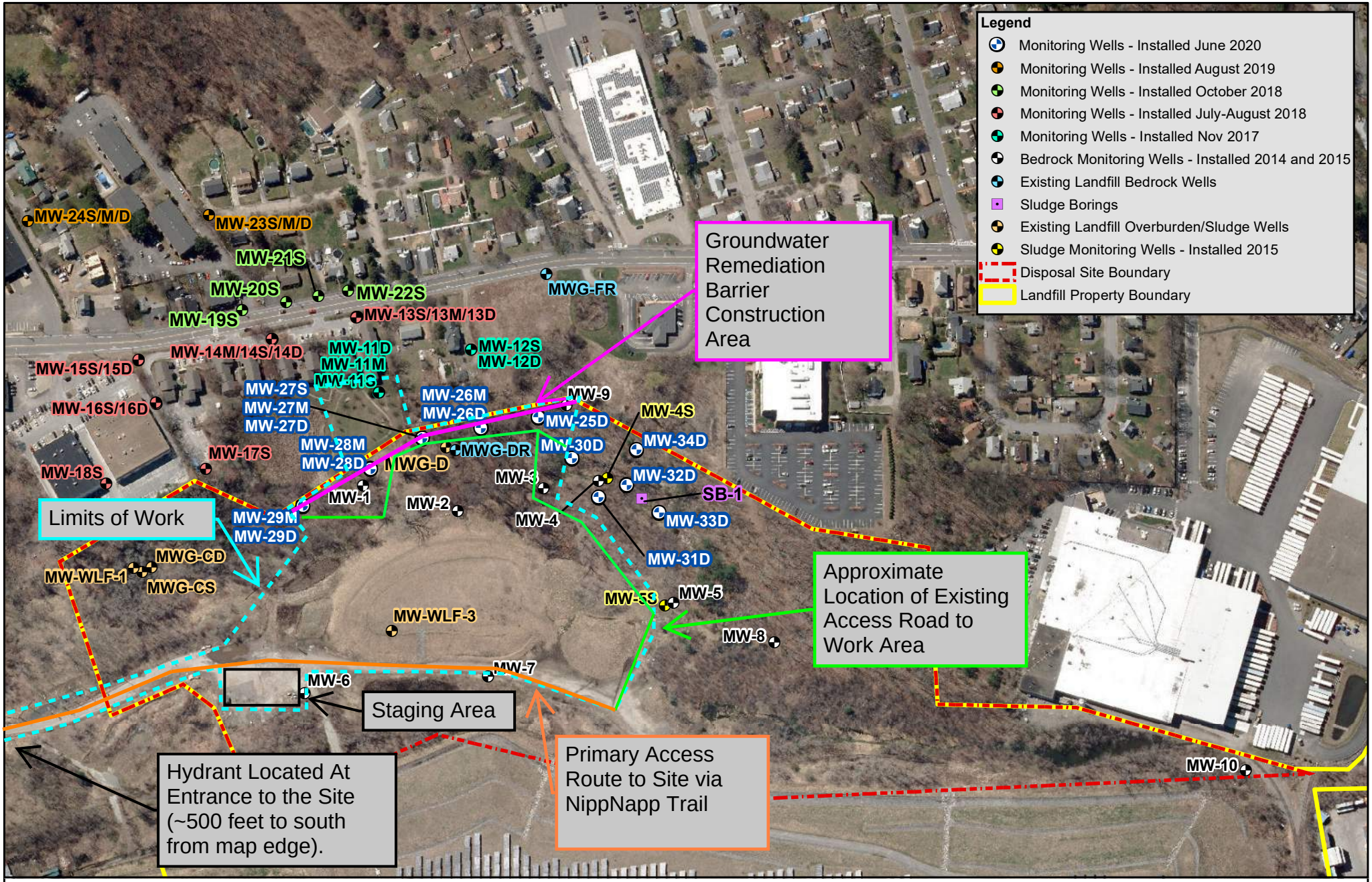


Figure 1- Site Overview Plan
Greenwood Street Landfill
Worcester, Massachusetts

CDM Smith

NEWELLJD F:\Greenwood_MA\Greenwood_Sept_2020.mxd 12/15/2020

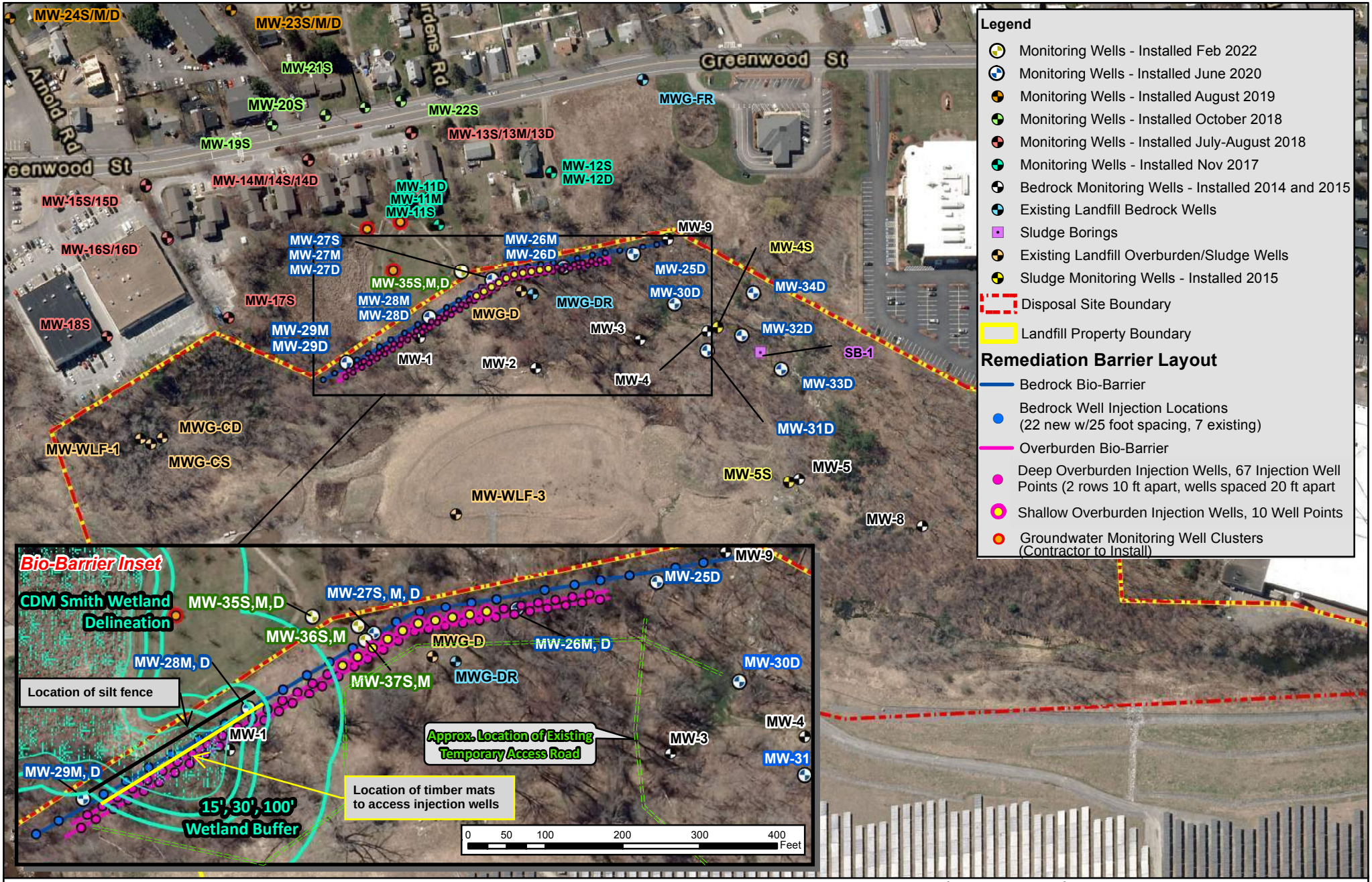


Figure 2 - Groundwater Remediation Barrier Construction Layout
Greenwood Street Landfill
Worcester, Massachusetts

Worcester, MA

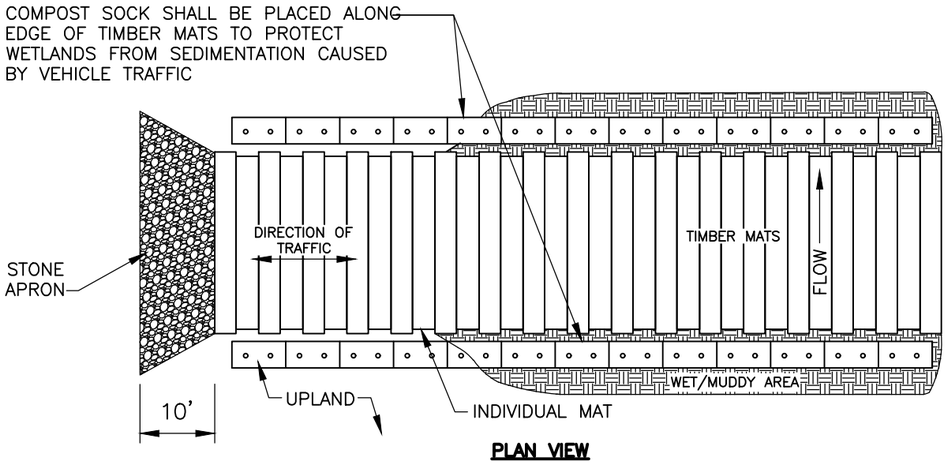
N

1 inch = 333 feet

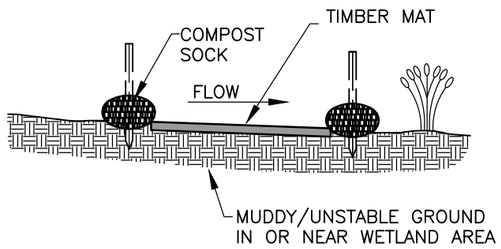
0 175 350 700
Feet

CDM Smith

MCCAFFREYZC P:\Worcester\GreenwoodSt_Landfill\MXD\Greenwood_Remediation_Barrier_with2.mxd 9/26/2022



PLAN VIEW



ELEVATION VIEW

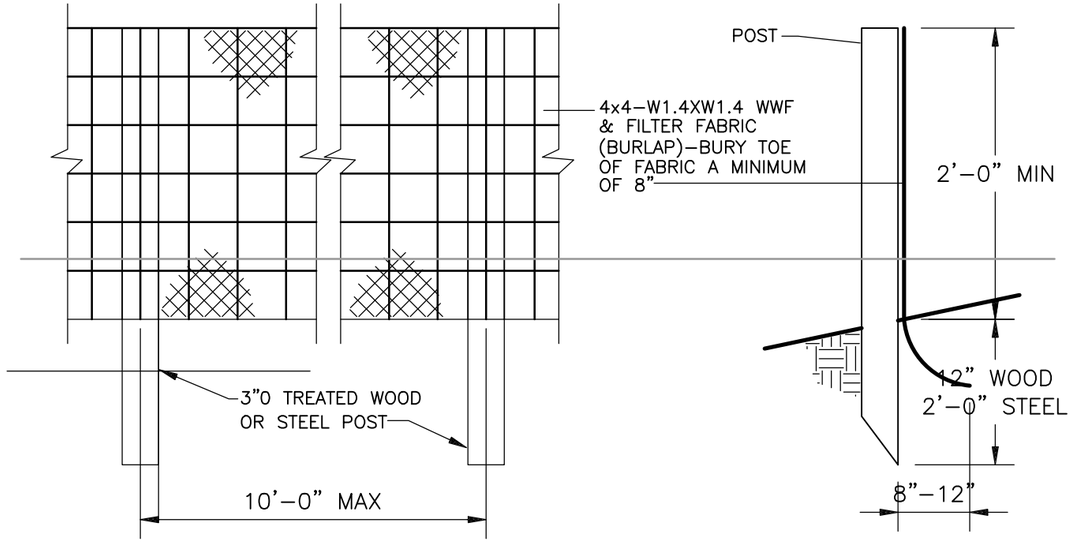
NOTES:

1. PLACE TIMBER MATS SO PLANKS ARE PERPENDICULAR TO DIRECTION OF TRAFFIC.
2. REMOVE SEDIMENT DEPOSITS ALONG EDGES OF MATS ON A REGULAR BASIS.
3. LENGTH OF MAT VARIES. SEE SHEETS C–7 THROUGH C–9 FOR LENGTHS.
4. WIDTH VARIES BY MULTIPLES OF 4–FT. TYPICAL WIDTH IS 12–FT.
5. SOURCE: USACE – NEW ENGLAND DISTRICT, NE GP PERMIT RESOURCES, CONSTRUCTION MAT BMP'S – 6/10/13 DRAFT.

TIMBER MAT

DETAIL 2

NOT TO SCALE –

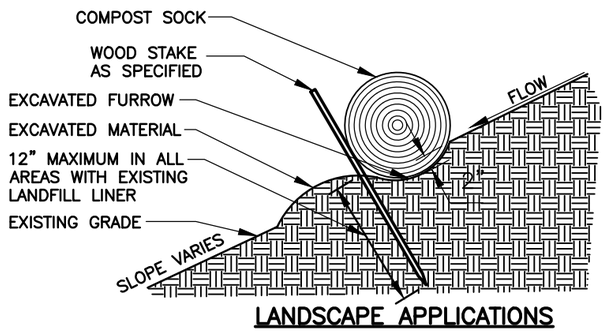


ELEVATION **SECTION**

SILT FENCE

DETAIL 1

SCALE: NTS



LANDSCAPE APPLICATIONS

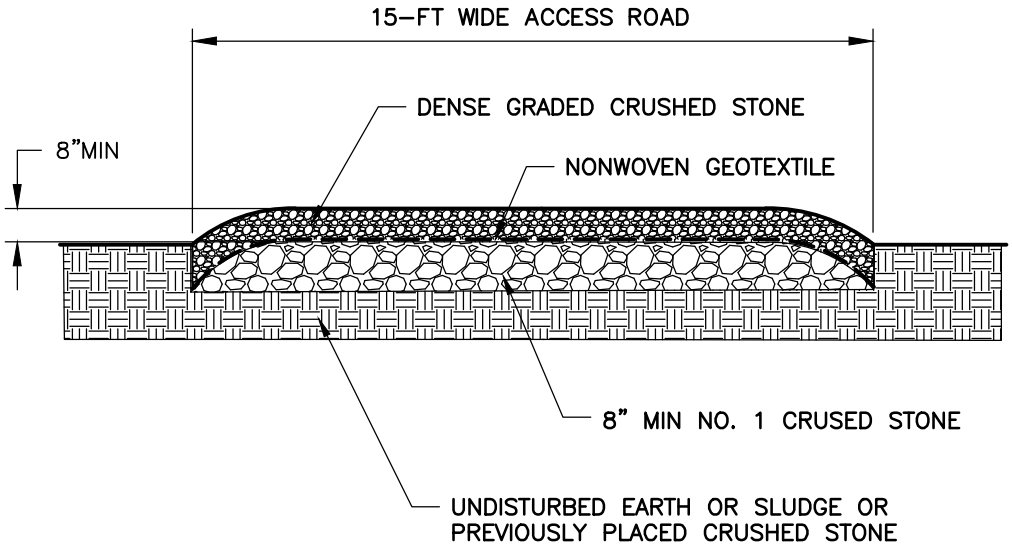
COMPOST SOCK

DETAIL 3

SCALE: NTS

CDM Smith

Figure 3 - Erosion Control Details
Greenwood Street Landfill
Worcester, MA
SPETEMBER 2022



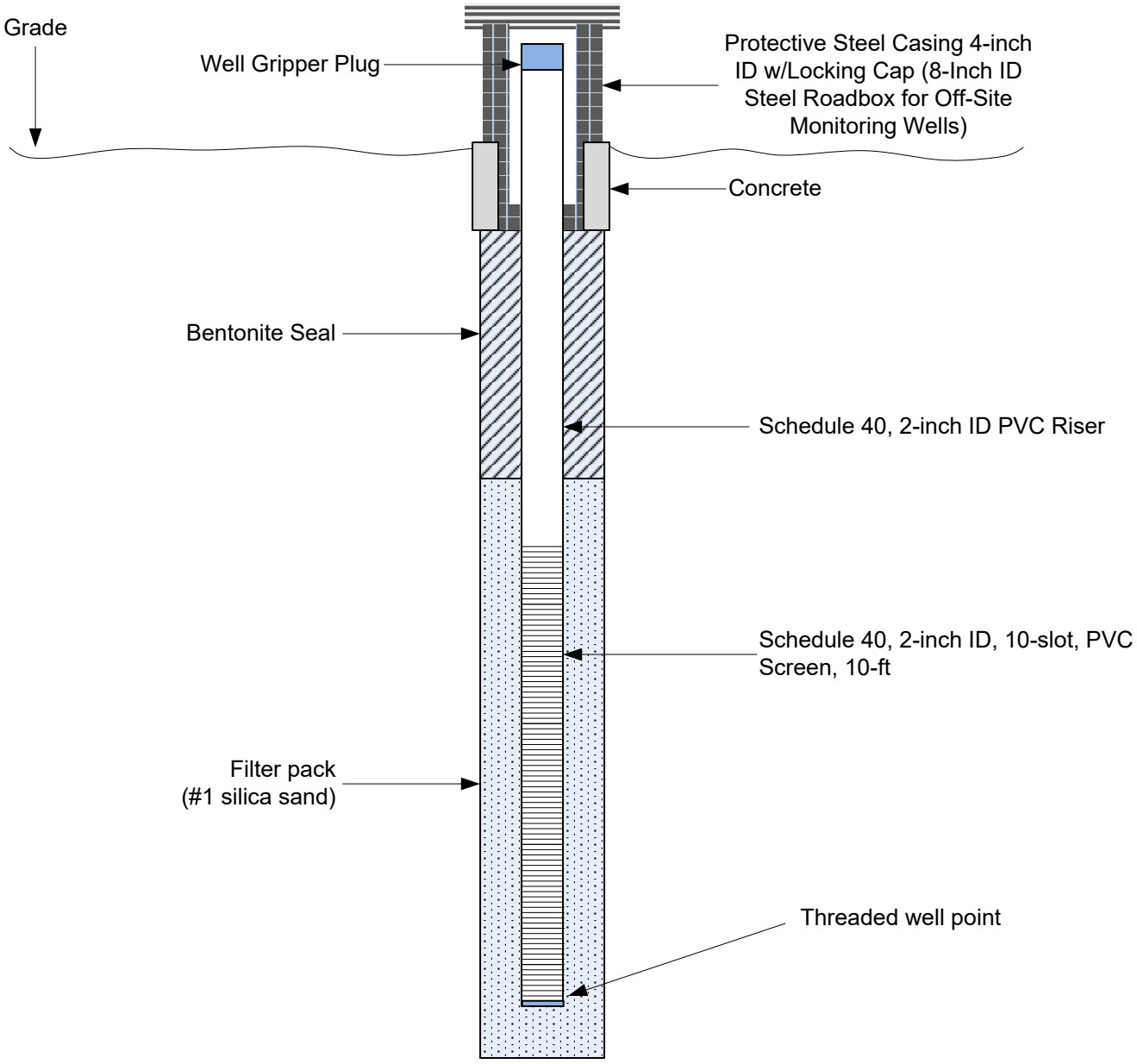
ACCESS ROAD IMPROVEMENTS

DETAIL 1/–

NOT TO SCALE

CDM Smith

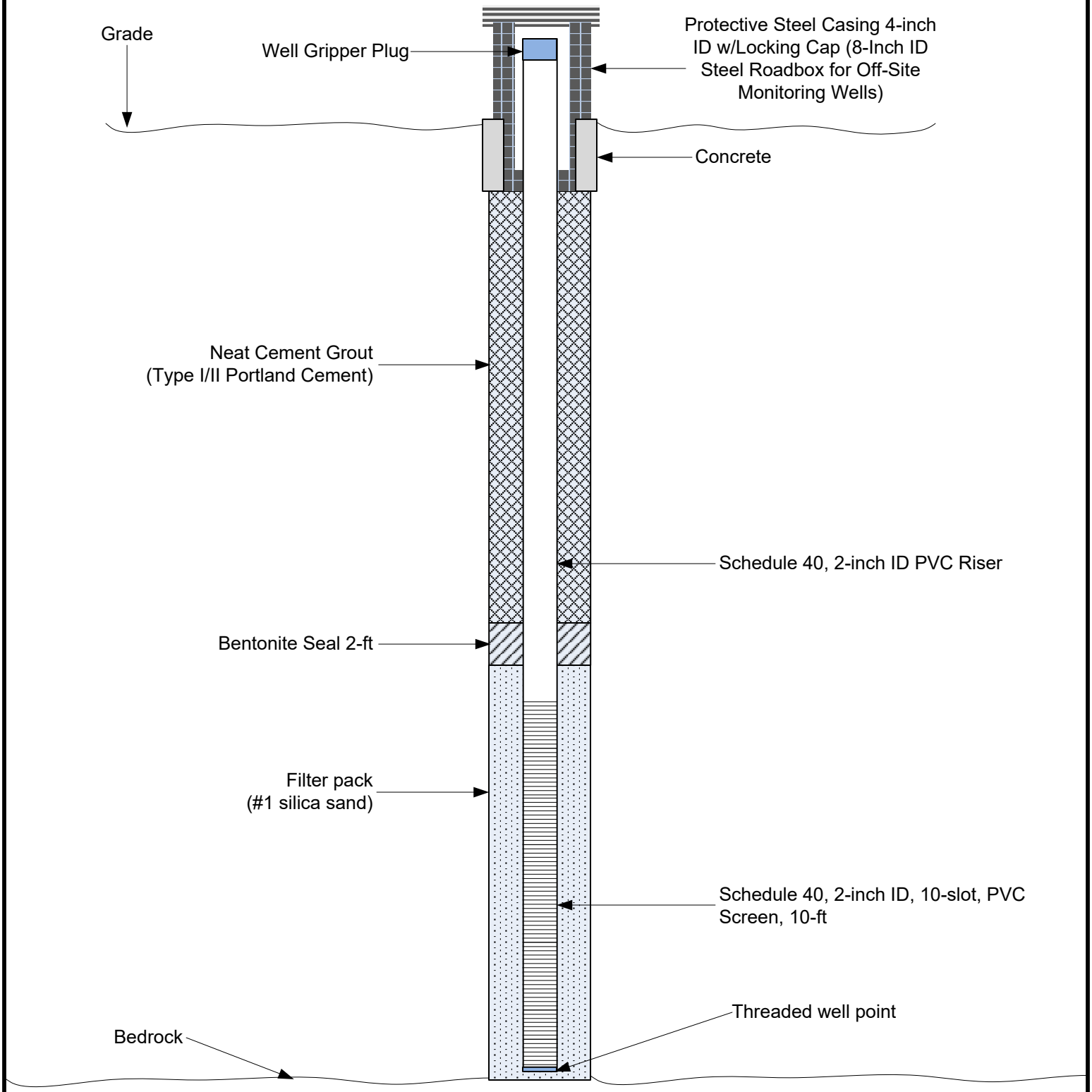
Figure 4 - Access Road Improvements Detail
Greenwood Street Landfill
Worcester, MA
SPETEMBER 2022



CDM Smith Inc.
75 State Street
Suite 701
Boston, MA 02109

Full-Scale *In-Situ* Groundwater Remediation Barrier Design
Greenwood St Landfill
Worcester, Massachusetts

Figure 5
Shallow Overburden Injection and Monitoring Well Construction Diagram
(not to scale)



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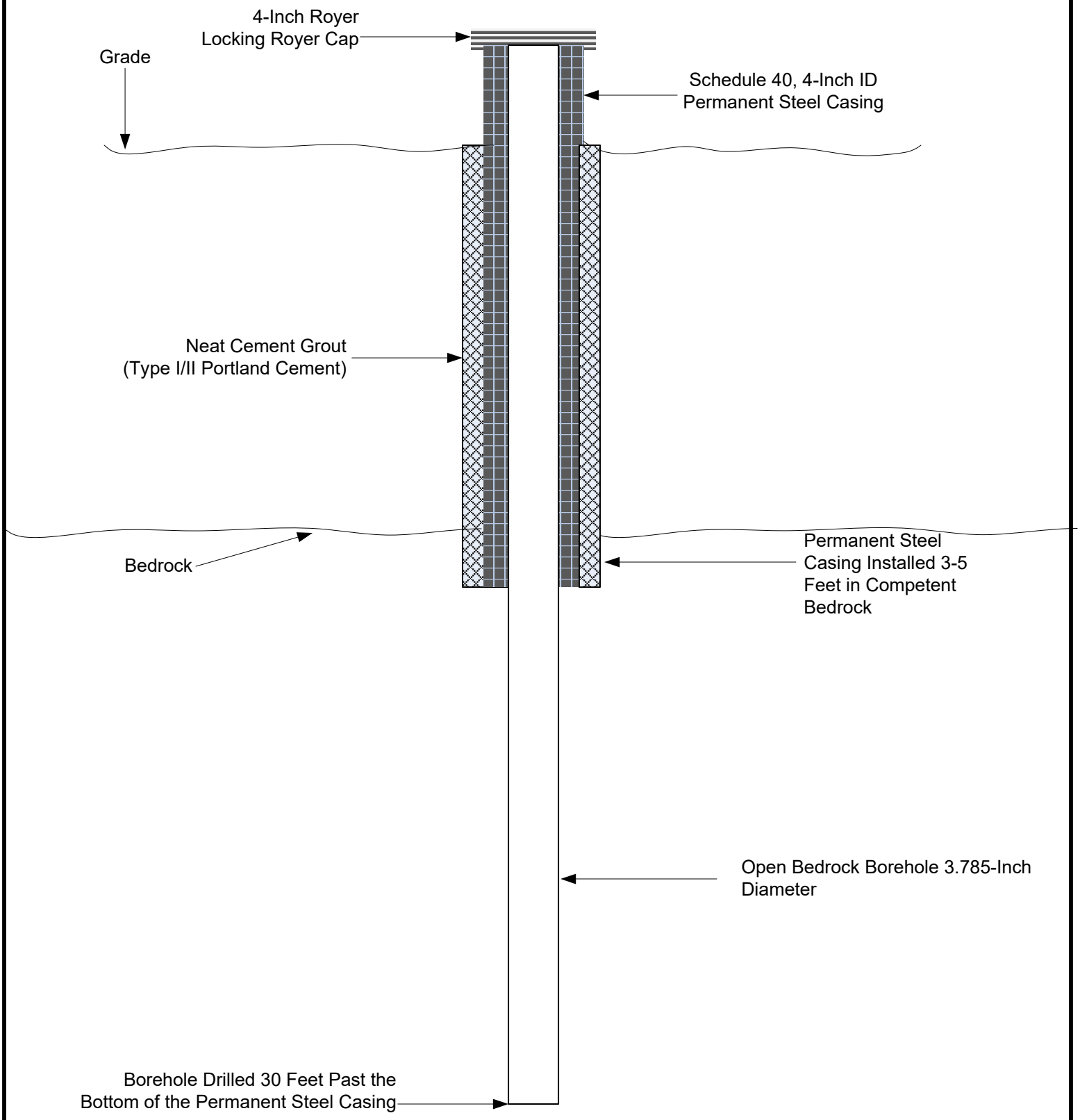
Full-Scale *In-Situ* Groundwater Remediation Barrier Design
Greenwood St Landfill
Worcester, Massachusetts

Figure 6
Deep Overburden Injection and Monitoring Well Construction Diagram
(not to scale)



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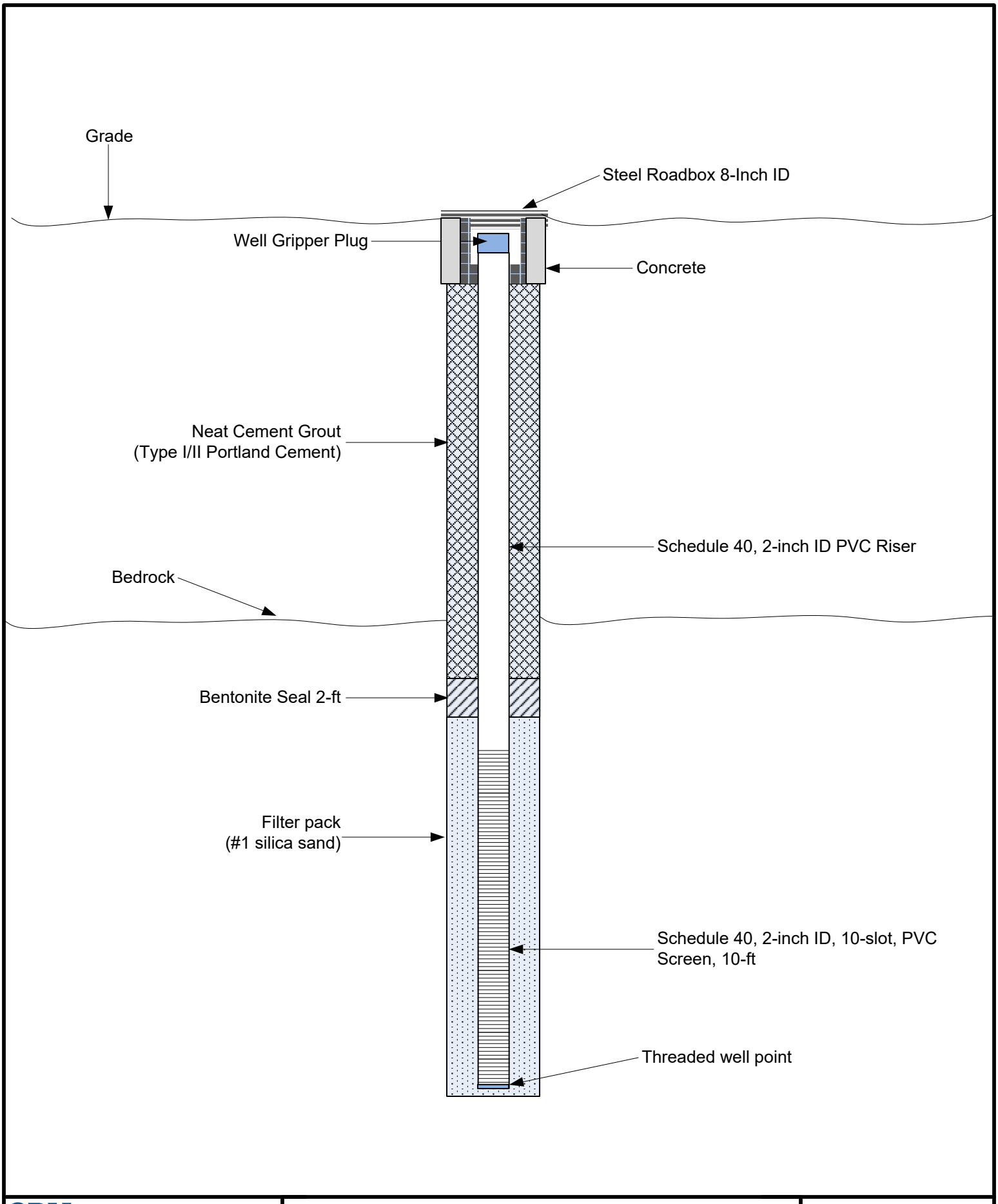
Full-Scale *In-Situ* Groundwater Remediation Barrier Design
Greenwood St Landfill
Worcester, Massachusetts

Figure 7
Bedrock Injection Well Construction Diagram
(not to scale)



CDM Smith Inc.
75 State Street
Suite 701
Boston, MA 02109

Full-Scale *In-Situ* Groundwater Remediation Barrier Design
Greenwood St Landfill
Worcester, Massachusetts

Figure 8
Bedrock Monitoring Well Construction Diagram
(not to scale)

Tables

Table 1 - Bedrock Hydraulic Fracturing and Amendment Injection Details

Parameter - Bedrock Injection Wells	Value	Unit
Assumed fracturing radius of influence	15	ft
Number of fractured boreholes	26	fractures
Number of fracture intervals per borehole	3	fracture intervals/borehole
Total fractures	78	fractures
Total injection volume	19,656	gal
Mass of ZVI to be injected	69,342	lbs
ZVI mass loading	3.5	lbs/gal
Mass of sand to be injected	69,342	lbs
Sand mass loading	3.5	lbs/gal
Mass of EVO to be injected	1,950	lbs
Parameter - per Bedrock Borehole Fracture	**Value**	**Unit**
Injection volume per fracture	252	gal
ZVI per fracture	889	lbs
Sand per fracture	889	lbs
EVO per fracture*	168	lbs

*168 lbs of EVO = 25 gal EVO

Table 2 - Overburden Amendment Injection Details

Parameter - Overburden Injection Wells	Value	Unit
Assumed injection radius of influence	6	ft
Assumed Injection thickness	10	ft
Injection concentration	30,000	mg/L
Emulsified Vegetable Oil concentration	9,000	mg/L
Sodium Lactate injection concentration	21,000	mg/L
Total injection volume per well	1,250	gal
Number of injection wells	77	wells
Total injection volume (77 wells)	96,250	gal
Total amount of stock emulsified vegetable oil (77 wells)*	7,469	lbs
Total amount of 60% stock sodium lactate solution (77 wells)	28,567	lbs
Total amount of sodium bicarbonate	4,081	lbs
Total amount of bioaugmentation culture	231	L
Parameter - per Overburden Injection Well	**Value**	**Unit**
Injection volume per well	1250	gal
EVO mass - stock solution*	97	lbs
EVO volume - stock solution*	12.5	gal
Sodium Lactate mass - 60% stock solution	371	lbs
Sodium Lactate volume - 60% stock solution	35	gal
Sodium bicarbonate	53	lbs
Bioaugmentation culture	3	L

*Assumes 98% fermentable carbon, adjust as appropriate.

Table 3 - Bedrock Amendment Injection Details

Parameter - Bedrock Injection Wells	Value	Unit
Sodium Lactate injection concentration	30,000	mg/L
Total injection volume per bedrock borehole	1,000	gal
Number of bedrock borehole injection wells	29	wells
Total injection volume	29,000	gal
Total amount of 60% stock sodium lactate solution (29 wells)	12,147	lbs
Total amount of sodium bicarbonate	1,160	lbs
Total amount of bioaugmentation culture	174	L
Parameter - per Bedrock Borehole Injection Well	**Value**	**Unit**
Injection volume per well	1000	gal
Sodium Lactate mass - 60% solution	419	lbs
Sodium Lactate volume - 60% solution	40	gal
Sodium bicarbonate	40	lbs
Bioaugmentation culture	6	L

Appendix A

City of Worcester Conservation Commission
Order of Conditions and Notice of Intent

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP: 349-1334
MassDEP File #

eDEP Transaction #

Worcester
City/Town

A. General Information

Please note: this form has been modified with added space to accommodate the Registry of Deeds Requirements

1. From: City of Worcester
Conservation Commission

2. This issuance is for (check one): a. ☒ Order of Conditions b. ☐ Amended Order of Conditions

3. To: Applicant:

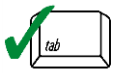
a. First Name | b. Last Name

City of Worcester Department of Public Works & Parks
c. Organization

20 East Worcester Street
d. Mailing Address

Worcester | MA | 01604
e. City/Town | f. State | g. Zip Code

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



4. Property Owner (if different from applicant):

a. First Name | b. Last Name

c. Organization

d. Mailing Address

e. City/Town | f. State | g. Zip Code

5. Project Location:

0 Greenwood Street | Worcester
a. Street Address | b. City/Town

29-047 | -00006
c. Assessors Map/Plat Number | d. Parcel/Lot Number

Latitude and Longitude, if known: 42d 13m 52.8s N (d. Latitude) | 71d 47m 37.35s W (e. Longitude)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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A. General Information (cont.)

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Worcester
a. County

b. Certificate Number (if registered land)

c. Book

d. Page

7. Dates: 8/10/2022 (a. Date Notice of Intent Filed) 8/29/2022 (b. Date Public Hearing Closed) 9/15/2022 (c. Date of Issuance)

8. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Greenwood Street Landfill: Existing Conditions / Proposed Groundwater Injection Wells
a. Plan Title

CDM Smith
b. Prepared By

n/a
c. Signed and Stamped by

6/29/2022
d. Final Revision Date

1”=100’ & 1”=270’
e. Scale

NOI Application Materials
f. Additional Plan or Document Title

August 2022
g. Date

B. Findings

1. Findings pursuant to the Massachusetts Wetlands Protection Act:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act (the Act). Check all that apply:

a. ☒ Public Water Supply
b. ☐ Land Containing Shellfish
c. ☒ Prevention of Pollution
d. ☒ Private Water Supply
e. ☒ Fisheries
f. ☒ Protection of Wildlife Habitat
g. ☒ Groundwater Supply
h. ☒ Storm Damage Prevention
i. ☒ Flood Control

2. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

a. ☒ the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

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B. Findings (cont.)

Denied because:

b. ☐ the proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Act, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

c. ☐ the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Act's interests, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).**

3. ☐ **Buffer Zone Impacts:** Shortest distance between limit of project disturbance and the wetland resource area specified in 310 CMR 10.02(1)(a) _____ a. linear feet

Inland Resource Area Impacts: Check all that apply below. (For Approvals Only)

Resource Area	Proposed Alteration **(Temporary)**	Permitted Alteration **(Temporary)**	Proposed Replacement	Permitted Replacement
4. ☐ Bank	a. linear feet	b. linear feet	c. linear feet	d. linear feet
5. ☒ Bordering Vegetated Wetland	3,560 a. square feet	3,560 b. square feet	3,560 c. square feet	3,560 d. square feet
6. ☐ Land Under Waterbodies and Waterways	a. square feet	b. square feet	c. square feet	d. square feet
	e. c/y dredged	f. c/y dredged		
7. ☐ Bordering Land Subject to Flooding	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
8. ☐ Isolated Land Subject to Flooding	a. square feet	b. square feet		
Cubic Feet Flood Storage	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
9. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		

Massachusetts Department of Environmental Protection
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B. Findings (cont.)

Coastal Resource Area Impacts: Check all that apply below. (For Approvals Only)

	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
10. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below			
11. ☐ Land Under the Ocean	a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
12. ☐ Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
13. ☐ Coastal Beaches	a. square feet	b. square feet	c. nourishment cu yd	d. nourishment cu yd
14. ☐ Coastal Dunes	a. square feet	b. square feet	c. nourishment cu yd	d. nourishment cu yd
15. ☐ Coastal Banks	a. linear feet	b. linear feet		
16. ☐ Rocky Intertidal Shores	a. square feet	b. square feet		
17. ☐ Salt Marshes	a. square feet	b. square feet	c. square feet	d. square feet
18. ☐ Land Under Salt Ponds	a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
19. ☐ Land Containing Shellfish	a. square feet	b. square feet	c. square feet	d. square feet
20. ☐ Fish Runs	Indicate size under Coastal Banks, Inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
	a. c/y dredged	b. c/y dredged		
21. ☐ Land Subject to Coastal Storm Flowage	a. square feet	b. square feet		
22. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

Massachusetts Department of Environmental Protection
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B. Findings (cont.)

*** #23**. If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c (BVW) or B.17.c (Salt Marsh) above, please enter the additional amount here.

23. ☐ Restoration/Enhancement *:

a. square feet of BVW | b. square feet of salt marsh

24. ☐ Stream Crossing(s):

a. number of new stream crossings | b. number of replacement stream crossings

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. The work is a maintenance dredging project as provided for in the Act; or
   b. The time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
   c. If the work is for a Test Project, this Order of Conditions shall be valid for no more than one year.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order. An Order of Conditions for a Test Project may be extended for one additional year only upon written application by the applicant, subject to the provisions of 310 CMR 10.05(11)(f).
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on _____ unless extended in writing by the Department.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

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C. General Conditions Under Massachusetts Wetlands Protection Act

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less than two square feet or more than three square feet in size bearing the words,

    "Massachusetts Department of Environmental Protection" [or, "MassDEP"]

    "File Number 349-1334 "

11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before MassDEP.

12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.

13. The work shall conform to the plans and special conditions referenced in this order.

14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.

18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

19. The work associated with this Order (the “Project”)
    (1) ☐ is subject to the Massachusetts Stormwater Standards
    (2) ☒ is NOT subject to the Massachusetts Stormwater Standards

    If the work is subject to the Stormwater Standards, then the project is subject to the following conditions:

    a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Construction General Permit as required by Stormwater Condition 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.

    b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that:

    i. all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures;

    ii. as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized;

    iii. any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10;

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

iv. all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition;

v. any vegetation associated with post-construction BMPs is suitably established to withstand erosion.

c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 18(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement) for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following:

i.) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and

ii.) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.

d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Multi-Sector General Permit.

e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 18(f) through 18(k) with respect to that BMP. Any failure of the proposed responsible party to implement the requirements of Conditions 18(f) through 18(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

g) The responsible party shall:
1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.

h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.

i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.

j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.

k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.

l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

Special Conditions (if you need more space for additional conditions, please attach a text document):

See Attachment A.

20. For Test Projects subject to 310 CMR 10.05(11), the applicant shall also implement the monitoring plan and the restoration plan submitted with the Notice of Intent. If the conservation commission or Department determines that the Test Project threatens the public health, safety or the environment, the applicant shall implement the removal plan submitted with the Notice of Intent or modify the project as directed by the conservation commission or the Department.

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D. Findings Under Municipal Wetlands Bylaw or Ordinance

1. Is a municipal wetlands bylaw or ordinance applicable? ☒ Yes ☐ No

2. The City of Worcester Conservation Commission hereby finds (check one that applies):

   a. ☐ that the proposed work cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw, specifically:
   City of Worcester Wetlands Protection Ordinance & Regulations (1. Municipal Ordinance or Bylaw)
   COW GRO Part 1. Ch. 6. (2. Citation)

   Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order of Conditions is issued.

   b. ☒ that the following additional conditions are necessary to comply with a municipal ordinance or bylaw:
   City of Worcester Wetlands Protection Ordinance & Regulations (1. Municipal Ordinance or Bylaw)
   COW GRO Part 1. Ch. 6. (2. Citation)

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.
   The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document):
   See Attachment A.

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E. Signatures

9/15/2022
1. Date of Issuance

4 of 5
2. Number of Signers

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.
The names typed below represent the intent to sign the foregoing document in accordance with MGL Chapter 110G §9
Duly authorized by Ch.110G and recorded at Worcester Registry of Deeds in Book 62537 Page 329.

Signatures:

DocuSigned by:
59FC5C358672476...
DocuSigned by:
F683C367C17D49E...
DocuSigned by:
1EC379ADB20C4D0...

DocuSigned by:
C30A7EB88061431...

☐ by hand delivery on

Date

☒ by certified mail, return receipt requested, on 9/15/2022

Date

F. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.
Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.
The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in

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the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

G. Recording Information

Prior to commencement of work, this Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Project Location | MassDEP File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

for: Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Conditions issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
349-1334
MassDEP File #

eDEP Transaction #

Worcester
City/Town

Document Number

Signature of Applicant

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Request for Departmental Action Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

Provided by DEP

A. Request Information

1. Location of Project

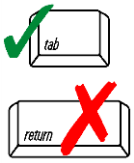
a. Street Address

b. City/Town, Zip

c. Check number

d. Fee amount

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



2. Person or party making request (if appropriate, name the citizen group's representative):

Name

Mailing Address

City/Town

State

Zip Code

Phone Number

Fax Number (if applicable)

3. Applicant (as shown on Determination of Applicability (Form 2), Order of Resource Area Delineation (Form 4B), Order of Conditions (Form 5), Restoration Order of Conditions (Form 5A), or Notice of Non-Significance (Form 6)):

Name

Mailing Address

City/Town

State

Zip Code

Phone Number

Fax Number (if applicable)

4. DEP File Number:

B. Instructions

1. When the Departmental action request is for (check one):

☐ Superseding Order of Conditions – Fee: $120.00 (single family house projects) or $245 (all other projects)

☐ Superseding Determination of Applicability – Fee: $120

☐ Superseding Order of Resource Area Delineation – Fee: $120

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Request for Departmental Action Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

Provided by DEP

B. Instructions (cont.)

Send this form and check or money order, payable to the *Commonwealth of Massachusetts,* to:

Department of Environmental Protection
Box 4062
Boston, MA 02211

2. On a separate sheet attached to this form, state clearly and concisely the objections to the Determination or Order which is being appealed. To the extent that the Determination or Order is based on a municipal bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

3. Send a **copy** of this form and a **copy** of the check or money order with the Request for a Superseding Determination or Order by certified mail or hand delivery to the appropriate DEP Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/).

4. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

ATTACHMENT A

Worcester Conservation Commission

Special Order of Conditions

City of Worcester Wetlands Protection Ordinance & City of Worcester Wetlands Protection Regulations

(City of Worcester Revised Ordinance Part I, Chapter 6)

And

Massachusetts General Laws, Chapter 131, §40 - Massachusetts Wetlands Protection Act

0 Greenwood Street (aka Greenwood Street Landfill) (CC-2022-061 & DEP#349-1334)

Project Description: To install 67 temporary overburden wells and 22 temporary bedrock wells.

Waivers Granted: Waiver of performance standard 4.2.4 for structure (temporary) within the 30' buffer zone and for work within the 15' buffer zone.

Table of Contents:

Notes:

- **Office of the Commission** is located at the Division of Planning and Regulatory Services (455 Main Street 4th floor, Worcester, MA), which can be contacted by e-mailing planning@worcesterma.gov or calling 508-799-1400 ext. 31440.
- **Asterisked (*) conditions** are standard conditions of approval for all projects.

I. Conditions to Meet Prior to and During Construction

21. Person Responsible for Compliance with the Order of Conditions* – A person shall be designated to be responsible to monitor compliance with the Order of Conditions. Their name and contact information (24/7) shall be provided to the Office of the Commission prior to start of any activity. This person shall conduct:
    a) periodic inspections to assure the adequacy and continued effectiveness of erosion and sediment controls;
    b) inspections of said controls following 0.5-inch or greater rain events, or after a heavy snow melt.
22. Contract* - This Order of Conditions and all approved plans shall be included as part of any contract and subcontract and shall be posted in a prominently displayed location in the supervisory office on site during all phases of construction.
23. Notification* - The applicant shall notify the Office of the Commission a minimum of 48 hours prior to the start of any activity.
24. Wetland Flagging – Prior to construction, wetland flags shall be installed along the BVW boundary, and shall remain in place during and after construction until approved for removal through the issuance of Certificate of Compliance for the entire project.

II. Conditions to Meet Before the Start of Any Activity

25. Stormwater Pollution Prevention Plan (SWPPP)* – That one (1) copy of the SWPPP submitted to the EPA in compliance with the NPDES permit requirements, if applicable, shall be provided to the Office of the Commission prior to commencement of work.
26. Tree Cutting* – Tree cutting is allowed following installation of erosion and sediment controls; otherwise, it may be allowed, prior to such installation, with the explicit permission of the Commission or its Agents.
27. Trees To Remain* – All trees to remain post construction shall be marked on site as shown on the approved plan so that the Commission or its representative can verify them before any clearing takes place.
28. Pre-Construction Conference* -
    a) The Conservation Commission or its Agents shall conduct a pre-construction conference prior to commencement of activities in each phase of the project. Phasing, if any, shall conform to the approved plans.
    b) The property owner / applicant and any person performing work that is subject to this Order are responsible for understanding and complying with the requirements of this Order, the Wetlands Protection Act, 310 CMR 10.00 and City of Worcester Wetlands Protection Ordinance and Regulations. Said persons shall acknowledge such in writing prior to commencement of activities.
29. Inspections Prior to Site Preparation and Site Work* - Erosion and sediment controls shall be installed and verified, in compliance with final approved plans, by the Commission or its Agents prior to the commencement of any excavation, grubbing and/or stumping of vegetation, grading, construction, or other site preparation.
30. Construction Schedule* - Submit a Construction Schedule consistent with Work Sequencing plans provided to the Office of the Commission prior to the start of any activities.

III. Stormwater Management System

31. Catch Basins* –

    a) The paved roadways and parking lots shall be bermed and shall be installed with standard City of Worcester catch basins.

    b) Prior to start of activity on site that causes soil erosion and sedimentation, catch basin filter traps shall be installed in the existing and new catch basins.

    c) Catch basins shall be cleaned as warranted during construction to keep them clear of sediment, and minimum twice a year thereafter.

IV. Conditions to Meet During Construction

32. Limit of Work* – No removal, filling, dredging or altering of jurisdictional areas shall take place outside the approved work under this Order of Condition.

33. Work Sequencing* – Activities shall take place in accordance with all phasing and sequencing shown on the plan and/or provided in the application materials on file with the Office of the Commission and shall follow any lot opening restrictions otherwise provided herein.

34. Time of Year Constraints – the work within the Bordering Vegetated Wetland shall take place during summer months when conditions are dry to minimize the ground disturbance impact of the machinery needed to complete the work.

35. Access Road Materials – placement of rip rap, trap rock, or any other permanent or loose fill material shall not be allowed within the Bordering Vegetated Wetland or 30’ buffer zone. Timber matting may be deployed as necessary to minimize impacts of equipment in the wetland.

36. Erosion Stabilization -

    a) *Erosion and Sediment Controls** - All erosion and sediment controls shall be monitored, maintained, and adjusted for the duration of the project to prevent adverse impacts to jurisdictional areas. Additional erosion and sediment controls may be utilized on site as needed.

    b) *Off Site Impacts** - There shall be no off-site erosion, flooding, ponding, or flood-related damage from runoff caused by the project activities.

    c) *Unanticipated Drainage or Erosion** - The applicant shall control any unanticipated drainage and/or erosion conditions that may cause damage to jurisdictional areas and/or abutting or downstream properties. Said control measures shall be implemented immediately upon need. The Office of the Conservation Commission shall be notified if such conditions arise and of the measures utilized.

    d) *Soil Stabilization due to Delay in Work** - If there is an interruption of more than 10, but less than 60 days between completion of grading and revegetation, the applicant shall sow all disturbed areas with annual rye grass to prevent erosion. If soils are to be exposed for longer than 60 days, a temporary cover of rye or other grass should be established following US Soil Conservation Services procedures, as recently amended, to prevent erosion and sedimentation. Once final grading is complete, loaming and seeding of final cover should be completed promptly.

    e) *Grading of Slopes**-

        i. >40% Slope – Slopes shall not exceed those specified in the plans approved by the Conservation Commission. Any slope equal to or greater than 40% (1 vertical to 2 1/2 horizontal) shall be stabilized with erosion control matting.

ii. <40% Slope – Final grades of vegetated areas shall not exceed a slope of 1 vertical to 2 1/2 horizontal (40%) and shall be stabilized to prevent erosion, particularly during the construction period.

f) *Stockpile Maintenance** - Any stockpiling of loose materials shall be properly stabilized to prevent erosion into and sedimentation of jurisdictional areas. Preventative controls such as strawbales or erosion control matting shall be implemented to prevent such an occurrence.

g) *Stockpile Location* – In no case shall any soil or excavated material be stockpiled within 50 feet of any wetland, floodplain, or storm drain inlet.

h) *Site Stabilization Prior to Winter** - Prior to winter, exposed soils shall be stabilized (e.g. with demonstrated vegetative growth, impermeable barriers, erosion control blankets, etc.).

37. Invasive Insects* -

a) *Plantings* – No trees to be planted shall be species susceptible to the Asian Longhorned Beetle or Emerald Ash Borer.

b) *Wood Removal* – All tree, brush & wood removal shall adhere to the most recently amended requirements set forth by the Massachusetts Department of Conservation & Recreation for any project located in the Asian Longhorned Beetle Quarantine Zone.

38. Invasive Vegetation – The goal of this condition is to keep jurisdictional areas (bufferzone and resource areas) free of all invasive, likely invasive, and potentially invasive species as identified in *The Evaluation of Non-native Plant Species for Invasiveness in Massachusetts,* published by the MA Invasive Plant Advisory Group in April 1, 2005. This condition is intended to prevent the introduction and spread of non-native and invasive species which are known to result in resource area alterations and have impacts on wildlife habitat, etc.

a) *Material Introduction* – All imported materials, such as compost, topsoil, etc. shall be inspected for evidence of invasive vegetation prior to use within jurisdictional areas at the site in order to prevent introduction and/or the spread of invasive vegetation. No materials with evidence of invasive vegetation shall be used in jurisdictional areas.

b) *On-going Management* - A weeding program must be implemented within all jurisdictional areas that are disturbed as part of the project. The weeding program shall begin within one month of when final grades are reached and shall continue, at a minimum of, twice per growing season until a Certificate of Compliance is issued for the project.

39. Dust Control* - Provisions for dust control shall be provided during all construction and demolition activities. Such provisions shall be conducted in compliance with all City of Worcester Water Use Restrictions, if in effect, during such activities.

40. Dewatering* – If dewatering is required,

a) Notice of such activities shall be given to the Office of the Commission within 24 hours of commencement;

b) There shall be no discharge of untreated dewatered stormwater or groundwater to jurisdictional areas either by direct or indirect discharge to existing drainage systems;

c) Any discharge to surface waters or drainage structures must be visibly free of sediment;

d) To the maximum extent practicable, proposed dewatering activities should be located outside of the 100’ buffer. If such activities must be located within the 100’ buffer, they shall be monitored at all times when the pumps are running;

e) Dewatering activities shall be confined within an area of secondary containment at all times.

41. Spill Prevention* -

a) No fuel, oil, or other pollutants shall be stored in any resource area or the buffer zone thereto, unless specified in this Order;

b) No refueling shall take place within resource areas or 100-ft to a resource area;

c) The applicant shall take all necessary precautions to prevent discharge or spillage of fuel, oil or other pollutants onto any part of the site;

d) A spill kit shall be present on site at all times.

V. Conditions to Meet at Completion of Project

42. Site Stabilization* - All disturbed areas shall be properly stabilized with well-established perennial vegetation or other approved methods before the project is considered complete.

43. Erosion and Sediment Controls* - Erosion and sediment controls shall not be removed from the site until all disturbed areas have been stabilized with final vegetative cover and approval has been received from the Commission or its Agents to do so. The controls must then be removed within two weeks of receipt of that certification.

44. Wetland Restoration – the Bordering Vegetated Wetland shall be restored and seeded with a native wetland seed mix at the conclusion of the work. At least 75% of the surface area of any disturbed vegetation shall be re-established with indigenous wetland plant species within two growing seasons. Annual monitoring reports prepared by a Professional Wetland Scientist shall be provided at the end of each of the two growing seasons following construction and planting.

45. Certificate of Compliance* - Upon completion of the project, the applicant shall request in writing a Certificate of Compliance from the Commission. If the project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect, or land surveyor, certification must include a written statement by such professional certifying the same.

VI. General Conditions

46. Change in Ownership* - If a change in ownership takes place while this Order is still in effect, it is the responsibility of the new owner to notify the Commission of the change and to provide the name of the person responsible for compliance with the Order.

47. Conservation Agent's Power to Act* - With respect to all conditions, except _____, the Conservation Commission designates the Conservation Agent, as its Agent with full powers to act on its behalf in administering and enforcing this Order, unless the Agent determines approval from the Commission is appropriate.

48. Right to Inspect* - A member of the Conservation Commission or its Agent may enter and inspect the property and the activity that are the subjects of this Order at all reasonable times, with or without probable cause or prior notice, and until a Certificate of Compliance is issued, for the purpose of evaluating compliance with this Order (and other applicable laws and regulations).

49. Changes to the Plan or Errors & Omissions* -

(a) If any plan, calculation, or other data presented to the Office of the Commission is in error or have omissions, and are deemed significant by the Commissioners or their Agents, all work will stop at the discretion of the Commission, until the discrepancies have been rectified to the Commission's satisfaction.

(b) The applicant must notify the Commission in writing of any changes in the plans or implementation of the proposed activity where mandated by any local, state, or federal agencies having jurisdiction over the proposed activity. If, in the opinion of the Commission, any changes in the plans or implementation of the proposed activity so require, then the Commission may modify, amend or rescind this Order in a way consistent with:

- M.G.L. Chapter 131, Section 40,
- 310 CMR 10.00, *Wetlands Protection*,
- the City of Worcester's *Wetlands Protection Ordinance*, and
- the Commission's *Wetlands Protection Regulations*

If any provisions of any conditions, or application thereof is held to be invalid, such invalidity shall not affect any other provisions of this Order. If the Commission deems that a proposed change is major or substantial, a new hearing may be required.

50. Liability* - The applicant shall indemnify and save harmless the Commonwealth, the City of Worcester, the Conservation Commission, and its Agents against all sites, claims or liabilities of every name and nature arising at any time out of or in consequence of the acts of the Commission or its Agents in the performance of the work covered by this Order and/or failure to comply with the terms and conditions or this Order whether by itself or its employees or subcontractors.

NOTICE OF INTENT

Groundwater Remediation Barrier Construction

Greenwood Street Landfill Worcester, Massachusetts

August 2022

CDM Smith

Table of Contents

WPA Form 3

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 3 - Notice of Intent
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File #:
eDEP Transaction #:1388022
City/Town:WORCESTER

A.General Information

1. Project Location:

a. Street Address	0 GREENWOOD STREET		
b. City/Town	WORCESTER	c. Zip Code	01605
d. Latitude	42.21667N	e. Longitude	71.79484W
f. Map/Plat #	29	g.Parcel/Lot #	047-00006

2. Applicant:

☐ Individual ☑ Organization

a. First Name	JAY J.	b.Last Name	FINK (COMMISSIONER)		
c. Organization	DEPARTMENT OF PUBLIC WORKS AND PARKS				
d. Mailing Address	20 EAST WORCESTER STREET				
e. City/Town	WORCESTER	f. State	MA	g. Zip Code	01604
h. Phone Number	508-799-1430	i. Fax	508-799-1448	j. Email	FinkJ@worcesterma.gov

3.Property Owner:

☐ more than one owner

a. First Name	JAY J.	b. Last Name	FINK (COMMISSIONER)		
c. Organization	DEPARTMENT OF PUBLIC WORKS AND PARKS				
d. Mailing Address	20 EAST WORCESTER STREET				
e. City/Town	WORCESTER	f.State	MA	g. Zip Code	01604
h. Phone Number	508-799-1430	i. Fax	508-799-1448	j.Email	FinkJ@worcesterma.gov

4.Representative:

a. First Name	MAGDALENA	b. Last Name	LOFSTEDT		
c. Organization	CDM SMITH INC.				
d. Mailing Address	75 STATE STREET, SUITE 701				
e. City/Town	BOSTON	f. State	MA	g. Zip Code	02109
h.Phone Number	617-452-6597	i.Fax		j.Email	lofstedtmh@cdmsmith.com

5.Total WPA Fee Paid (Automatically inserted from NOI Wetland Fee Transmittal Form):

a.Total Fee Paid	b.State Fee Paid	c.City/Town Fee Paid

6.General Project Description:

INSTALL 67 TEMPORARY OVERBURDEN WELLS AND 22 TEMPORARY BEDROCK WELLS AT THE DEVELOPMENT PARCELS PROPERTY OF THE GREENWOOD STREET LANDFILL. THE OVERBURDEN AND BEDROCK WELLS ARE BEING INSTALLED FOR THE PURPOSE OF CONDUCTING INJECTIONS TO TREAT THE GROUNDWATER IN THE FORM OF A GROUNDWATER REMEDIATION BARRIER. REFER TO ATTACHMENT A: PROJECT NARRATIVE FOR A DETAILED PROJECT DESCRIPTION.

7a.Project Type:

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Limited Project Driveway Crossing
4. ☐ Commercial/Industrial
5. ☐ Dock/Pier
6. ☐ Utilities

7. ☐ Coastal Engineering Structure
8. ☐ Agriculture (eg., cranberries, forestry)
9. ☐ Transportation
10. ☑ Other

7b.Is any portion of the proposed activity eligible to be treated as a limited project subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☑ Yes ☐ No If yes, describe which limited project applies to this project:

2. Limited Project: 310 CMR 10.53 (3)(Q): THE PROPOSED WORK IS A COMPONENT OF OF THE CLOSURE OF THE LANDFILL UNDERTAKEN TO COMPLY WITH THE REQUIREMENTS OF THE MASSACHUSETTS CONTINGENCY PLAN (310 CMR 40.000)

8.Property recorded at the Registry of Deeds for:

a.County:	b.Certificate:	c.Book:	d.Page:
WORCESTER			

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1.Buffer Zone & Resource Area Impacts (temporary & permanent):

☐ This is a Buffer Zone only project - Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.

2.Inland Resource Areas: (See 310 CMR 10.54 - 10.58, if not applicable, go to Section B.3. Coastal Resource Areas)

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☑ Bordering Vegetated Wetland	3560 1. square feet	3560 2. square feet
c. ☐ Land under Waterbodies and Waterways	1. Square feet	2. square feet
	3. cubic yards dredged	
d. ☐ Bordering Land Subject to Flooding	1. square feet	2. square feet
	3. cubic feet of flood storage lost	4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet	
	2. cubic feet of flood storage lost	3. cubic feet replaced

f. ☐ Riverfront Area

1. Name of Waterway (if any)

2. Width of Riverfront Area (check one)
☐ 25 ft. - Designated Densely Developed Areas only
☐ 100 ft. - New agricultural projects only
☐ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project

square feet

4. Proposed Alteration of the Riverfront Area:

a. total square feet	b. square feet within 100 ft.	c. square feet between 100 ft. and 200 ft.

5. Has an alternatives analysis been done and is it attached to this NOI? ☐ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☐ Yes ☐ No

3.Coastal Resource Areas: (See 310 CMR 10.25 - 10.35)

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under	Land under the ocean below,
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beaches	Indicate size under Coastal Beaches and/or Coatstal Dunes, below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab, crea.
i. ☐ Land Under Salt Ponds	1. square feet	
	2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, Inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above	
	1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4.Restoration/Enhancement

☐ Restoration/Replacement

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been

entered in Section B.2.b or B.3.h above, please entered the additional amount here.

a. square feet of BVW | b. square feet of Salt Marsh

5.Projects Involves Stream Crossings

☐ Project Involves Streams Crossings

If the project involves Stream Crossings, please enter the number of new stream crossings/number of replacement stream crossings.

a. number of new stream crossings | b. number of replacement stream crossings

C. Other Applicable Standards and Requirements

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage of Endangered Species program (NHESP)?

a. ☐ Yes ☑ No

If yes, include proof of mailing or hand delivery of NOI to:
Natural Heritage and Endangered Species Program
Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

b. Date of map:7/7/2022

If yes, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18)....

c. Submit Supplemental Information for Endangered Species Review * (Check boxes as they apply)

1.☐ Percentage/acreage of property to be altered:

(a) within Wetland Resource Area — percentage/acreage

(b) outside Resource Area — percentage/acreage

2.☐ Assessor's Map or right-of-way plan of site

3.☐ Project plans for entire project site, including wetland resource areas and areas outside of wetland jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

a.☐ Project description (including description of impacts outside of wetland resource area & buffer zone)

b.☐ Photographs representative of the site

c.☐ MESA filing fee (fee information available at: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/mass-endangered-species-act-mesa/mesa-fee-schedule.html)
Make check payable to "Natural Heritage & Endangered Species Fund" and **mail to NHESP** at above address

*Projects altering **10 or more acres** of land, also submit:*

d.☐ Vegetation cover type map of site

e.☐ Project plans showing Priority & Estimated Habitat boundaries

d. OR Check One of the following

1.☐ Project is exempt from MESA review. Attach applicant letter indicating which MESA exemption applies. (See 321

CMR 10.14, http://www.mass.gov/eea/agencies/dfg/dfw/laws-regulations/cmr/321-cmr-1000-massachusetts-endangered-species-act.html#10.14; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing.
   a. NHESP Tracking Number
   b. Date submitted to NHESP
3. ☐ Separate MESA review completed.
   Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review...

2. For coastal projects only, is any portion of the proposed project located below the mean high waterline or in a fish run?
   a. ☑ Not applicable - project is in inland resource area only
   b. ☐ Yes ☐ No

   If yes, include proof of mailing or hand delivery of NOI to either:

South Shore - Cohasset to Rhode Island, and the Cape & Islands:	North Shore - Hull to New Hampshire:
Division of Marine Fisheries - Southeast Marine Fisheries Station Attn: Environmental Reviewer 836 S. Rodney French Blvd New Bedford, MA 02744	Division of Marine Fisheries - North Shore Office Attn: Environmental Reviewer 30 Emerson Avenue Gloucester, MA 01930

   If yes, it may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional office.

3. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☐ Yes ☑ No

   If yes, provide name of ACEC (see instructions to WPA Form 3 or DEP Website for ACEC locations). **Note:** electronic filers click on Website.

   b. ACEC Name

4. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?
   a. ☐ Yes ☑ No

5. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L.c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L.c. 130, § 105)?
   a. ☐ Yes ☑ No

6. Is this project subject to provisions of the MassDEP Stormwater Management Standards?
   a. ☑ Yes, Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:
      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol.2, Chapter 3)
      2. ☐ A portion of the site constitutes redevelopment

3. ☐ Proprietary BMPs are included in the Stormwater Management System

b. ☐ No, Explain why the project is exempt:

1. ☐ Single Family Home

2. ☐ Emergency Road Repair

3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department by regular mail delivery.

1. USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the ☑ Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)
2. Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland ☑ [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.
3. Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s). ☑ Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.
4. List the titles and dates for all plans and other materials submitted with this NOI. ☑

a. Plan Title:	b. Plan Prepared By:	c. Plan Signed/Stamped By:	c. Revised Final Date:	e. Scale:
SHEET 1: EXISTING CONDITIONS	Z. MCCAFFREY		August 2022/1"=100'	
SHEET 2: PROPOSED GROUNDWATER INJECTION WELL LOCATIONS	Z. MCCAFFREY		August 2022/1"=270'	
SHEET C-1: MISCELLANEOUS DETAILS	C. PETERSON		JULY 2022/NA	

5. If there is more than one property owner, please attach a list of these property owners not listed on this form. ☐

6. Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed. ☐

7. Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed. ☐

8. Attach NOI Wetland Fee Transmittal Form. ☐

9. Attach Stormwater Report, if needed. ☐

E. Fees

1. Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payer name on check: First Name

7. Payer name on check: Last Name

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant
Jay J. Fine, Commissioner DAREP

2. Date
August 8, 2022

3. Signature of Property Owner(if different)

4. Date

5. Signature of Representative (if any)

6. Date
August 8, 2022

For Conservation Commission:

Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:

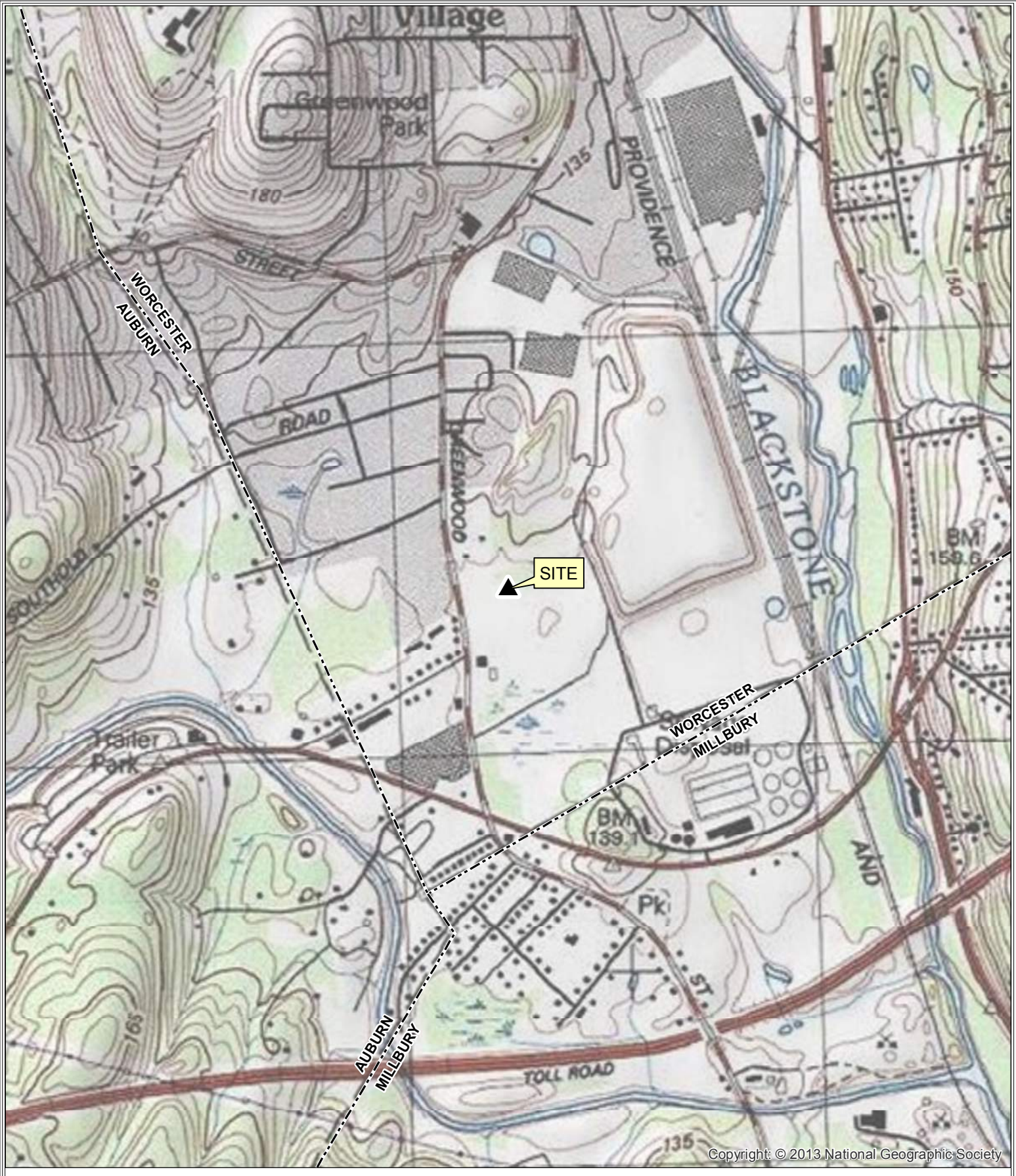
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a copy of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:

If the applicant has checked the "yes" box in Section C, Items 1-3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

FIGURES



N

Basemap: NGS Topo US 2D (1:24,000)
Source: ESRI ArcGIS Online, USGS, and NGS
Coordinate System: NAD83 Mass. State Plane Mainland (feet)

0 500 1,000 2,000 Feet

Greenwood Street Landfill
Worcester, Massachusetts

Figure 1
Site Locus Plan

CDM Smith

\\CDMD38HG4D1\Project_bup\Worcester\MXD\SensitiveReceptors_GreenwoodStLandfill.mxd MB 08/2012

N

Greenwood Street Landfill
Worcester, Massachusetts

0 50 100 200 300 400
Feet

Figure 2
NHESP Priority Habitats
of Rare Species

CDM Smith

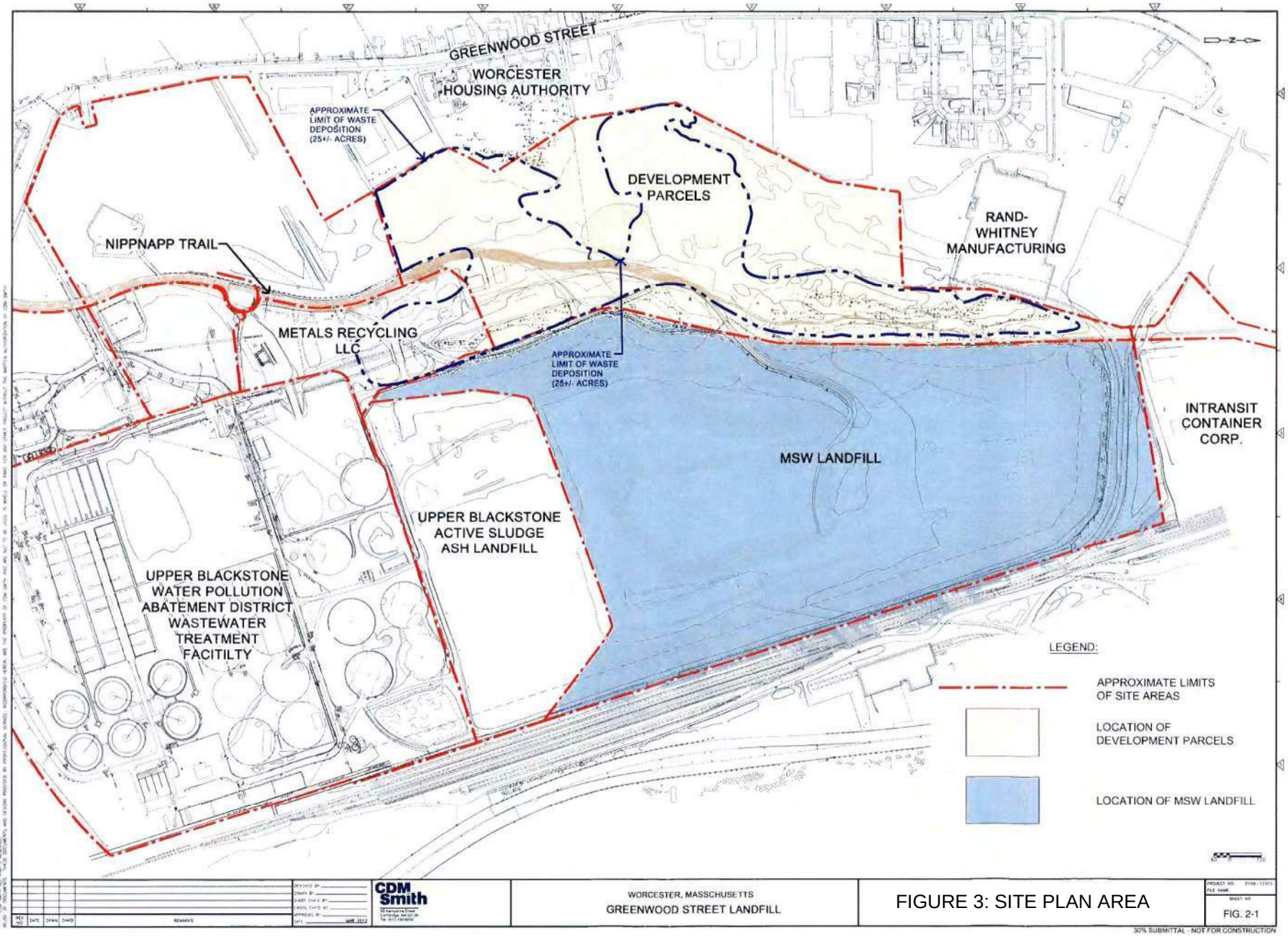


FIGURE 3: SITE PLAN AREA

1DWLRQDO)ORRG+D]DUG'DWD)6WWH

FEMA

)HHW

%DVHPDS 1DWLRQDO)ORRG+D]DUG'DWD8SGDWHG2QWREHU

/HJHQG

7KHSURGXFWSODFHGRQWKHVLWHGRHVQRWVXSHUVHGH
SRQW VHOHFWHGE\WKHXVHU DQGGRHVQRW UHSUHVHQW
DQDWKRULWDWLYHSURFHGXUHVORFDWLRQ

7KLVPSFRROLHVZLWKSVVWDQGDUGIRU WKHXVHR
GLJLWDO IORRGPS/LI LW LVQRW YRLGV GHVFULEHGEHORZ
7KHEDVHPSVKRZQFRROLHVZLWKSVEDVHPS
DFFXUDWHVWDQGDUG/

7KHIORRGKDJDUGRUDWLQJVLQGLYLGGLUHFWO\IURPWKH
DWKRULWDWLYHJHEVHUYLFHVSURYLGHGE\3 7KLVPS
ZVHSRUWHGRQ DW `$ DQGGRHVQRW
UHOHFWFKDQJHVRU DPGPQWV VXEVHTXQW WRWKLVGDWHDQG
WLFI 7KHJHDQGHIHFWLYHQRUDWLQJPLQRQEHFKDQJHRU
EHFRPVXSHUVHGEQHZGDWDRYHU WLFI

7KLVPSLBHLVYRLGLI WKHIQHRUFRWHIOORZLQJPS
HOHPQWV GRQW DSSHDU EDVHPSLBH\\ IORRGRQHODEHOV
OHHG VEDOHEDU PSEUHDWLRGGWH EFRO W\LGHWLLHUV

FIGURE 2: FEMA FLOODPLAIN MAP

ATTACHMENT A

Project Narrative

Project Narrative

1.0 Introduction and Proposed Work

The City of Worcester Department of Public Works and Parks (the City) is submitting this Notice of Intent (NOI) for the installation of 67 temporary overburden wells and 22 temporary bedrock injection wells at the Greenwood Street Landfill Development Parcels property (Site) as shown in **Figure 1**. The overburden and bedrock injection wells are being installed for the purpose of conducting injections to treat the groundwater in the form of a groundwater remediation barrier at the western property line of the Site. The remedial additives to be injected include emulsified vegetable oil, sodium lactate and zero valent iron to reduce concentrations of chlorinated volatile organic compounds (cVOCs) in overburden and bedrock groundwater to prevent further off-site migration of the cVOC plume.

The overburden injection wells will be installed in two rows, spaced approximately 10 feet apart and in each row the wells will be installed approximately 20 feet apart. The bedrock injection wells will be installed in one row with wells spaced 25 feet apart. The maximum anticipated installation depths of the overburden wells will be approximately 30 feet below ground surface (BGS). The maximum anticipated installation depths for the bedrock injection wells will be approximately 60-70 feet BGS. Above ground structures will consist of 4-inch diameter 2 to 3-foot high protective steel locking casing. The locations of the overburden and bedrock injection wells within the wetland and wetland buffer zones are shown on the attached Sheet 2 in Attachment E. A total of approximately 17 injection wells (overburden and bedrock) will be located within the Bordering Vegetated Wetlands (BVW) and approximately 28 injection wells (overburden and bedrock) will be located within the 100-foot Buffer Zone.

Access to the proposed injection well installation locations will be from the Site via an existing access road. During the pre-design investigations in 2020, a temporary access road was constructed for drill rigs and support vehicles. There will be some additional vegetation clearing of brush and small to large diameter trees to access the injection well locations along the property line. To avoid adverse environmental impacts, vegetation clearing/trimming activities at these locations will be minimized to the extent practicable to allow for the execution of work. Additional fill material (rip rap or trap rock) will also be required to maintain the existing site access road to allow for drill rigs, fracturing equipment, and support vehicle access. Placement of additional fill within the BVW and the 100-ft buffer zone will not be allowed. The environmental drilling contractors can access the well locations within the BVW using an all-terrain vehicle (ATV) track drill rig, similar to what is shown in photo below.

The proposed work is subject to review by the Worcester Conservation Commission under the Massachusetts Wetlands Protection Act (MWPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00) (the Regulations) and the City of Worcester Wetlands Protection Ordinance (WWPO) and Wetlands Protection Regulations. Note that 310 CMR 10.02(b)2. g exempts activities within the 100-ft buffer zone that are temporary in nature such as installation of monitoring wells. This proposed project also meets the criteria for limited projects as stated in 310 CMR 10.53 (3)(q) as the proposed work is a component of the closure of the landfill undertaken to comply with the requirements of the Massachusetts Contingency Plan (310 CMR 40.000).

The proposed work, existing conditions, site history, wetland resource area impacts, proposed mitigation measures, and compliance with performance standards are discussed below.

2.0 Existing Conditions

2.1 Site Description

The Greenwood Street Landfill property is an approximate 100-acre property located at 30 Nippnapp Trail, south of Quinsigamond Village, in the southern part of the City of Worcester. The eastern side of the property consists of an approximate 60-acre capped municipal solid waste (MSW) landfill that includes an approximate 8-acre portion of a permitted wastewater residuals landfill operated by the Upper Blackstone Water Protection Abatement District (UBWPAD). The Development Parcels (Site) is an approximate 34-acre area on the western portion of the property where wastewater sludge from former sludge drying beds was buried and remains uncapped. An undeveloped approximate 5.0-acre area to the north of the Landfill Site makes up the remainder of the property. The Development Parcels Site is an unpaved area covered with grass, trees, and generally dense vegetation. The Greenwood Street Landfill property is owned by the City of Worcester Sewer Department and is identified at the City of Worcester Assessor's

Office as Map 29, Block 47, Lot 6. The property is bordered on all sides by a combination of residential, commercial, and industrial properties. The approximate limits of the various areas that make up both the Site and the Landfill property are shown on the Site Area Plan (**Figure 2**).

2.2 Wetland Delineation

On-site wetland resource areas were delineated by Magdalena H. Lofstedt, PWS, on June 1, 2022. Existing field-delineated wetlands resource area boundaries were evaluated for conformance with the MWPA and Regulations (310 CMR 10.00), the US. Army Corps of Engineers 1987 Wetlands Delineation Manual (Environmental Laboratory, 1987), and the U.S. Army Corps of Engineers 2011 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0). The wetland boundary was marked in the field by blue nylon flags labelled 1-1 through 1-51End. Wetland delineation date sheets are included as Attachment B. Photographs of the delineated BVW are included as Attachment D.

The following wetland resource area is present within and adjacent to the proposed work as shown on Sheet 1 in Attachment E.

2.1.1 Bordering Vegetated Wetland

Bordering Vegetated Wetlands (BVW) is defined as:

"Freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps, and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants." [310 CMR 10.55(2)]

A bordering vegetated wetland (BVW) is located east of the Worcester Housing Authority (WHA) property on Greenwood Street. A stormwater drainage pipe discharges into a basin at the northern end of the wetland. The basin is dominated by cattails (*Typha latifolia*). Further to the south, the BVW can be characterized as a shrub swamp dominated by box elder (*Acer negundo*), glossy buckthorn (*Frangula alnus*), and silver maple (*Acer saccharinum*) in the overstory and by stinging nettle (*Urtica dioica),* soft rush (*Juncus effusus*), sensitive fern (*Onoclea sensibilis*), and spotted jewelweed (*Impatiens capensis*) in the herbaceous layer. Uncapped landfilled sludge from historical disposal practices is present across a large portion of the Development Parcels Site including the portion of the BVW where the overburden and bedrock injection wells will be installed.

2.2 Wetland Resource Areas Regulated by the Ordinance

In addition to the wetland resource areas regulated under the MWPA and Regulations, the local Ordinance regulates activities within the 15-ft and 30-ft Buffer Zone as described below

30-foot No Structure Setback

Per the WWPO:

> *"Except as may be allowed, no permanent or temporary foundation, building, road, sidewalk, bridge, sign, billboard or other permanent or temporary structure shall be placed within 30 feet of any resource area, unless,*

1. It is a component of a qualified limited project under the state Wetlands Protection Act and the regulations promulgated pursuant thereto; or

2. It is a component of any storm water, flood control, water conservation, erosion control or soil conservation project otherwise approved." [Worcester Wetlands Protection Ordinance Section 4.2.4 (A)]

The Project will not result in temporary structures to be placed within thirty feet of a BVW, but the proposed work is a component of a limited project as defined in 310 CMR 10.53 (3)(q) and therefore a permittable activity under the WWPO.

15-Foot No Construction Setback

Per the WWPO:

"Except as may be allowed below, no grading, filling, excavation, removal of vegetation or other construction activity (hereinafter, collectively the work) shall be allowed within fifteen feet (15') of any resource area, unless,

1. The Work is required to provide access to a resource area where a discretionary taking has been allowed under section 4.1 of these regulations; or

2. The Work is a component of any of the activities cited in (1) or (2) of subsection (A), above." [Worcester Wetlands Protection Ordinance Section 4.2.4 (B)]

The Project will require construction (borings, well installation, injections) within the fifteen foot setback of resource areas and will require a variance from the WWPO (see Section 4.0 below).

2.3 State-listed Estimated and Priority Habitat

The Massachusetts Natural Heritage & Endangered Species Program shows mapped polygons of Priority Habitat outside of the proposed work area (see Figure 2). There will be no alteration of Priority Habitat from the proposed paving program as all work is located outside of mapped protected habitats.

3.0 Site History and Regulatory Status

Prior to the operation of the MSW Landfill, the Landfill which is currently capped was the location of sixty-six filter beds that were constructed between 1899 and 1910. The sand filtration beds were eventually converted to sewage sludge drying beds in 1919 where sludge was dewatered. Once a year the sludge was reportedly removed from the drying beds and used as fill material elsewhere on the property. This practice ceased once the UBWPAD treatment facility was constructed in the mid-1970's and the drying beds were no longer needed. In the early 1970s, when the City began using a portion of the closed sludge drying beds for the MSW Landfill, remaining sewage sludge was reportedly removed and deposited on the western area that makes up the Development Parcels property. A clay liner and landfill leachate collection system were installed to construct the MSW Landfill. The sludge that was deposited from the drying beds currently covers much of the Development Parcels property (see **Figure 3**).

The Worcester Department of Public Health assigned 85 acres of the property for use as a sanitary landfill on January 23, 1970. Of the 85 acres, approximately 62 acres were used for solid waste disposal. The western area of the Landfill Site was historically used for sludge disposal related to the former sludge drying beds. Approximately 8 acres of the southern side slopes of the MSW Landfill were developed by the UBWPAD WWTP in the 1990s for use as part of their wastewater residuals landfill. The MSW Landfill began accepting municipal solid waste in April 1973. The Worcester Department of Public Works and Parks operated the sanitary landfill between April 1973 and June 1985. In early 1985, the Worcester City Council voted to stop operating the MSW Landfill on June 30, 1985. In accordance with MassDEP's Solid Waste Management Regulations (310 CMR 19.000), the City of Worcester was required to cap the MSW Landfill. The MSW Landfill was capped in 1986 with a closure certification issued by MassDEP dated June 21, 1995. The City recently completed a cap repair project on the MSW Landfill including importing MassDEP approved grading and shaping materials and re-constructing the final cap. A final approval of the cap repair project was issued by MassDEP on February 25, 2016. The plateau of the capped MSW Landfill is currently utilized for ground-mount solar photovoltaic system as approved by MassDEP.

3.1 Release and Remedial Response History

On June 11, 2013, MassDEP was notified of a 120-day reporting condition regarding the detection of cVOCs in groundwater above the MCP reportable concentrations (RCs). MassDEP issued release tracking number (RTN) 2-18909 in response to the notification. The concentrations of cVOC compounds exceeding MassDEP GW-1 RCs in the groundwater sample collected from bedrock monitoring well MWG-DR are presented in Table 3-1.

Table 3-1 December 2012 Groundwater Monitoring Results at Well MWG-DR

Parameter	RCGW-1 (µg/L)	Concentration (µg/L)
1,1-Dichloroethane	70	350
1,1-Dichloroethene	7	1,100
cis-1,2-Dichloroethene	20	540,000
trans-1,2-Dichloroethene	80	2,400
Vinyl Chloride	2	47,000

Notes:

µg/L denotes micrograms per liter

RCGW denotes Reportable Concentrations of OHM in Groundwater (310 CMR 40.0362)

Reporting Category RCGW-1 standards listed above reflect current 2014 standards. At the time this sample was collected the 2007 standards applied, however concentrations are above both.

The sample was collected from the bedrock monitoring well MWG-DR during a semi-annual water quality monitoring round completed on December 6, 2012, by EST Associates Inc. on behalf of Geosyntec. Bedrock monitoring well MWG-DR and the overburden monitoring well installed next to it (MWG-D) were installed upgradient of the capped landfill as part of Comprehensive Site Assessment (CSA) activities for the Landfill Site in 2005. Semi-annual groundwater and surface water monitoring was being performed at the property to satisfy the environmental monitoring requirements of the MassDEP Solid Waste Management Regulations (310 CMR 19.000).

Prior to June 11, 2013, the cVOC detections in samples collected from monitoring well MWG-DR were adequately regulated along with the remainder of the Landfill Site under the Massachusetts Solid Waste Management Regulations. Based upon discussions among MassDEP, the City of Worcester, and CDM Smith prior to the cVOC release notification to MassDEP on June 11, 2013, it was agreed that the City of Worcester would address the cVOCs in groundwater under 21E/MCP, 310 CMR 40.0000 (Revised Scope of Work, Supplemental CSA - Development Parcels, Greenwood Street Landfill, May 2013).

3.1.1 Phase I-II Initial and Comprehensive Site Assessments

In August 2014, CDM Smith on behalf of the City Worcester submitted the Initial Site Assessment (ISA) Report to MassDEP for the Site in accordance with the MCP (310 CMR 40.000). In December 2017, CDM Smith submitted the Phase II CSA Report for the Site in accordance the MCP. Activities conducted during the Phase I and II assessments included passive soil gas sampling, bedrock fracture mapping, installation of bedrock monitoring wells, borehole geophysics, bedrock wireline fluid sampling, groundwater monitoring, as well as research on historical practices from on-site operations and surrounding properties to investigate potential sources of the cVOCs. The findings of the Phase II CSA Report (CDM Smith, 2017) indicated the presence of cVOCs at concentrations above the MassDEP GW-1 and GW-3 standards in numerous bedrock monitoring wells. As part of the Phase II CSA Report, an MCP Method 1 Risk Characterization was completed and concluded that the cVOCs in groundwater pose a condition of "significant risk" to human health and the environment and that completion of a MCP Phase III RAP was necessary (CDM Smith, 2017).

3.1.2 Immediate Response Action

During groundwater monitoring activities conducted at the Site on November 6 and 7, 2017, as part of the Phase II CSA, approximately 4.25 feet of DNAPL was noted in bedrock monitoring well MW-4 using an oil-water interface probe. This observation resulted in a 72-hour notification condition which was reported to MassDEP on November 9, 2017, and resulted in a new RTN, 2-0020362. An Immediate Response Action (IRA) Plan to continue gauging and monitoring accumulation of DNAPL was communicated to MassDEP along with the notification. As this condition is directly related to the existing RTN for chlorinated solvents (RTN 2-0018909), RTN 2-0020362 was linked to the parent site on November 15, 2018, with on-going gauging of MW-4 on an approximate quarterly basis. An IRA Completion Report was submitted to MassDEP on November 16, 2021, which closed out RTN 2-0020362. The DNAPL RTN (2-0020362) was already linked to the parent site (RTN 2-0018909) in 2018 as stated above.

3.1.3 Phase III Remedial Action Plan

In June 2018, CDM Smith on behalf of the City of Worcester submitted the Phase III Remedial Action Work Plan (RAP) to MassDEP in accordance with the MCP. The Phase III RAP utilized information from the Phase II CSA (CDM Smith, 2017) to identify and evaluate remedial action alternatives in sufficient detail to support selection of the "preferred" remedial action alternative.

Based on the screening of potentially applicable cleanup technologies, the following remedial alternatives were identified as being effective, implementable, and having the potential to reduce cVOCs in groundwater to ultimately achieve the remedial action objectives:

- Alternative #1 – No Action
- Alternative #2 – Monitored Natural Attenuation (MNA) with Land Use Controls (LUCs)
- Alternative #3 – In-Situ Enhanced Bioremediation/In-Situ Chemical Reduction (ISEB/ISCR), MNA, and LUCs
- Alternative #4 –ISEB/ISCR, MNA, In-Situ Thermal Desorption (ISTD), and LUCs

A detailed comparative evaluation was conducted for the remedial alternatives and Alternative #4 (ISEB/ISCR, MNA, ISTD, LUCs) was selected as the preferred remedy for remediation of cVOCs in bedrock groundwater. Due to the concerns associated with adequately targeting and treating the DNAPL utilizing the technologies in the preferred remedy, an adaptive management approach was recommended that included additional characterization while simultaneously installing the infrastructure needed to affect remediation.

3.1.4 Phase IV Remedial Implementation Plan

In May 2020, CDM Smith on behalf of the City of Worcester submitted the Phase IV Remedial Implementation Plan (RIP) to MassDEP in accordance with the MCP 40.0877. The Phase IV RIP incorporated information from the Phase II CSA (CDM Smith, 2017) and Phase III RAP (CDM Smith, 2018) to provide the preliminary design for implementation of the remedial response action for cVOCs in groundwater. The engineering design information presented in the Phase IV RIP supported the preliminary design investigation of the groundwater remediation barrier to prevent further off-site migration of the cVOC plume, identification of effective amendments (i.e., ISEB or ISCR) through a bench scale study to mitigate the cVOC plume in bedrock across the Site, and remediation of the source area via ISTD technology to mitigate DNAPL, if required. The preliminary design investigation and bench scale study results completed in 2020 supported the design of the groundwater remediation barrier. The Draft Supplemental Phase IV RIP Report presenting details of the engineering design, construction plans, and operation and maintenance plans for the groundwater remediation barrier was provided to MassDEP for review in August 2021.

3.1.5 Phase IV Remedial Implementation Plan Status Report (October 2020)

In October 2020, CDM Smith on behalf of the City of Worcester submitted a Phase IV RIP Status Report to MassDEP in accordance with the MCP 40.0877. The October Phase IV Status Report included a summary of pre-design field investigations completed in June through August 2020 and provided an update on the bench scale study which was on-going in October 2020. As described in the October 2020 Phase IV Status Report, supporting pre-design documentation that was not included in the October 2020 Phase IV Status Report was included in the Supplemental Phase IV Report provided to MassDEP in August 2021.

3.1.6 Phase IV Remedial Implementation Plan Status Report (June 2021)

In June 2021, CDM Smith on behalf of the City of Worcester submitted a Phase IV RIP Status Report to MassDEP in accordance with the MCP 40.0877. The June 2021 Phase IV Status Report included a short summary of the bench scale study results, included an update on the groundwater remediation design progress and included an updated schedule for implementation of Site activities.

3.1.7 Tier I Classification Extension (June 2021)

In June 2021, CDM Smith on behalf of the City of Worcester submitted a Tier I Classification Extension Report in accordance with the MCP 40.0560(7). The Tier I Classification Extension extended the compliance date for the Site for two years from August 1, 2021, to August 1, 2023.

3.1.8 Phase IV Remedial Implementation Plan Status Report (November 2021)

In November 2021, CDM Smith on behalf of the City of Worcester submitted a Phase IV RIP Status Report to MassDEP in accordance with the MCP 40.0877. The November 2021 Phase IV Status Report included an updated summary scope of work and schedule for implementation of Site pilot field program and associated activities.

3.1.9 DNAPL IRA Completion Report (November 2021)

In November 2021, CDM Smith on behalf of the City of Worcester submitted an IRA Completion Report to MassDEP for RTN 2-0020362 associated with the presence of DNAPL in bedrock monitoring well MW-4. RTN 2-0020362 was previously linked to the parent RTN 2-0018909 on November 15, 2018. As summarized in the IRA Completion Report, future DNAPL gauging activities will be documented in the Phase IV Remedial Implementation Plan Status Reports for RTN 2-0018909.

3.1.10 Phase IV Remedial Implementation Plan Status Report (June 2022)

In June 2022, CDM Smith on behalf of the City of Worcester submitted a Phase IV RIP Status Report to MassDEP in accordance with the MCP 40.0877. The June 2022 Phase IV Status Report included a summary of pre-pilot field activities including additional monitoring well installation, pre-pilot groundwater sampling results, DNAPL gauging results and a summary scope of work for the overburden and bedrock pilot field program.

4.0 Waiver Request

The MWPA and the WWPO establish the protection of BVW, and the 30-foot No Structure Setback and the 15-foot No Construction Setback adjacent to any wetland resource area, respectively. No work is allowed within the resource areas and setback. Temporary alterations within BVW, the 30-foot and the 15-foot setbacks are unavoidable since the injection wells are necessary to be placed in this location to provide a continuous line of groundwater remediation injection wells so that the injection remediation product injections form a barrier to effectively reduce groundwater concentrations.

Note, it is anticipated that the future landfill closure work will also require work within the BVW, the 30-foot, and the15-foot setbacks as the area contains historical wastewater landfilled sludge (see Figure 2). It is anticipated as part of the landfill cap installation, the landfilled sludge within the BVW will be removed and the wetland restored with high organic content loam and planted with native species.

On behalf of the City of Worcester Department of Public Works and Parks, a variance from the protected resource areas and the setbacks is respectfully requested for the installation of the injection wells proposed herein.

5.0 Construction Mitigation Measures

The following summary of mitigation measures will be implemented to protect the downstream wetland resource area during and after injection well installation.

- A supply of speedy dry oil absorbent pads, or an approved equivalent will be maintained with the drilling equipment at all times which will be used to contain any accidental release of oil or other petroleum products during field work.
- CDM Smith will notify the Worcester Conservation Commission prior to the start of work.
- A CDM Smith representative will be conducting oversight during the drilling/injection well installation activities;.
- Compost logs will be installed at the downgradient side of each well location in the buffer zone and around each well location within the BVW prior to commencement of work to prevent the potential transport of sediment to the downgradient basin. Compost logs will remain in place until all remediation work is completed.
- The drilling contractor will use a tracked drill rig when installing the injection wells within the wetland area and work off of timber mats to minimize disturbance within the wetland area.
- The drilling contractor will be required to maintain spill response materials (e.g., "speedy dry", shovels, oil absorbent pads, etc.) with the drilling equipment at all times to contain any accidental release of hydraulic fluids.
- Refueling and staging of drill rig(s) will take place outside of wetland resource areas and the 100-ft buffer zone.
- Clearing of vegetation will be limited to what is necessary for equipment to access the well installation locations. When clearing is necessary, all trees and shrubs will be cut off level with the ground surface. Roots will not be removed. This will allow revegetation of the work area by stump sprouts.
- Work in and adjacent to wetlands will proceed as rapidly as possible. Limiting the exposure time of disturbed soils to wind and precipitation will minimize the soil erosion and subsequent sedimentation. It is anticipated that the injection well installations within the wetland resource area and wetland buffer zones will take approximately two to three months.
- Upon completion of injection well installation, each well installation location will be backfilled to match adjacent grades with drill cuttings, raked smoothed and the BVW will be seeded with a wetland seed mixture and the buffer zone areas will be seeded with an erosion control seed mixture.

6.0 Compliance with Performance Standards

6.1 Mass Wetlands Protection Act (M.G.L. c. 131 §40) and Regulations (310 CMR 10.00)

6.1.1 Limited Projects

This proposed project is a component of a limited projects as stated in 310 CMR 10.53 (3)(q). The following presents how this project complies with performance standards for these limited projects.

(1) There are no practicable alternatives to the response action being proposed that are consistent with the provisions of 310 CMR 40.0000: Massachusetts Contingency Plan and that would be less damaging to resource areas.

The alternatives analysis shall include, at a minimum, the following:

a. an alternative that does not alter resource areas, which will provide baseline data for evaluating other alternatives; and

b. an assessment of alternatives to both temporary and permanent impacts to resource areas

A "Comprehensive Remedial Action Alternative" that is selected in accordance with the provisions of 310 CMR 40.0851 through 40.0869 shall be deemed to have met the requirements of 310 CMR 10.53(3)(q)1.

The Development Parcels (Site) landfill related impacts are adequately regulated under the MassDEP Solid Waste Regulations (310 CMR 19.00) and is currently managed by others. The cVOC related impacts are currently managed under the MCP (310 CMR 40.00). Under the MCP regulations, CDM Smith conducted a remedial action alternatives analysis as summarized below.

In June 2018, CDM Smith on behalf of the City of Worcester submitted the Phase III RAP to MassDEP in accordance with the MCP. The Phase III RAP utilized information from the Phase II CSA (CDM Smith, 2017) to identify and evaluate remedial action alternatives in sufficient detail to support selection of the “preferred” remedial action alternative.

Based on the screening of potentially applicable cleanup technologies, the following remedial alternatives were identified as being effective, implementable, and having the potential to reduce cVOCs in groundwater to ultimately achieve the remedial action objectives:

- Alternative #1 – No Action
- Alternative #2 – MNA with LUCs
- Alternative #3 – ISEB/ISCR, MNA, and LUCs
- Alternative #4 –ISEB/ISCR, MNA, ISTD, and LUCs

A detailed comparative evaluation was conducted for the remedial alternatives and Alternative #4 (ISEB/ISCR, MNA, ISTD, LUCs) was selected as the preferred remedy for remediation of cVOCs in bedrock groundwater. Due to the concerns associated with adequately targeting and treating

the DNAPL utilizing the technologies in the preferred remedy, an adaptive management approach was recommended that included additional characterization while simultaneously installing the infrastructure needed to affect remediation. The Phase III RAP including the alternatives analysis can be found on the MassDEP Waste Site/Reportable Release File Data Portal site at the following link:

https://eeaonline.eea.state.ma.us/EEA/fileviewer/Default.aspx?formdataid=0&documentid=453938.

2. such projects shall be designed, constructed, implemented, operated, and maintained to avoid or, where avoidance is not practicable, to minimize impacts to resource areas, and to meet the following standards to the maximum extent practicable:

a. hydrological changes to resource areas shall be minimized;

The proposed project will not result in hydrological changes to the wetland resource area.

b. best management practices shall be used to minimize adverse impacts during construction, including prevention of erosion and siltation of adjacent water bodies and wetlands in accordance with standard U.S.D.A. Soil Conservation Service methods;

Staked compost logs will be installed prior to installation of the injection wells within the wetland resource area to prevent transport of sediment laden waters to the adjacent basin.

c. mitigating measures shall be implemented that contribute to the protection of the interests identified in M.G.L. c. 131, § 40;

The wetland resource area to be disturbed is located within and adjacent to historical wastewater sludge deposition areas. It is anticipated that the historical wastewater sludge will be eventually be removed from the wetlands where present and placed beneath a landfill cap, and that the wetland resource area will be restored with native vegetation. As described above, this work is being conducted under the MassDEP Solid Waste Regulations (310 CMR 19.000) and is currently being managed by another consulting/engineering company.

d. compensatory storage shall be provided in accordance with the standards of 310 CMR 10.57(4)(a)1. for all flood storage volume that will be lost;

Not applicable.

e. no access road, assessment or monitoring device, or other structure or activity shall restrict flows so as to cause an increase in flood stage or velocity;

Access roads are located outside of wetland resource areas.

f. temporary structures and work areas in resource areas, such as access roads and assessment and monitoring devices, shall be removed within 30 days of completion of the work. Temporary alterations to resource areas shall be substantially restored to preexisting hydrology and topography. At least 75% of the surface of any area of disturbed vegetation shall be reestablished with indigenous wetland plant species within two growing seasons and prior to said vegetative

reestablishment any exposed soil in the area of disturbed vegetation shall be temporarily stabilized to prevent erosion in accordance with standard U.S.D.A. Soil Conservation Service methods. Temporary structures, work areas, and alterations to resource areas are those that no longer are necessary to fulfill the requirements of 310 CMR 40.0000: Massachusetts Contingency Plan.

g. work in resource areas shall occur only when the ground is sufficiently frozen, dry, or otherwise stable to support the equipment being used.

Timber mats will be used to support the equipment if the ground is not dry enough to provide sufficient support.

6.1.2 Bordering Vegetated Wetlands

Work in BVW consists of temporary alteration from installation of the groundwater injection wells. The provisions of 310 CMR 10.55(4) apply.

1. *Where the presumption set forth above is not overcome, any proposed work in a bordering vegetated wetland shall not destroy or otherwise impair any portion of said area.*

Preventative measures including timber mats, compost socks, silt fence and erosion control blankets will be implemented to minimize damage to the BVW. Temporary altered BVW will be restored following the groundwater remediation barrier construction (installation/injections).

2. *notwithstanding section 7(3) (d) 1. above, the Conservation Commission may issue a Permit allowing the work which results in the loss of up to 5,000 square feet of bordering vegetated wetlands after review of an alternatives analysis and when said area is replaced in accordance with the following general conditions and any additional, specific conditions the Conservation Commission deems necessary to ensure that the replacement area will function in a manner like the area that will be lost:*

The temporary impact to BVW is less than 5,000 square feet.

a. *the surface of the replacement area to be created ("the replacement area") shall require up to 2:1 replication of the area that will be lost ("the lost area"), except where conditions warrant as determined by the Conservation Commission;*

Temporarily altered BVW will be restored in-kind resulting in a no net loss of BVW. Wetland replication is not required.

b. *the distance between ground water elevation and surface elevation of the replacement area shall be approximately equal to that of the lost area.*

Upon completion of well installations/injections, each well installation location will be backfilled to match adjacent grades with drill cuttings, raked smoothed and the BVW will be seeded with New England Wetland Plants Inc. New England Wet mix, or approved equal.

c. *the replacement area shall have an unrestricted hydraulic connection to the same water body or waterway associated with the lost area;*

Temporarily altered BVW will be restored in-kind.

d. the replacement area shall be located within the same general area of the water body or reach of the waterway as the lost area;

Temporarily altered BVW will be restored in-kind.

e. at least 75% of the surface of the replacement area shall be reestablished with indigenous wetland plant species within two growing seasons, and prior to said vegetative reestablishment any exposed soil in the replacement area shall be temporarily stabilized to prevent erosion in accordance with standard US Natural Resource Conservation Service methods (formerly Soil Conservation Service); and

Upon completion of injection well installation, each well installation location will be backfilled to match adjacent grades with drill cuttings, raked smoothed and the BVW will be seeded with New England Wetland Plants Inc. New England Wet mix, or approved equal.

f. the replacement shall be provided in a manner which is consistent with all other General Performance Standards for each resource area described in these regulations.

Altered BVW will be restored in place. No other wetland resource areas will be impacted from the proposed work.

3. notwithstanding the provisions of (d) 1.and 2. above, no project may be permitted which will have any adverse effect on specific habitat sites of rare vertebrate or invertebrate species as identified on the Natural Heritage and Endangered Species Estimated Habitat Maps, as identified under section 310 CMR 10.59, as may be amended, ("Rare Species") of the Wetland Protection Act Regulations and/or correspondence provided by the Division of Fisheries and Wildlife, Natural Heritage Endangered Species Program.

The BVW on the project site is not located within Estimated or Priority Habitat (see Figure 2).

6.2 Wetland Resource Areas Regulated by the Ordinance

6.2.1 Activities within Area Subject to Protection Under the Ordinance

The general performance standards for BVW are as stated in 310 CMR 10.55, see Section 6.1 above.

All impacts to BVW are temporary and will be restored upon completion of the work.

6.2.2 Activities within the Buffer Zone

Work in Buffer Zone consists of temporary alteration from installation of the groundwater injection wells. The provisions of 4.2.4 of the WWPO apply.

A. Structures and Improvements to Land - Except as may be allowed, no permanent or temporary foundation, building, road, sidewalk, bridge, sign, billboard or other permanent or temporary structure shall be placed within 30 feet of any resource area, unless,

1. It is a component of a qualified limited project under the state Wetlands Protection Act and the regulations promulgated pursuant thereto; or

2. It is a component of any storm water, flood control, water conservation, erosion control or soil conservation project otherwise approved.

This proposed is a component of a limited project as stated in 310 CMR 10.53 (3)(q).

7.0 Summary

All proposed work will be completed in compliance with the MWPA and the Regulations, and the WWPO. Impacts to BVW and the 15-foot and 30-foot offsets will be temporary and will be restored to preconstruction conditions upon completion of work. Sedimentation and erosion controls will be installed prior to commencement of work to prevent the transport of sediment to the downstream basin.

ATTACHMENT B

WETLAND DELINEATION DATA SHEETS

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: City of Worcester__ Prepared by:_M. Lofstedt_____ Project location: Greenwood Ave. Landfill Plot: 1-1 Wet DEP File _____
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Trees				
Populus tremuloides	15%	100%	Yes	FACU
Saplings				
None				
Shrubs				
Cornus amomum*	20%	44%	Yes	FACW
Frangula alnus*	20%	44%	Yes	FAC
Acer saccharinum	5%	12%	No	FACW
Herbs				
Typha latifolia*	20%	25%	Yes	OBL
Lemna minor*	60%	75%	Yes	OBL

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? **yes** no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? **yes** no
title/date:
map number: **275B**
soil type mapped: **Agawam fine sandy loam, 3-8% slope**
hydric soil inclusions: **No**

Are field observations consistent with soil survey? yes **no**
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O1	0-2”	10YR 2/1 (muck)	
B1	2-4”	10YR 2/1 (loamy sand)	
B2	4-18”	10YR 3/1 (loamy sand) with Depletions of 2.5Y 5/3 (5%)	

Remarks:

3. Other

Conclusion: Is soil hydric? **yes** no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
  Depth to free water in observation hole: _____
- X Depth to soil saturation in observation hole: _4 inches __
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
  Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	_X__	____
Wetland hydrology present:		
Hydric soil present	_X___	_____
Other indicators of hydrology present	_X___	_____
Sample location is in a BVW	_X___	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: City of Worcester__ Prepared by:_M. Lofstedt_____ Project location: Greenwood Ave. Landfill Plot: 1-1 Up DEP File _____
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Trees				
Populus tremuloides	30%	38%	Yes	FACU
Acer negundo*	40%	50%	Yes	FAC
Prunus serotina	10%	12%	No	FACU
Saplings				
Prunus serotina	10%	40%	Yes	FACU
Acer negundo*	15%	60%	Yes	FAC
Shrubs				
None				
Vines				
Toxicodendron radicans*	20%	100%	Yes	FAC
Herbs				
Aster sp.	40%	57%	Yes	NI
Glechoma hederacea	30%	43%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 4

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes **no**

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? **yes** no
title/date:
map number: **275B**
soil type mapped: **Agawam fine sandy loam, 3-8% slope**
hydric soil inclusions: **No**

Are field observations consistent with soil survey? **yes** no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0-15”	5YR 3/3 (loamy sand) with concentrations of 7.5YR 4/4 (5%)	
B	15-18”	10YR 4/4 (loamy sand)	Depletions of 2.5Y 6/4 (5%)

Remarks:

3. Other

Conclusion: Is soil hydric? yes **no**

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
  Depth to free water in observation hole: _____
  Depth to soil saturation in observation hole: _____ __
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
  Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	___	_X___
Wetland hydrology present:		
Hydric soil present	____	_X___
Other indicators of hydrology present	____	_X____
Sample location is in a BVW	____	_X____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

ATTACHMENT C

ABUTTER NOTIFICATION INFORMATION

NOTIFICATION TO ABUTTERS UNDER THE
MASSACHUSETTS WETLANDS PROTECTION ACT

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40, you are hereby notified of the following:

A. The name of the applicant is **City of Worcester Parks and Recreation.**

B. The applicant has filed a Notice of Intent with the **Worcester Conservation Commission** seeking permission to remove, fill, dredge or alter an Area Subject to Protection Under the Wetlands Protection Act (MGL Chp. 131, Sec. 40)*.

C. The address of the lot where the activity is proposed is **0 Greenwood Avenue.**

D. The Notice of Intent may be examined at the **Worcester Conservation Commission** Office at the Division of Planning & Regulatory Services, City Hall, 455 Main Street, Room 404, in Worcester, Massachusetts, between the hours of 8.30AM and 2.00PM, Monday through Friday. Information regarding the time, date, and place of the Public Hearing may also be obtained from the **Worcester Conservation Commission**. For information call **(508) 799-1400**, **ext. 31440.**

E. Copies of the Notice of Intent may be obtained from **CDM Smith Inc.**
75 State Street, Suite 701, Boston, MA 02109. Attn: Magdalena Lofstedt or by calling **(617) 452-6597** between **9 AM** and **5 PM** Monday through Friday.

F. It is our understanding that the Public Hearing will be scheduled for **Monday August 29, 2022, at 5.30PM**, and will be held in the Levi Lincoln Chamber, Room 309, 3rd floor of City Hall located at 455 Main Street, Worcester, MA 01608. Please call the **Worcester Conservation Commission at (508) 799-1400, ext. 31440** to confirm the date and time of the hearing and any additional information.

NOTE: Notice of Public Hearing, including its date, time and place will also be published at least five (5) days in advance in **the Worcester Telegram & Gazette.** You may also contact your local Conservation Commission or the nearest Department of Environmental Protection Regional Office for more information about this application or the Wetlands Protection Act. To contact the Department of Environmental Protection, call the **Central Regional Office at (508) 792-7650.**

* This abutter notification is for the installation of bedrock wells within wetland resource areas and/or buffer zone for injections to treat the groundwater in the form of a groundwater remediation barrier at the Greenwood Street Landfill.

CITY OF WORCESTER, MASSACHUSETTS

Eric D. Batista
Acting City Manager

Samuel Konieczny, MAA
City Assessor

Administration and Finance
Division of Assessing

REQUEST FOR MAPS AND/OR ABUTTERS' LISTS:

Please be advised that requested lists will typically be completed within ten (10) business days. Lists will be provided for a fee of $20.00 paid at the time of request. Please state the reason for the abutters' list and indicate if the subject parcel has shared ownership with an adjoining parcel, this will ensure the provided list meets the appropriate regulations. Two sets of mailing labels will be included when required.

Our email address is: Assessing@worcesterma.gov and our fax number is (508) 799-1021.

Please contact our office with any questions.

✓ **ABUTTER'S LIST** LABELS ✓ Yes No 1 SET ✓ 2 SETS

✓ **MAP(S)**

PROPERTY ADDRESS 0 Greenwood Street

PAID 20$

MBL No. 29-047-00006

REASON:

_____PLANNING
_____ZONING
_____LIQUOR LICENSE
__✓__CONSERVATION COMMISSION
_____HISTORICAL COMMISSION
_____OTHER-_____

Footage for radius 100

CONTACT:

NAME: Magdalena Lofstedt, CDM Smith Inc.

ADDRESS: 75 State Street, Suite 701, Boston, MA 02109

TELEPHONE: 617-448-5562

Edward M. Augustus, Jr.
CITY MANAGER

CITY OF WORCESTER

ADMINISTRATION & FINANCE

Timothy J. McGourthy
CHIEF FINANCIAL OFFICER

Samuel E. Konieczny
CITY ASSESSOR

Certified Abutters List

A list of 'parties in interest' shall be attached to the application form and shall include the names and addresses. All such names and addresses shall be obtained from the most recent applicable tax list maintained by the City's Assessing Department. The Assessing Department certifies the list of names and addresses.

Total Count: 18

Parcel Address: 0000 GREENWOOD STREET
Assessor's Map-Block-Lot(s): 29-047-00006

Owner: CITY OF WORCESTER SEWER DEPT
Owner Mailing: 455 MAIN ST
WORCESTER, MA 01606

Petitioner (if other than owner): MAGDALENA LOFSTEDT, CDM SMITH
Petitioner Mailing Address: 75 STATE STREET SUITE 701
BOSTON, MA 02109
Petitioner Phone: 617-448-5562

Planning: ____ Zoning: ____ Liquor License: ____ ConComm: X
Historical: ____ Cannabis: ____ Other: ____

29-047-00A+B	METALS RECYCLING LLC	PO BOX 847	CARLSBAD CA 92018
29-043-00005	WEBSTER FIRST FEDERAL	0271 GREENWOOD ST PO BOX 70505	WORCESTER MA 01607
29-047-0008B	MONTREUX REALTY CORP	3311FANNY BAY LANE	NAPLES FL 34114
29-037-00001	SOUSA RICHARD + ANN MARIE	0241 FRANCIS AVE	MANSFIELD MA 02048
29-013-09-22	1 LUNDBERG STREET LLC	0241 FRANCIS AVE	MANSFIELD MA 02048
29-047-00006	CITY OF WORCESTER SEWER DEPT	455 MAIN ST	WORCESTER MA 01608
31-024-00004	PROVIDENCE + WORCESTER RR CO	0100 CONGRESS AVE SUITE 1900	AUSTIN TX 78701
29-043-00003	SHADOW BROOK ACRES LLC	0063 CHERRY ST	NORTHBOROUGH MA 01532
29-043-0001A	GUERTIN ALICE M TRUSTEE	0325 GREENWOOD ST	WORCESTER MA 01607

29-043-00001	GUERTIN ALICE M TRUSTEE	325A GREENWOOD ST	WORCESTER MA 01607
29-047-00009	WORCESTER HOUSING AUTHORITY	00040 BELMONT ST	WORCESTER MA 01605
29-047-00007	UPPER BLACKSTONE WPAD	50 SOUTHWEST CUTOFF	MILLBURY MA 01527
29-047-00008	GALLO DONNA M TRUSTEE RDG REALTY TR	43 KENDALL AVE #208	SHERBORN MA 01770
RR-ROW-000PW	PROVIDENCE & WORCESTER RAILROAD CO	75 HAMMOND ST	WORCESTER MA 01610
29-047-07A-C	CITY OF WORCESTER CITY HALL	455 MAIN ST	WORCESTER MA 01608
29-013-23-76	GREENWOOD LLC C/O INTRANSIT CONTAINER	0241 FRANCIS AVE	MANSFIELD MA 02048
29-047-1-002	AGRAND REALTY CORP	0241 GREENWOOD ST	WORCESTER MA 01607
29-047-1-001	207 GREENWOOD STREET LLC	0207 GREENWOOD ST	WORCESTER MA 01607

This is to certify that the above is a list of abutters to Assessor's Map-Block-Lots 29-047-00006 as cited above.
Certified by:

Samuel E. Konieczny
Signature

06/06/2022
Date

Edward M. Augustus, Jr.
CITY MANAGER

Timothy J. McGourthy
CHIEF FINANCIAL OFFICER

Samuel E. Konieczny
CITY ASSESSOR

CITY OF WORCESTER

ADMINISTRATION & FINANCE

Abutters Map

ATTACHMENT D

PHOTOGRAPHS

Photo 1: View of basin from WF 1-11, facing north

Photo 2: View of southern portion of flagged basin from WF 1-20 facing south

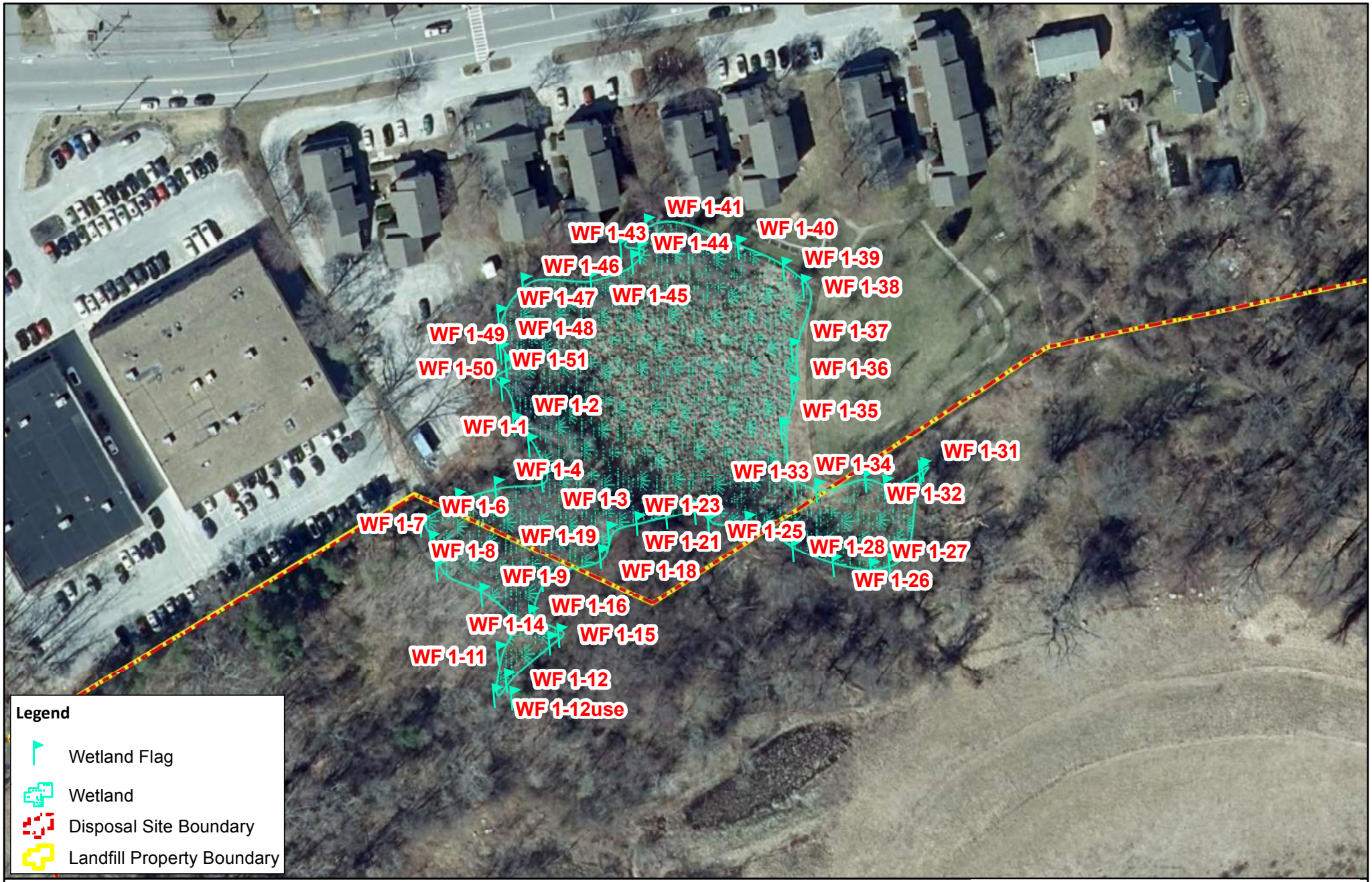
Photo 3: Cattail dominated basin

Photo 4: Eastern portion of basin to be impacted by proposed project, photo taken from WF 1-30

Photo 5: Photo facing WF 1-30 and pipe that discharges into basin

ATTACHMENT E

PROJECT PLANS



N

Greenwood Street Landfill
Worcester, Massachusetts

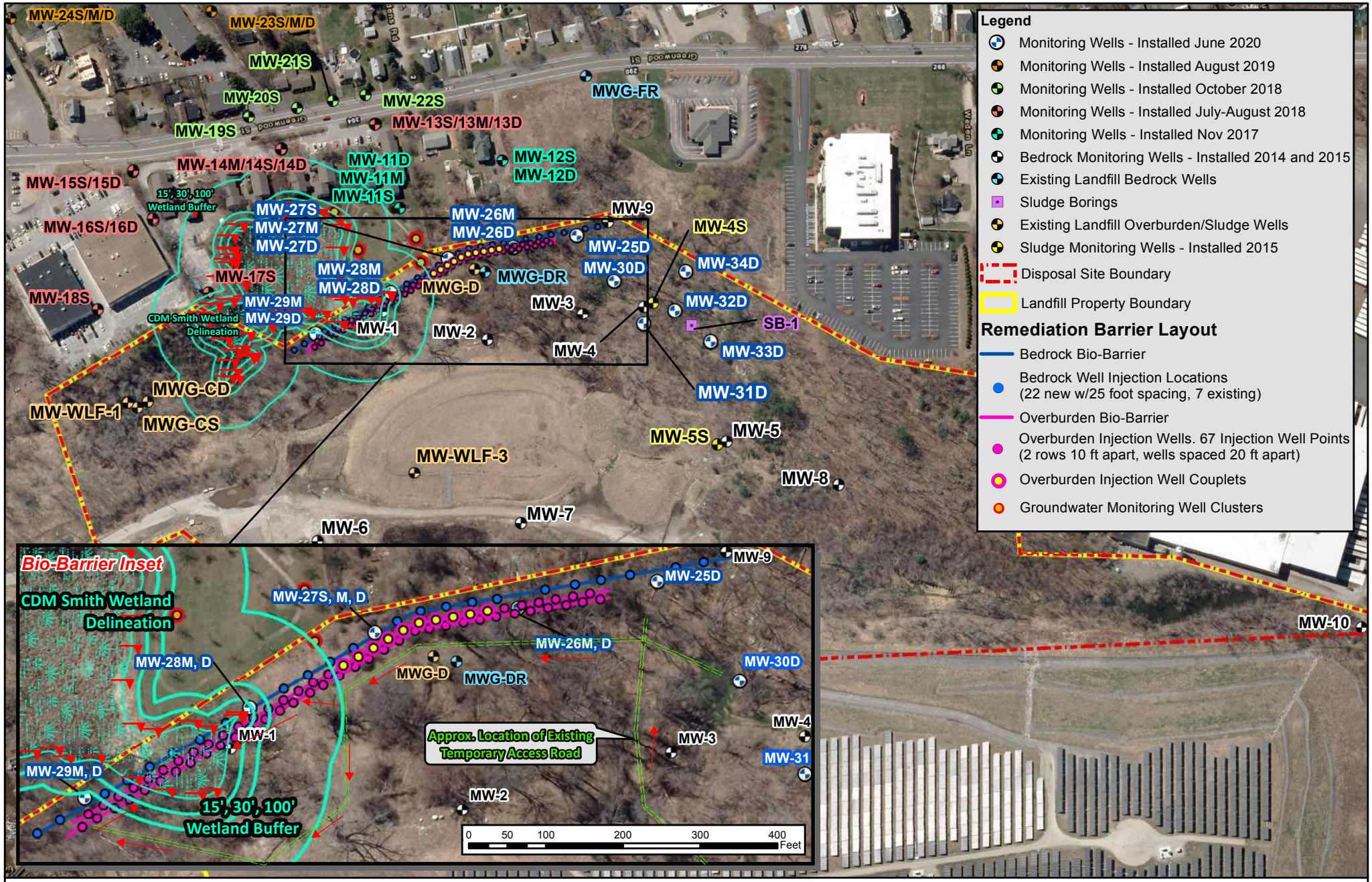
SHEET 1: EXISTING CONDITIONS

1 inch = 100 feet

0 50 100 200 Feet

CDM Smith

MCCAFFREYZC P:\Worcester\GreenwoodSt_Landfill\MXD\Sheet1_preexisting.mxd 6/29/2022



Worcester, MA

SHEET 2: PROPOSED GROUNDWATER INJECTION WELLS

Greenwood Street Landfill

Worcester, Massachusetts

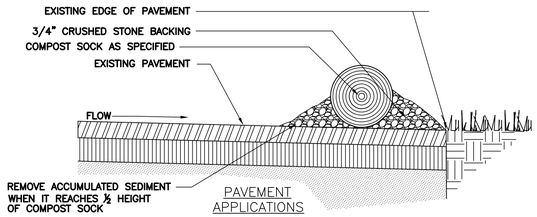
N

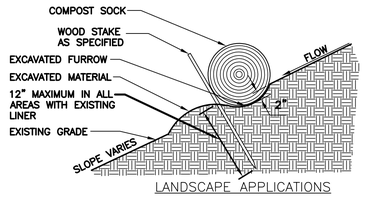
1 inch = 270 feet

0 150 300 600 Feet

CDM Smith

MCCAFFREYZC P:\Worcester\GreenwoodSt_Landfill\MXD\Greenwood_Remediation_Barrier_with.mxd 6/28/2022

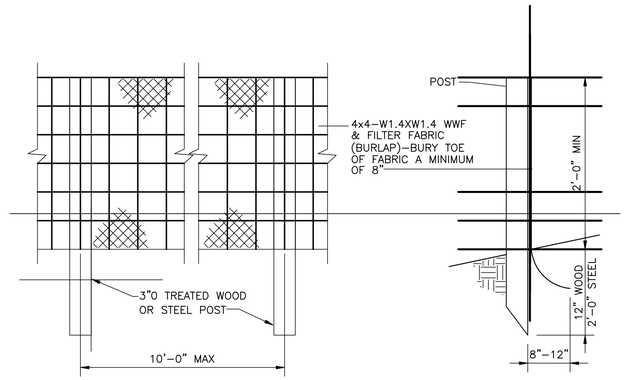




COMPOST SOCK

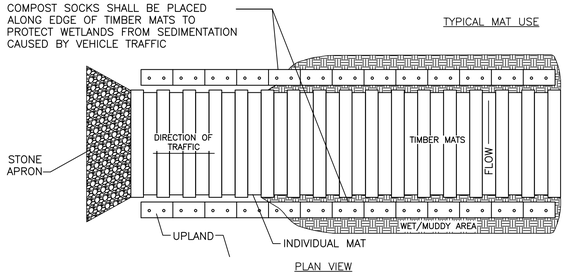
DETAIL

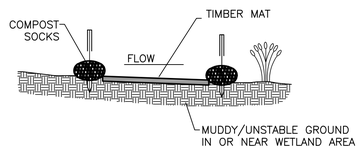
NOT TO SCALE



SILT FENCE DETAIL

NTS





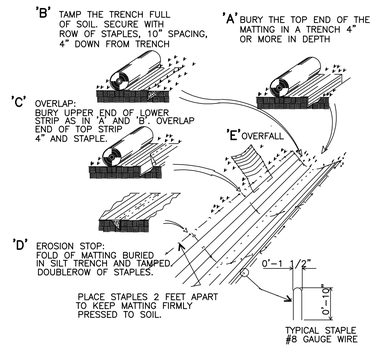
NOTES:

1. PLACE TIMBER MATS SO PLANKS ARE PERPENDICULAR TO DIRECTION OF TRAFFIC.
2. REMOVE SEDIMENT DEPOSITS ALONG EDGES OF MATS ON A REGULAR BASIS.
3. LENGTH OF MAT VARIES.
4. WIDTH VARIES BY MULTIPLES OF 4–FT. TYPICAL WIDTH IS 12–FT.
5. SOURCE: USACE – NEW ENGLAND DISTRICT, NE GP PERMIT RESOURCES, CONSTRUCTION MAT BMP'S – 6/10/13 DRAFT.

TIMBER MAT

DETAIL

NOT TO SCALE



EROSION CONTROL BLANKET

DETAIL

NTS

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: C. PETERSON
DRAWN BY: C. PETERSON
SHEET CHK'D BY: X
CROSS CHK'D BY: X
APPROVED BY: X
DATE: JULY 2022

CDM Smith
50 Hampshire Street
Cambridge, MA 02139
Tel: (617) 452-6000

CITY OF WORCESTER, MASSACHUSETTS

GREENWOOD STREET LANDFILL

MISCELLANEOUS DETAILS

PROJECT NO. 0198–223874
FILE NAME: C001STDT.DWG

SHEET NO.
C-1

30% SUBMITTAL - NOT FOR CONSTRUCTION

s

Appendix B

Existing Boring/Well Construction Logs and Borehole Geophysical Logs

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-1

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-95827

Drilling Contractor: Geosearch
Drilling Method/Rig: HSA, RC, RB/ATV CME 55 Track Rig
Drillers: J. Keenan, P. McClenahan, R. Richard, S. Preston
Drilling Date: Start: 8/8/14 **End:** 8/11/14
Logged By: N. Castonguay
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,187.50 E 576,325.61

Surface Elevation (ft.): 428.00
Top of PVC Riser Elevation (ft.): NA
Total Depth (ft.): 58
Depth to Initial Water Level (ft. BGS): 22.00
Development Method: Jetting
Development Date: Start 8/11/14 **End** 8/11/14

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								428.0	*Ground Surface*
					FILL	(0-10') No sample collected. Auger to 10' BGS. SLUDGE coming up with augers.		0	
								423.0 5	
								418.0	
SS	S1	0.0	2 3 9 7	24/6	FILL/ SP	(10-12') Top 2": Dry, medium dense, red-brown, SLUDGE. Bottom 4": Moist-wet, medium dense, tan, fine SAND, some silt, trace fine gravel.		10	
						(12-15') No sample collected. Auger to 15' BGS.			

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
RC = Rock Core
RB = Rollerbit
NA = Not applicable

Reviewed by: S. Lukas **Date:** 12-18-2017

BR MW LOG W/ 5 FOOT CORE GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 12/18/17

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-1

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-95827

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								413.0	
SS	S2	0.0	4 5 5 10	24/12	SP	(15-17') Wet, medium dense-loose, tan, fine SAND, some silt, little coarse sand, trace fine gravel.		15	
						(17-20') No sample collected. Auger to 20' BGS.		408.0	
SS	S3	0.0	10 20 23 12	24/12	SP	(20-22') Wet, dense, tan, fine SAND, some silt, little coarse-medium sand.		20	
					GNEISS	(22-28') GNEISS, NASHOBA FORMATION. Augers grinding and refusal at 22' BGS. Bedrock encountered at 22' BGS, rollerbit (5.785" ID) 22' to 28' BGS and install 4" permanent steel casing to 28' BGS. Tremie grout casing, let set overnight.		403.0 25	
CORE	S4		2min/12" 2min/12"	24/24	GNEISS	(28-30') Very hard, fresh, dark gray, coarse-fine feldspar, quartz, and sillimanite, medium-fine biotite mica, fine garnet and amphibolite, foliated with high angle gneissic banding (GNEISS). Joint set: low angle, moderate spacing, rough, stepped, tight and open fractures, NASHOBA FORMATION. Secondary mineralization observed on fracture surfaces, fractures noted at 31.2' BGS and 32.0' BGS. RQD = 100% Excellent.		398.0	
CORE	S5		3min/12" 8min/12" 10min/12" 18min/12" 20min/12"	60/60	GNEISS	(30-35') Very hard, fresh, light gray, coarse-fine quartz, feldspar, and sillimanite, medium-fine muscovite and garnet, gneissic banding (GNEISS). Primary joint set: horizontal-low angle, moderate-very close spacing, rough, stepped, tight and open fractures, NASHOBA FORMATION. Secondary mineralization and oxidation observed on fracture surfaces.		30 393.0	
					GNEISS	(35-58') GNEISS, NASHOBA FORMATION. Rollerbit (3.785") to 58' BGS.		35 388.0 40	

CDM Smith
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Boston, MA 02109

MONITORING WELL DETAIL
MW-1

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-95827

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						(35-58') GNEISS, NASHOBA FORMATION. Rollerbit (3.785") to 58' BGS.		383.0 / 45	
								378.0 / 50	
								373.0 / 55	
						End of Exploration at 58' BGS.		368.0 / 60	
								363.0 / 65	
								358.0	

CDM Smith

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MONITORING WELL DETAIL
MW-9

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-95827

Drilling Contractor: Geosearch
Surface Elevation (ft.): 436.00
Drilling Method/Rig: HSA/ATV CME 55 Track Rig
Top of PVC Riser Elevation (ft.): NA
Drillers: J. Keenan, S. Thomas
Total Depth (ft.): 40
Drilling Date: Start: 8/27/15 **End:** 8/28/15
Depth to Initial Water Level (ft. BGS):
Logged By: N. Castonguay
Development Method: Jetting
Field Screening Instrument: PID
Development Date: Start 8/28/15 **End** 8/28/15
Borehole Coordinates:
N 2,904,662.71 E 576,138.71

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								436.0	*Ground Surface*
					FILL	(0-5') No Sample Collected, Auger to 5' BGS with HSA. Augers starting to grind at 3-4' BGS and competent bedrock observed at 5' BGS.		0	
								431.0	
					GNEISS	(5-8') Rollerbit (6") to 8' BGS 3 feet into bedrock. Install and grout 4" permanent steel casing to 8' BGS. GNEISS, NASHOBA FORMATION		5	
					GNEISS	(8-50') Rollerbit (3.785") to 48' BGS - Open Borehole. GNEISS, NASHOBA FORMATION. Fractures at ~8' BGS, 11' BGS, and 13' BGS		426.0 10	
								421.0 15	
						Lost water due to fractures at 17' BGS			
								416.0	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- AH - Air Hammer
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- AS - Auger/Grab Sample
- CS - California Sampler
- BX - 1.5" Rock Core
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
RC = Rock Core
RB = Rollerbit
NA = Not applicable

Reviewed by: S. Lukas **Date:** 12-18-2017

BR MW LOG W/ 5 FOOT CORE GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 12/18/17

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-9

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-95827

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								416.0	
								20	
						Fracture at 24' BGS		411.0	
								25	
								406.0	
								30	
						Fracture at 32' BGS			
								401.0	
								35	
								396.0	
						End of Exploration at 40' BGS		40	
								391.0	
								45	
								386.0	
								50	
								381.0	
								55	
								376.0	

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL

MW-25D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, AH/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/2/20 **End:** 6/3/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,596.72 E 576,166.81

Surface Elevation (ft.): 432.51
Top of Casing Elevation (ft.): 439.16
Total Depth (ft.): 43
Depth to Initial Water Level (ft. AGS): 1.96
Development Method: Jetting
Development Date: Start 6/3/20 **End** 6/3/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								432.5	Top of PVC Riser @ 439.16 ft. Steel Casing Below PVC Riser *Ground Surface*
					SW	(0-5') Advace HSA (6.25" ID) to 5' BGS. Well graded sand and silt in auger cuttings.		0	
								427.5	
SS	S-1	0.0	12 33/3"	12/9	SW	(5-6') Top 3": Moist, hard, brown, SILT, trace roots and wood. Bottom 6": Moist, very dense, brown-gray, coarse-medium-fine SAND, little silt.		5	
					GNEISS	Spoon refusal and top of weathered bedrock observed at approximately 6' BGS.		422.5 10	(0-13.5') 4" Permanent Steel Casing
					GNEISS	(6-13.5') Airhammer (5.785" ID) 7.5' into bedrock. Encounter weathered bedrock first 3' from 6-9' BGS. Competent bedrock observed at 9' BGS. Install and tremie grout 4" permanent steel casing to 13.5' BGS. GNEISS, NASHOBA FORMATION.		417.5 15	
						(13.5-43') Airhammer (3.785" ID) to 43' BGS - Open Borehole. GNEISS, NASHOBA FORMATION.			(13.5-45') Open Bedrock Borehole
						(16.5-18') Fractures 16.5-18' BGS.		412.5	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
AGS = Above Ground Surface
PVC riser added to top of the permanent steel casing to 6.65' AGS (measuring point of well). Depth to initial water level (ft. AGS) measured July 2, 2020. Water observed AGS in casing.

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-25D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								412.5	
								20	
								407.5 25	
						(29-29.5) Major water bearing fracture at 29-29.5' BGS. Borehole producing water with sheen and odor. PID readings ~50 ppm in return water.		402.5 30	
						(29.5-43') No fractures encountered from 29.5-43' BGS.		397.5 35	
								392.5 40	Bottom of Bedrock Borehole at 43' BGS
						End of Exploration at 43' BGS. Artesian flowing conditions observed following jetting. Approximetly 6.65' of 4" PVC stickup added to permanent steel casing to allow for hydarulic head stabilizaton.		387.5 45	
								382.5 50	
								377.5 55	
								372.5	

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MONITORING WELL DETAIL
MW-26D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, AH/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/2/20 **End:** 6/3/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,465.21 E 576,192.15

Surface Elevation (ft.): 432.25
Top of Casing Elevation (ft.): 434.65
Total Depth (ft.): 53
Depth to Initial Water Level (ft. AGS): 1.78
Development Method: Jetting
Development Date: Start 6/3/20 **End** 6/3/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								432.3	Top of Steel Casing @ 434.65 ft. *Ground Surface*
SS	S-1	0.0	1 2 3 7	24/16	SP	(0-2') Top 4": Moist, loose, dark brown, SILT, trace roots. Bottom 12": Moist, loose, tan-light brown, fine SAND. Little FeO staining in top 3".		0	
SS	S-2	0.0	6 8 8 6	24/14	SP	(2-4') Moist, medium dense, tan, medium-fine SAND, little silt and fine gravel. FeO staining throughout.			
						(4-5') Advance HSA (6.25" ID) to 5' BGS.		427.3	
SS	S-3	0.0	13 16 10 10	24/14	SP	(5-7') Moist, medium dense, gray-light brown, fine SAND, some silt, trace coarse-medium sand.		5	(0-23') 4" Permanent Steel Casing
						(7-10') Advance HSA to 10' BGS.		422.3	
SS	S-4	0.0	8 14 9 10	24/11	SP	(10-12') Moist to wet, medium dense, light brown, fine SAND, some silt.		10	
						(12-15') Advance HSA to 15' BGS.		417.3	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
AGS = Above Ground Surfce
Depth to initial water level (ft. AGS) measured July 2, 2020. Water observed AGS in steel casing.

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-26D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								417.3	
SS	S-5	0.0	12 22 30 50	24/16	ML-SM	(15-17') Moist to wet, very dense-hard, gray, fine SAND and SILT, trace fine gravel and medium sand. Little FeO staining.		15	
						(17-19') Advance HSA to 19' BGS. Augers grinding to refusal at 19' BGS. Attempt SS sample at 19' BGS.			
SS	S-6	0.0	50/4"	4/3	ML-SM	(19-19.25') Moist to wet, very dense-hard, gray, fine SAND and SILT, trace fine gravel and medium sand. Little FeO staining.			
					GNEISS	Spoon refusal and top of competent bedrock observed at 19.25' BGS.		412.3 20	
						(19.25-23') Airhammer (5.785" ID) 3.75' into bedrock. Install and tremie grout 4" permanent steel casing to 23' BGS. GNEISS, NASHOBA FORMATION.			
					GNEISS	(23-53') Airhammer (3.785" ID) to 53' BGS - Open Borehole. GNEISS, NASHOBA FORMATION.		407.3 25	
								402.3 30	(23-53') Open Bedrock Borehole
								397.3 35	
						(38') Fracture at 38' BGS.		392.3 40	
								387.3	

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MONITORING WELL DETAIL
MW-26D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								387.3 45	
						(49') Water bearing fracture at 49' BGS.		382.3 50	
						End of Exploration at 53' BGS.		377.3 55	Bottom of Bedrock Borehole at 53' BGS
								372.3 60	
								367.3 65	
								362.3 70	
								357.3	

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-26M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/3/20 **End:** 6/3/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,459.49 E 576,190.15

Surface Elevation (ft.): 432.25
Top of Casing Elevation (ft.): 434.78
Total Depth (ft.): 19
Depth to Initial Water Level (ft. BGS): 6.45
Development Method: Surge and Purge via Whale pump
Development Date: Start 6/23/20 **End** 6/23/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								432.3 / 0	Protective Casing Top of Riser @ 434.78 ft. *Ground Surface*
SS	S-1	0.0	1 2 3 7	24/16	SP	(0-2') Top 4": Moist, loose, dark brown, SILT, trace roots. Bottom 12": Moist, loose, tan-light brown, fine SAND. Little FeO staining in top 3".			(0-1') Concrete (1-3') Slough Backfill
SS	S-2	0.0	6 8 8 6	24/14	SP	(2-4') Moist, medium dense, tan, medium-fine SAND, little silt and fine gravel. FeO staining throughout.		427.3 / 5	(3-7') Medium Bentonite Chips
SS	S-3	0.0	13 16 10 10	24/14	SP	(4-5') Advance HSA (6.25" ID) to 5' BGS. (5-7') Moist, medium dense, gray-light brown, fine SAND, some silt, trace coarse-medium sand. (7-10') Advance HSA to 10' BGS.		422.3 / 10	(7-19') #2 Silica Sand
SS	S-4	0.0	8 14 9 10	24/11	SP	(10-12') Moist to wet, medium dense, light brown, fine SAND, some silt. (12-15') Advance HSA to 15' BGS.			(0-19') 2" Schedule 40 PVC Riser
SS	S-5	0.0	12 22 30 50	25/16	ML-SM	(15-17') Moist to wet, very dense-hard, gray, fine SAND and SILT, trace fine gravel and medium sand. Little FeO staining. (17-19') Augers grinding and top of competent bedrock observed at 19' BGS. End of Exploration at 19' BGS.		417.3 / 15 412.3 / 20	Bottom of Well at 19' BGS

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020
Material descriptions provided are those observed in MW-26D

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-27D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Surface Elevation (ft.): 431.20
Drilling Method/Rig: HSA, AH, RC, RB/ATV CME 55 Track Rig
Top of Casing Elevation (ft.): 433.28
Drillers: S. Preston, A. Gonzales
Total Depth (ft.): 60
Drilling Date: Start: 6/4/20 **End:** 6/8/20
Depth to Initial Water Level (ft. AGS): 0.86
Logged By: S. Lukas
Development Method: Jetting
Field Screening Instrument: PID
Development Date: Start 6/8/20 **End** 6/8/20
Borehole Coordinates:
N 2,904,328.47 E 576,213.67

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								431.2	Top of Steel Casing @ 433.28 ft. *Ground Surface*
SS	S-1	0.0	2 2 4 6	24/24	SW	(0-2') Top 12" Moist, loose, brown, SILT, trace roots. Bottom 12": Moist, loose, tan, medium-fine SAND, little silt.		0	
SS	S-2	0.0	13 16 18 19	24/24	SW	(2-4') Top 12": Moist, dense, tan-brown, coarse-medium-fine SAND, trace fine gravel. Bottom 12": Moist, dense, gray-brown, medium-fine SAND, trace silt.			
						(4-5') Advance HSA (6.25" ID) to 5' BGS.		426.2 5	
SS	S-3	0.0	4 8 8 8	24/24	SW	(5-7') Moist to wet, medium dense, tan, coarse-medium-fine SAND, little silt. Trace FeO staining in bottom 3".			(0-30') 4" Permanent Steel Casing
SS	S-4	0.0	6 15 17 17	24/18	SP	(7-9') Wet, dense, gray-brown, medium-fine SAND, some silt, trace fine gravel.			
						(9-10') Advance HSA to 10' BGS.		421.2 10	
SS	S-5	0.0	4 6 15 6	24/17	SP	(10-12') Wet, medium dense, gray, fine SAND, some silt, little medium-fine gravel and medium sand.			
SS	S-6	0.1	6 6 5 8	24/24	SP	(12-14') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel.			
						(14-15') Advance HSA to 15' BGS.		416.2	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
RC = Rock Core
RB = Rollerbit
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. AGS) measured July 2, 2020. Water observed in steel casing.

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-27D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								416.2	
SS	S-7	0.0	3 6 12 12	24/16	SP	(15-17') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel and clay.		15	
SS	S-8	0.0	10 14 27 30	24/24	SP	(17-19') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel and clay.			
						(19-20') Advance HSA to 20' BGS.		411.2	
SS	S-9	0.0	42 33 30 26	24/17	ML-SM	(20-22') Wet, very dense, gray, fine SAND and SILT, some medium-fine gravel, trace clay.		20	
SS	S-10	0.0	35 40 46 100/5"	23/23	ML-SM	(22-24') Wet, very dense-hard, fine SAND and SILT, some medium-fine gravel, trace clay.			
						(24-25') Advance HSA to 25' BGS.		406.2	
SS	S-11	0.3	27 27 50/4"	16/12	ML-SM	(25-26.3') Wet, very dense-hard, fine SAND and SILT, some medium-fine gravel, trace clay.		25	
					GNEISS	Spoon refusal and top of competent bedrock at 26.3' BGS.			
						(26.3-30') Rollerbit (5.785" ID) 3.7' into bedrock. Install and tremie grout 4" permanent steel casing to 30' BGS. GNEISS, NASHOBA FORMATION.		401.2	
					GNEISS	(26.3-60') Rollerbit (3.785") from 30-50' BGS. GNEISS, NASHOBA FORMATION.		30	(30-60') Open Bedrock Borehole
						(33') Fracture at 33' BGS.		396.2 35	
								391.2 40	
						(41.5') Fracture at 41.5' BGS.			
								386.2	

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Boston, MA 02109

MONITORING WELL DETAIL
MW-27D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								386.2	
						(50-60') Advance via HQ core to 60' BGS.		45	
								381.2	
CORE	C-1		10 min/ft 9 min/ft 5 min/ft 4 min/ft NM	60/55	GNEISS	(50-55') Very hard, fresh, dark gray, coarse-fine feldspar, quartz, sillimanite, medium-fine biotite mica, fine amphibolite, foliated with low to gneissic banding. Joint set; low angle, close-moderate spacing, tight to open fractures, rough, stepped. RQD: 72% FAIR. -GNEISS, NASHOBA FORMATION-		50	
								376.2	
CORE	C-2		5 min/ft 10 min/ft 6 min/ft 7 min/ft 6 min/ft	60/60	GNEISS	(55-60') Very hard, fresh, dark gray, coarse-fine feldspar, quartz, sillimanite, medium-fine biotite mica, fine amphibolite, foliated with low to gneissic banding. Joint set; low angle, close-moderate spacing, tight to open fractures, rough, stepped. RQD: 88% GOOD. -GNEISS, NASHOBA FORMATION-		55	
								371.2	Bottom of Bedrock Borehole at 60' BGS
						End of Exploration at 60' BGS.		60	
								366.2	
								65	
								361.2	
								70	
								356.2	

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-27M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/8/20 **End:** 6/8/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,323.65 E 576,214.03

Surface Elevation (ft.): 431.20
Top of Casing Elevation (ft.): 433.21
Total Depth (ft.): 26
Depth to Initial Water Level (ft. BGS): 8.57
Development Method: Surge and Purge via Whale pump
Development Date: Start 6/23/20 **End** 6/23/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								431.2	Protective Casing Top of Riser @ 433.21 ft. *Ground Surface*
SS	S-1	0.0	2 2 4 6	24/24	SW	(0-2') Top 12" Moist, loose, brown, SILT, trace roots. Bottom 12": Moist, loose, tan, medium-fine SAND, little silt.		0	(0-1') Concrete (1-3') Slough Backfill
SS	S-2	0.0	13 16 18 19	24/24	SW	(2-4') Top 12": Moist, dense, tan-brown, coarse-medium-fine SAND, trace fine gravel. Bottom 12": Moist, dense, gray-brown, medium-fine SAND, trace silt.			
						(4-5') Advance HSA (6.25" ID) to 5' BGS.		426.2 5	
SS	S-3	0.0	4 8 8 8	24/24	SW	(5-7') Moist to wet, medium dense, tan, coarse-medium-fine SAND, little silt. Trace FeO staining in bottom 3".			(3-14') Medium Bentonite Chips
SS	S-4	0.0	6 15 17 17	24/18	SP	(7-9') Wet, dense, gray-brown, medium-fine SAND, some silt, trace fine gravel.			
						(9-10') Advance HSA to 10' BGS.		421.2 10	
SS	S-5	0.0	4 6 15 6	24/17	SP	(10-12') Wet, medium dense, gray, fine SAND, some silt, little medium-fine gravel and medium sand.			
SS	S-6	0.1	6 6 5 8	24/24	SP	(12-14') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel.			(0-16') 2" Schedule 40 PVC Riser
						(14-15') Advance HSA to 15' BGS.		416.2	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
AGS = Above Ground Surface
Depth to initial water level (ft. AGS) measured July 2, 2020. Water observed AGS in PVC riser.
Material descriptions provided are those observed in MW-27D.

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-27M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								416.2	
SS	S-7	0.0	3 6 12 12	24/16	SP	(15-17') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel and clay.		15	
SS	S-8	0.0	10 14 27 30	24/24	SP	(17-19') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel and clay.			(14-26') #2 Silica Sand
						(19-20') Advance HSA to 20' BGS.		411.2	
SS	S-9	0.0	42 33 30 26	24/17	ML-SM	(20-22') Wet, very dense-hard, gray, fine SAND and SILT, some medium-fine gravel, trace clay.		20	(16-26') 2" (.01") Slot Schedule 40 PVC Screen
SS	S-10	0.0	35 40 46 100/5"	23/23	ML-SM	(22-24') Wet, very dense-hard, fine SAND and SILT, some medium-fine gravel, trace clay.			
						(24-25') Advance HSA to 25' BGS.		406.2	
SS	S-11	0.3	27 27 50/4"	16/12	ML-SM	(25-26.3') Wet, very dense-hard, fine SAND and SILT, some medium-fine gravel, trace clay. 2" piece of granite gneiss in bottom of spoon. Spoon refusal and top of bedrock encountered at 26.3' BGS. End of exploration at 26.3' BGS.		25	Bottom of Well at 26' BGS
								401.2 30	
								396.2 35	
								391.2 40	
								386.2	

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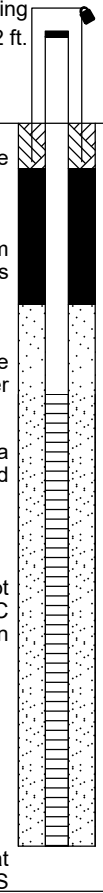
MONITORING WELL DETAIL
MW-27S

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/10/20 **End:** 6/10/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,323.65 E 576,214.03

Surface Elevation (ft.): 431.20
Top of Casing Elevation (ft.): 433.12
Total Depth (ft.): 16
Depth to Initial Water Level (ft. BGS): 8.68
Development Method: Surge and Purge via Whale pump
Development Date: Start 6/23/20 **End** 6/23/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)
								431.2 / 0 *Ground Surface*
SS	S-1	0.0	2 2 4 6	24/24	SW	(0-2') Top 12" Moist, loose, brown, SILT and ORGANIC MATERIAL (TOPSOIL), trace roots. Bottom 12": Moist, loose, tan, medium-fine SAND, little silt.		
SS	S-2	0.0	13 16 18 19	24/24	SW	(2-4') Top 12": Moist, dense, tan-brown, coarse-medium-fine SAND, trace fine gravel. Bottom 12": Moist, dense, gray-brown, medium-fine SAND, trace silt.		426.2 / 5
SS	S-3	0.0	4 8 8 8	24/24	SW	(4-5') Advance HSA (6.25" ID) to 5' BGS.		
SS	S-4	0.0	6 15 17 17	24/18	SP	(5-7') Moist to wet, medium dense, tan, coarse-medium-fine SAND, little silt. Trace FeO staining in bottom 3".		
						(7-9') Wet, dense, gray-brown, medium-fine SAND, some silt, trace fine gravel.		421.2 / 10
SS	S-5	0.0	4 6 15 6	24/17	SP	(9-10') Advance HSA to 10' BGS. (10-12') Wet, medium dense, gray, fine SAND, some silt, little medium-fine gravel and medium sand.		
SS	S-6	0.1	6 6 5 8	24/24	SP	(12-14') Wet, medium dense, gray, fine SAND, some silt, trace fine gravel.		
						Advance augers to 16' BGS. End of Exploration at 16' BGS.		416.2 / 15



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020
Material descriptions provided are those observed in MW-27D

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-28D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, AH, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/9/20 **End:** 6/11/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,205.15 E 576,281.65

Surface Elevation (ft.): 428.36
Top of Casing Elevation (ft.): 430.61
Total Depth (ft.): 60
Depth to Initial Water Level (ft. BGS): 6.74
Development Method: Jetting
Development Date: Start 6/11/20 **End** 6/11/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								428.4	Top of Steel Casing @ 430.61 ft. *Ground Surface*
SS	S-1	0.0	2 2 2 2	24/18	SP	(0-2') Top 6": Dry to moist, very loose, brown SILT and ORGANIC MATERIAL (TOPSOIL), trace roots and medium-fine sand. Bottom 12": Moist, very loose, light brown-tan, fine SAND, little silt, trace medium sand. (2-5') Advance HSA (6.25" ID) to 5' BGS.		0 423.4	
SS	S-2	0.0	5 4 2 4	24/24	SLUDGE	(5-7') Moist, loose, red-brown, SLUDGE, trace roots.		5	(0-29') 4" Permanent Steel Casing
					SLUDGE	(7-10') Advance HSA to 10' BGS.		418.4	
SS	S-3	0.0	18 11 9 10	24/10	SW	(10-12') Top 4": Dry, medium dense, gray, crushed rock (cobble). Bottom 6": Moist, medium-dense, gray-brown, medium-fine SAND, some silt, little fine gravel. Augers grinding and refusal encountered at 12.25' BGS. Move borehole approx. 3.5' southeast. (0-15') Advance HSA (6.25" ID) to 15' BGS.		10 413.4	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-28D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								413.4	
17	S-4	0.0	4 4 10 15	24/11	ML-SM	(15-17') Moist, medium dense-stiff, gray, fine SAND and SILT, little fine gravel, trace clay.		15	
						(17-20') Advance HSA to 20' BGS.		408.4	
22	S-5	0.0	20 22 20 22	24/14	ML-SM	(20-22') Wet, dense-hard, gray-light brown, fine SAND and SILT, some medium sand, little fine gravel.		20	
					GNEISS	(22-29') HSA grinding to refusal and top of competent bedrock encountered at 22' BGS. Airhammer (5.785") 7' into bedrock. Install and tremie grout 4" permanent steel casing to 29' BGS. GNEISS, NASHOBA FORMATION.		403.4 25	
					GNEISS	(29-60') Airhammer (3.785" ID) to 60' BGS - Open Borehole. GNEISS, NASHOBA FORMATION.		398.4 30	(29-60') Open Bedrock Borehole
						(34') Fracture at 34' BGS.		393.4 35	
						(37.5') Fracture at 37.5' BGS.			
						(39') Fracture at 39' BGS.		388.4 40	
						(44.5-46') Fractures 44.5-46' BGS.		383.4	

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MONITORING WELL DETAIL
MW-28D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								383.4 45	
						(47') Water produced from borehole at approximately 47' BGS.			
								378.4 50	
						(54') Fracture at 54' BGS.			
								373.4 55	
								368.4 60	Bottom of Bedrock Borehole at 60' BGS
						End of Exploration at 60' BGS.			
								363.4 65	
								358.4 70	
								353.4	

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MONITORING WELL DETAIL
MW-28M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/10/20 **End:** 6/10/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,208.40 E 576,289.25

Surface Elevation (ft.): 428.36
Top of Casing Elevation (ft.): 430.43
Total Depth (ft.): 24
Depth to Initial Water Level (ft. BGS): 6.68
Development Method: Surge and Purge via Whale pump
Development Date: Start 6/23/20 **End** 6/23/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Protective Casing Top of Riser @ 430.43 ft.
								428.4	*Ground Surface*
SS	S-1	0.0	2 2 2 2	24/18	SP	(0-2') Top 6": Dry to moist, very loose, brown SILT, trace roots and medium-fine sand. Bottom 12": Moist, very loose, light brown-tan, fine SAND, little silt, trace medium sand.		0	(0-1') Concrete
						(2-5') Advance HSA (6.25" ID) to 5' BGS.			(1-12') Medium Bentonite Chips
								423.4	
SS	S-2	0.0	5 4 2 4	24/24	SLUDGE	(5-7') Moist, loose, red-brown, SLUDGE, trace roots.		5	
					SLUDGE	(7-10') Advance HSA to 10' BGS.			(0-16') 2" Schedule 40 PVC Riser
								418.4	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020
Material descriptions provided are those observed in MW-28D

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-28M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								418.4	
SS	S-3	0.0	18 11 9 10	24/10	SW	(10-12') Top 4": Dry, medium dense, gray, crushed rock (cobble). Bottom 6": Moist, medium dense, gray-brown, medium-fine SAND, some silt, little fine gravel.		10	
						Augers grinding and refusal encountered at 12.25' BGS. Move borehole approx. 3.5' southeast. (0-15') Advance HSA (6.25" ID) to 15' BGS at secondary location.			
								413.4	
17	S-4	0.0	4 4 10 15	24/11	ML-SM	(15-17') Moist, medium dense-stiff, gray, fine SAND and SILT, little fine gravel, trace clay.		15	(12-24') #2 Silica Sand
						(17-20') Advance HSA to 20' BGS.			(14-24') 2" (.01") Slot Schedule 40 PVC Screen
								408.4	
22	S-5	0.0	20 22 20 22	24/14	ML-SM	(20-22') Wet, dense-hard, gray-light brown, fine SAND and SILT, some medium sand, little fine gravel.		20	
						Advance HSA to 24' BGS.			
						End of Exploration at 24' BGS.			Bottom of Well at 24' BGS
								403.4 25	
								398.4	

CDM Smith

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Boston, MA 02109

MONITORING WELL DETAIL
MW-29D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, AH, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/11/20 **End:** 6/12/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,043.57 E 576,373.12

Surface Elevation (ft.): 424.49
Top of Casing Elevation (ft.): 426.99
Total Depth (ft.): 69
Depth to Initial Water Level (ft. BGS): 5.26
Development Method: Jetting
Development Date: Start 6/12/20 **End** 6/12/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Top of Steel Casing @ 426.99 ft.
								424.5	*Ground Surface*
SS	S-1	0.0	WOH WOH WOH WOH	24/6	SLUDGE	(0-2') Dry, loose, brown, SLUDGE.		0	
					SLUDGE	(2-5') Advance HSA (6.25" ID) to 5' BGS.		419.5	
SS	S-2	0.0	3 2 4 3	24/18	SLUDGE	(5-7') Top 3": Dry, loose, brown, SLUDGE. Bottom 15": Moist, loose, black-gray, fine SAND and SLUDGE, some silt, little coarse-medium sand. Black staining.		5	(0-34') 4" Permanent Steel Casing
					SLUDGE	(7-10') Advance HSA to 10' BGS.		414.5	
SS	S-3	0.0	6 10 13 6	24/10	SP	(10-12') Top 3": Wet, moist, medium dense, black-gray, fine SAND and SLUDGE, some silt, little coarse-medium sand. Black staining.		10	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-29D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						Bottom 7": Wet, medium dense, tan, fine SAND, some silt, little medium-fine gravel. Water table encountered at approximate 10' BGS. (12-15') Advance HSA to 15' BGS.		409.5 15	
SS	S-4	0.0	6 12 23 40	24/14	ML-SM	(15-17') Wet, dense-very hard, tan, fine SAND and SILT, trace fine gravel and coarse-medium sand.			
						(17-20') Advance HSA to 20' BGS.		404.5 20	
SS	S-5	0.0	25 80 150/6"	18/12	ML-SM	(20-21.5') Wet, very dense, tan-gray, fine SAND and SILT, some medium-fine gravel and medium sand, trace clay.			
						Spoon refusal encountered at 21.5' BGS. (21.5-22') Advance HSA to 22' BGS. Augers grinding and refusal at 22' BGS. Airhammer (5.785") past boulder to 22.5. Airhammer through overburden to top of bedrock at 30' BGS. See MW-29M log for 25-27' SS.		399.5 25	
						(30-34') Airhammer (5.785") 4' into bedrock. Install and tremie grout 4" permanent steel casing to 34' BGS. GNEISS, NASHOBA FORMATION.		394.5 30	
					GNEISS	(34-69') Airhammer (3.785" ID) to 69' BGS - Open Borehole. GNEISS, NASHOBA FORMATION.		389.5 35	

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MONITORING WELL DETAIL
MW-29D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						(38.5') Fracture at 38.5' BGS.		384.5 / 40	(34-69') Open Bedrock Borehole
						(44') Fracture at 44' BGS.		379.5 / 45	
						(48-49') Fractures 48-49' BGS.		374.5 / 50	
						(51-52') Fractures 51-52' BGS.			
						(55') Fracture at 55' BGS.		369.5 / 55	
								364.5	

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MONITORING WELL DETAIL
MW-29D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								364.5 / 60	
								359.5 / 65	Bottom of Bedrock Borehole at 69' BGS
						End of Exploration at 69' BGS.		354.5 / 70	
								349.5 / 75	
								344.5 / 80	

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MONITORING WELL DETAIL
MW-29M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch, Inc.
Drilling Method/Rig: HSA, RB/ATV CME 55 Track Rig
Drillers: S. Preston, A. Gonzales
Drilling Date: Start: 6/12/20 **End:** 6/12/20
Logged By: S. Lukas
Field Screening Instrument: PID
Borehole Coordinates:
N 2,904,050.74 E 576,371.18

Surface Elevation (ft.): 424.49
Top of Casing Elevation (ft.): 427.13
Total Depth (ft.): 30
Depth to Initial Water Level (ft. BGS): 5.04
Development Method: Surge and Purge via Whale pump
Development Date: Start 6/23/20 **End** 6/23/20

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Protective Casing Top of Riser @ 427.13 ft.
								424.5	*Ground Surface*
SS	S-1	0.0	WOH WOH WOH WOH	24/6	SLUDGE	(0-2') Dry, loose, brown, TOPSOIL and SLUDGE.		0	(0-1') Concrete
					SLUDGE	(2-5') Advance HSA (6.25" ID) to 5' BGS.		419.5	
SS	S-2	0.0	3 2 4 3	24/18	SLUDGE	(5-7') Top 3": Dry, loose, brown, SLUDGE. Bottom 15": Moist, loose, black-gray, fine SAND and SLUDGE, some silt, little coarse-medium sand. Black staining.		5	(1-16') Grout
					SLUDGE	(7-10') Advance HSA to 10' BGS.		414.5	
SS	S-3	0.0	6 10 13 6	24/10	SP	(10-12') Top 3": Wet, moist, medium dense, black-gray, fine SAND and SLUDGE, some silt, little coarse-medium sand. Black staining.		10	

EXPLANATION OF ABBREVIATIONS

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HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
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FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
PID = Photoionization Detector
NA = Not Applicable
ID = Inside Diameter
Depth to initial water level (ft. BGS) measured July 2, 2020
Material descriptions provided are those observed in MW-29D

Reviewed by: N. Castonguay **Date:** 11/5/2020

V3 GREENWOOD STREET BEDROCK WELL BLOCK GREENWOOD ST JULY-AUGUST DRILLING LOGS.GPJ CDM_MA.GDT 11/23/20

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-29M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 in./ Drilling Rate	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						Bottom 7": Wet, medium dense, tan, fine SAND, some silt, little medium-fine gravel. Water table encountered at approximate 10' BGS. (12-15') Advance HSA to 15' BGS.		409.5 15	(0-20') 2" Schedule 40 PVC Riser
SS	S-4	0.0	6 12 23 40	24/14	ML-SM	(15-17') Wet, dense-very hard, tan, fine SAND and SILT, trace fine gravel and coarse-medium sand.			
						(17-20') Advance HSA to 20' BGS.		404.5 20	(16-18') Medium Bentonite Chips
SS	S-5	0.0	25 80 150/6"	18/12	ML-SM	(20-21.5') Wet, very dense, tan-gray, fine SAND and SILT, some medium-fine gravel and medium sand, trace clay.			
						(21.5-25') Advance HSA to 25' BGS.			(18-30') #2 Silica Sand
SS	S-6	0.0	22 43 50/5"	17/11	ML-SM	(25-27') Wet, very dense, fine SAND and SILT, trace fine gravel.		399.5 25	(20-30') 2" (.01") Slot Schedule 40 PVC Screen
						Advance HSA to 30' BGS.			
						End of Exploration at 30' BGS.		394.5 30	Bottom of Well at 30' BGS
								389.5 35	

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MONITORING WELL DETAIL
MW-35D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Surface Elevation (ft.): Not Measured
Drilling Method/Rig: HSA / AH/CME 55LC ATV
Top of PVC Riser Elevation (ft.): 0.25
Drillers: P. McClenahan, C. Stamas
Total Depth (ft.): 50
Drilling Date: Start: 2/7/2022 **End:** 2/7/2022
Depth to Initial Water Level (ft. BGS): 5.97
Logged By: D. Roth
Development Method: Surge & Purge via Whale Pump
Field Screening Instrument: PID

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Top of Riser @ 0.25 ft.
									Ground Surface
SS	S-1	0.0	9 10 11 5	24/15	SW	(0-2') Dry, medium dense, dark to light-brown, coarse to fine SAND.		0	(0-1') Concrete
						(2-5') Advance HSA (4.25" ID) to 5 ft BGS.			
SS	S-2	0.0	3 4 4 7	24/13	SW	(5-7') Dry to moist, loose, light-brown to grey, coarse to fine SAND, little silt.		5	
						(7-10') Advance HSA to 10 ft BGS.			
SS	S-3	0.8	1 4 3 3	24/13	SW	(10-12') Wet, loose, light-brown to grey, coarse to fine SAND, little silt.		10	(1-35') Grout
SS	S-4	0.2	3 7 8 6	24/21	SW	(12-14') Wet, medium dense, light-brown, medium to fine SAND, little silt.			
						(14-15') Advance HSA to 15 ft BGS.			
SS	S-5	NM	3 3 4 5	24/13	SW	(15-17') Wet, loose, brown to grey, medium to fine SAND, some silt, little to trace coarse to fine gravel.		15	
						(17-20') Advance HSA to 20 ft BGS.			

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- AH - Air Hammer
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- AS - Auger/Grab Sample
- CS - California Sampler
- BX - 1.5" Rock Core
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/7/2022 following well installation.

Reviewed by: N. Castonguay **Date:** 9/23/2022

CDM Smith
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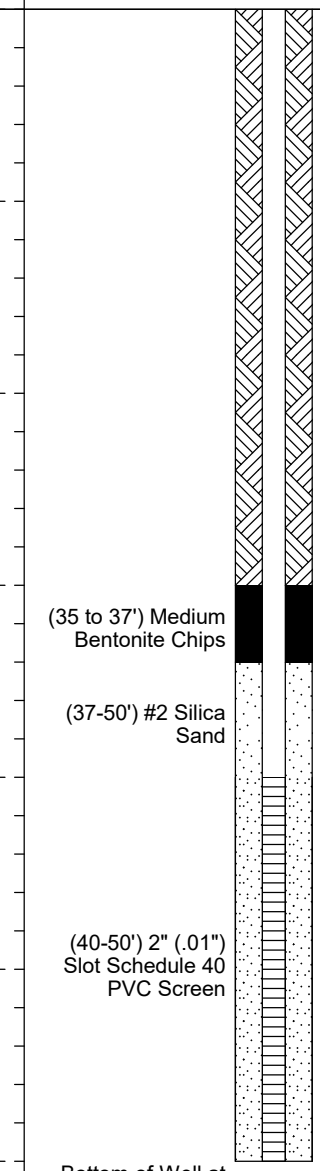
MONITORING WELL DETAIL
MW-35D

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Elev. Depth (ft.)
SS	S-6	0.9	13 17 23 31	24/15	SP-SM	(20-22') Wet, dense, fine SAND & SILT, little medium sand, trace coarse sand.	20
						(22-25') Advance HSA to 25 ft BGS.	
SS	S-7	16.0	20 19 15 20	24/11	SP-SM	(25-27') Wet, dense, fine SAND & SILT, little medium sand, trace coarse sand.	25
SS	S-8	9.4	20 20 23 23	24/13	SP-SM	(27-29') Wet, dense, light-brown to grey, fine SAND, some silt, trace weathered rock. Advance HSA to bedrock refusal at 29 ft BGS, Switch to Air Hammer drilling (3.785" ID)	
					GNEISS	(29-50') Advance Air Hammer through bedrock to 50 ft BGS (30') Fracture at 30 ft BGS	30
						(36') Fracture at 36 ft BGS	35
						(45') Fracture at 45 ft BGS	40 45
						End of Exploration at 50 ft BGS	50
							55



BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
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MONITORING WELL DETAIL
MW-35M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/7/2022 **End:** 2/7/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): 0.36
Total Depth (ft.): 29
Depth to Initial Water Level (ft. BGS): 8.36
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
SS	S-1	0.0	9 10 11 5	24/15	SW	(0-2') Dry, medium dense, dark to light-brown, coarse to fine SAND.		0
						(2-5') Advance HSA (4.25" ID) to 5 ft BGS.		
SS	S-2	0.0	3 4 4 7	24/13	SW	(5-7') Dry to moist, loose, light-brown to grey, coarse to fine SAND, little silt.		5
						(7-10') Advance HSA to 10 ft BGS.		
SS	S-3	0.8	1 4 3 3	24/13	SW	(10-12') Wet, loose, light-brown to grey, coarse to fine SAND, little silt.		10
SS	S-4	0.2	3 7 8 6	24/21	SW	(12-14') Wet, medium dense, light-brown, medium to fine SAND, little silt.		
						(14-15') Advance HSA to 15 ft BGS.		
SS	S-5	NM	3 3 4 5	24/13	SW	(15-17') Wet, loose, brown to grey, medium to fine SAND, some silt, little to trace coarse to fine gravel.		15
						(17-20') Advance HSA to 20 ft BGS.		

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- AH - Air Hammer
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- AS - Auger/Grab Sample
- CS - California Sampler
- BX - 1.5" Rock Core
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/7/2022 following well installation.

Reviewed by: N. Castonguay **Date:** 9/23/2022

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MONITORING WELL DETAIL

MW-35M

Client: City of Worcester

Project Name: Greenwood St. Landfill

Project Location: Worcester, MA

Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
SS	S-6	0.9	13 17 23 31	24/15	SP-SM	(20-22') Wet, dense, fine SAND & SILT, little medium sand, trace coarse sand.		20	
						(22-25') Advance HSA to 25 ft BGS.			(19-29') 2" (.01") Slot Schedule 40 PVC Screen
SS	S-7	16.0	20 19 15 20	24/11	SP-SM	(25-27') Wet, dense, fine SAND & SILT, little medium sand, trace coarse sand.		25	
SS	S-8	9.4	20 20 23 23	24/13	SP-SM	(27-29') Wet, dense, light-brown to grey, fine SAND, some silt, trace weathered rock.			
						End of Exploration at 29 ft BGS.		30	Bottom of Well at 29 ft BGS
								35	
								40	
								45	
								50	
								55	

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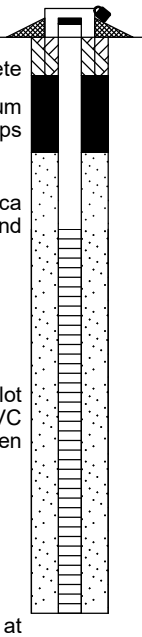
MONITORING WELL DETAIL
MW-35S

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/8/2022 **End:** 2/8/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): Not Measured
Total Depth (ft.): 15
Depth to Initial Water Level (ft. BGS): 7.95
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
SS	S-1	0.0	9 10 11 5	24/15	SW	(0-2') Dry, medium dense, dark to light-brown, coarse to fine SAND.		0
						(2-5') Advance HSA (4.25" ID) to 5 ft BGS.		
SS	S-2	0.0	3 4 4 7	24/13	SW	(5-7') Dry, loose, light-brown to grey, coarse to fine SAND, little silt.		5
						(7-10') Advance HSA to 10 ft BGS.		
SS	S-3	0.8	1 4 3 3	24/13	SW	(10-12') Wet, loose, light-brown to grey, coarse to fine SAND, little silt.		10
SS	S-4	0.2	3 7 8 6	24/21	SW	(12-14') Wet, medium dense, light-brown, medium to fine SAND, little silt.		
						(14-15') Advance HSA to 15 ft BGS.		
						End of Exploration at 15 ft BGS.		15



EXPLANATION OF ABBREVIATIONS

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- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
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- AH - Air Hammer
- DTR - Dual Tube Rotary
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- MR - Mud Rotary
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- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- AS - Auger/Grab Sample
- CS - California Sampler
- BX - 1.5" Rock Core
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/8/2022 following well installation.

Reviewed by: N. Castonguay **Date:** 9/23/2022

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-36M

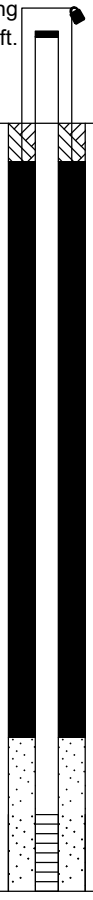
Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/9/2022 **End:** 2/9/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): 2.55
Total Depth (ft.): 28
Depth to Initial Water Level (ft. BGS): 6.73
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
						(0-5') Advance HSA (4.25" ID) to 5 ft BGS.		0
SS	S-1	0.2	5 5 6 7	24/20	SW	(5-7') Moist, medium dense, grey to light-brown, coarse to fine SAND, little silt.		5
						(7-10') Advance HSA to 10 ft BGS.		
SS	S-2	0.8	4 2 3 2	24/12	SP-SM	(10-12') Top 4": Wet, loose, grey to light-brown, coarse to fine SAND, little silt. Bottom 8": Wet, loose, grey to light-brown, fine SAND, some silt, trace medium to fine gravel.		10
						(12-15') Advance HSA to 15 ft BGS.		
SS	S-3	1.8	3 3 9 15	24/15	SP-SM	(15-17') Wet, medium dense, grey to light-brown, fine SAND, some silt, trace medium to fine gravel.		15
						(17-20') Advance HSA to 20 ft BGS.		

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

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HSA - Hollow Stem Auger
SSA - Solid Stem Auger
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DTC - Drill Through Casing

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BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/8/2022 following well installation.
MW-36M installed 10 ft downgradient from MW-27 well cluster.

Reviewed by: N. Castonguay **Date:** 9/23/2022

CDM Smith
75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-36M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
SS	S-4	11.5	13 14 14 18	24/16	SP-SM	(20-22') Wet, medium dense, grey, fine SAND & SILT, trace medium to fine sand.		20	
						(22-25') Advance HSA to 25 ft BGS.			(18-28') 2" (.01") Slot Schedule 40 PVC Screen
SS	S-5	16.6	23 50 51 33	24/13	SW	(25-27') Wet, very dense, grey to light-brown, medium to fine SAND, little silt, weathered rock at bottom of spoon (suspected bedrock).		25	
						(27-28') Advance HSA to bedrock refusal at 28 ft BGS.			Bottom of Well at 28 ft BGS
						End of Exploration at 28 ft BGS.		30	
								35	
								40	
								45	
								50	
								55	

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-36S

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/9/2022 **End:** 2/9/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): 2.81
Total Depth (ft.): 15
Depth to Initial Water Level (ft. BGS): 5.98
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Protective Casing Top of Riser @ 2.81 ft. *Ground Surface*
						(0-5') Advance HSA (4.25" ID) to 5 ft BGS.		0	(0-2') Concrete (2-4') Medium Bentonite Chips
SS	S-1	0.2	5 5 6 7	24/20	SW	(5-7') Moist, medium dense, grey to light-brown, coarse to fine SAND, little silt.		5	(4-15') #2 Silica Sand
						(7-10') Advance HSA to 10 ft BGS.			
SS	S-2	0.8	4 2 3 2	24/12	SP-SM	(10-12') Top 4": Wet, loose, grey to light-brown, coarse to fine SAND, little silt. Bottom 8": Wet, loose, grey to light-brown, fine SAND, some silt, trace medium to fine gravel.		10	(5-15') 2" (.01") Slot Schedule 40 PVC Screen
						(12-15') Advance HSA to 15 ft BGS.			
						End of Exploration at 15 ft BGS.		15	Bottom of Well at 15 ft BGS

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- AH - Air Hammer
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- AS - Auger/Grab Sample
- CS - California Sampler
- BX - 1.5" Rock Core
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/8/2022 following well installation.
MW-36S installed 10 ft downgradient from MW-27 well cluster.

Reviewed by: N. Castonguay **Date:** 9/23/2022

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
Boston, MA 02109

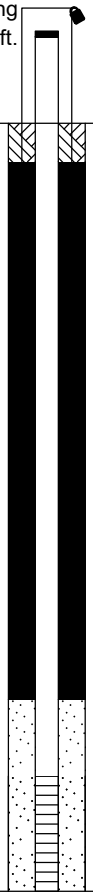
MONITORING WELL DETAIL
MW-37M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/8/2022 **End:** 2/8/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): 2.54
Total Depth (ft.): 27
Depth to Initial Water Level (ft. BGS): 8.96
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
						(0-5') Advance HSA (4.25" ID) to 5 ft BGS.		0
SS	S-1	0.2	4 6 8 8	24/19	SW	(5-7') Moist, medium dense, grey to light-brown, coarse to fine SAND, little silt.		5
						(7-10') Advance HSA to 10 ft BGS.		
SS	S-2	0.1	13 10 17 9	24/8	SW	(10-12') Wet, medium dense, grey to light-brown, coarse to fine SAND, trace silt.		10
						(12-15') Advance HSA to 15 ft BGS.		
SS	S-3	0.1	2 3 7 11	24/24	SP-SM	(15-17') Wet, loose to medium dense, grey, fine SAND, some silt, trace medium to fine gravel.		15
						(17-20') Advance HSA to 20 ft BGS.		



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
AH - Air Hammer
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/8/2022 following well installation.
MW-37M installed 5 feet cross-gradient from MW-27 well cluster

Reviewed by: N. Castonguay **Date:** 9/23/2022

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-37M

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
SS	S-4	0.1	22 15 15 14	24/14	SW	(20-22') Wet, medum dense to dense, grey, medium to fine SAND, little coarse sand and silt, trace coarse to fine gravel.		20	(17-27') 2" (.01") Slot Schedule 40 PVC Screen
						(22-25') Advance HSA to 25 ft BGS.			
SS	S-5	27.3	27 42 50/6"	17/17	SW	(25-26.5') Wet, very dense, grey, medium to fine SAND, some coarse sand, little silt.		25	Bottom of Well at 27 ft BGS
						(26.5-27.5') Advance HSA to bedrock refusal at 27.5 ft BGS.			
						End of Exploration at 27.5 ft BGS.			
								30	
								35	
								40	
								45	
								50	
								55	

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

CDM Smith

75 State Street Suite 701
Boston, MA 02109

MONITORING WELL DETAIL
MW-37S

Client: City of Worcester
Project Name: Greenwood St. Landfill
Project Location: Worcester, MA
Project Number: 0198-223874

Drilling Contractor: Geosearch Inc.
Drilling Method/Rig: HSA/CME 55LC ATV
Drillers: P. McClenahan, C. Stamas
Drilling Date: Start: 2/9/2022 **End:** 2/9/2022
Logged By: D. Roth
Field Screening Instrument: PID

Surface Elevation (ft.): Not Measured
Top of PVC Riser Elevation (ft.): 2.42
Total Depth (ft.): 15
Depth to Initial Water Level (ft. BGS): 6.15
Development Method: Surge & Purge via Whale Pump

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Protective Casing Top of Riser @ 2.42 ft. *Ground Surface*
						(0-5') Advance HSA (4.25" ID) to 5 ft BGS.		0	(0-2') Concrete (2-3) Medium Bentonite Chips
SS	S-1	0.2	4 6 8 8	24/19	SW	(5-7') Moist, medium dense, grey to light-brown, coarse to fine SAND, little silt.		5	(3-15') #2 Silica Sand
						(7-10') Advance HSA to 10 ft BGS.			
SS	S-2	0.1	13 10 17 9	24/8	SW	(10-12') Wet, medium dense, grey to light-brown, coarse to fine SAND, trace silt.		10	(5-15') 2" (.01") Slot Schedule 40 PVC Screen
						(12-15') Advance HSA to 15 ft BGS.			
						End of Exploration at 15 ft BGS.		15	Bottom of Well at 15 ft BGS

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
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GP - Geoprobe
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SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

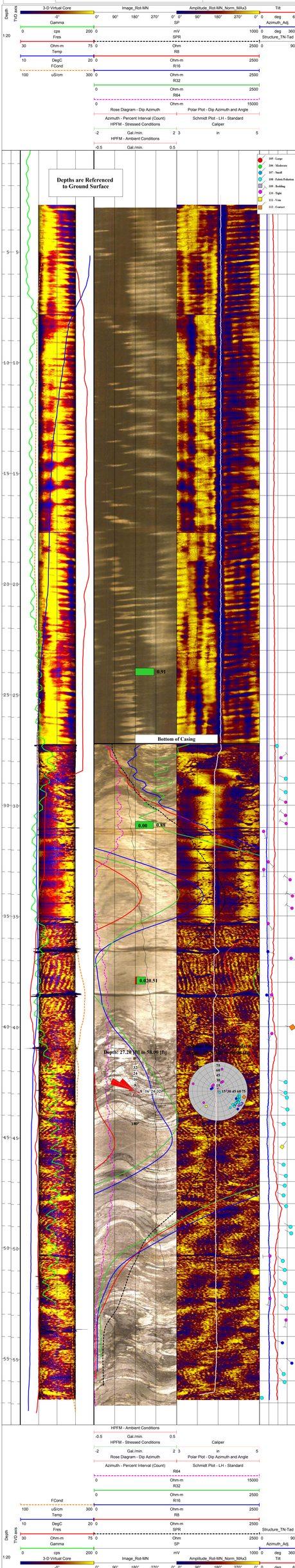
REMARKS

BGS = Below Ground Surface
ID = Inside Diameter
NM = Not Measured
PID = Photoionization Detector
Depth to initial water level recorded 2/8/2022 following well installation.
MW-37S installed 5 feet cross-gradient from MW-27 well cluster

Reviewed by: N. Castonguay **Date:** 9/23/2022

BEEBE MW LOG GREENWOOD ST FEB 22 LOGS - SM REVISED 9-29-2022.GPJ CDM_MA.GDT 9/30/22

Hager GeoScience Inc.	Geophysical Logging Record: **Composite Log**
Site: Greenwood Street Landfill	Boring #: MW-1
Location: Worcester, MA	Date Logged: 8-12-2014
Client: CDM Smith	Logged By: KD, KS

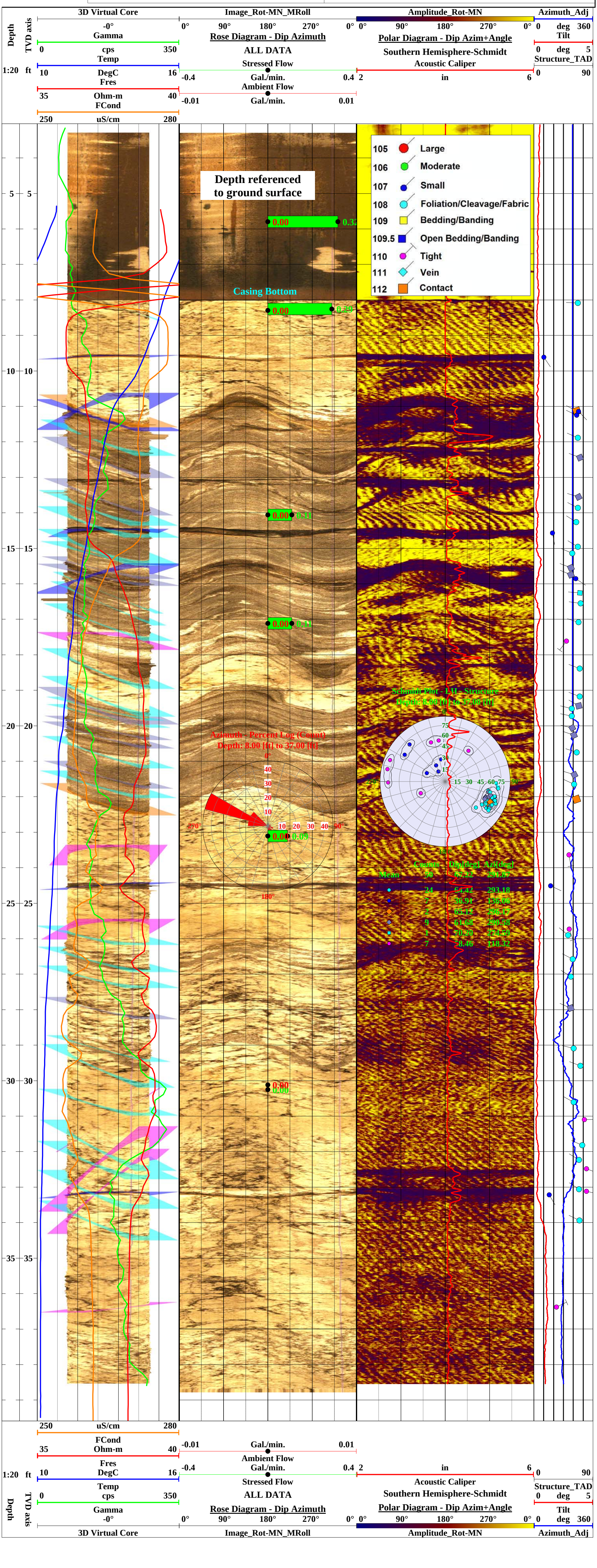


Hager GeoScience Inc.

Geophysical Logging Record:

Composite Image Log

Site:	Greenwood Landfill	Boring #:	MW-09	Depth (ft)	~38.8
Location:	Worcester, MA	Date Logged:	9-18-2015	Casing (ft)	8
Client:	CDM Smith	Logged By:	MD, PG	Water (ft):	~3.6



HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire
Tel: 603.893.9944

Fords, New Jersey
Tel: 732.661.0555

MW-25D - BOREHOLE GEOPHYSICAL LOGS

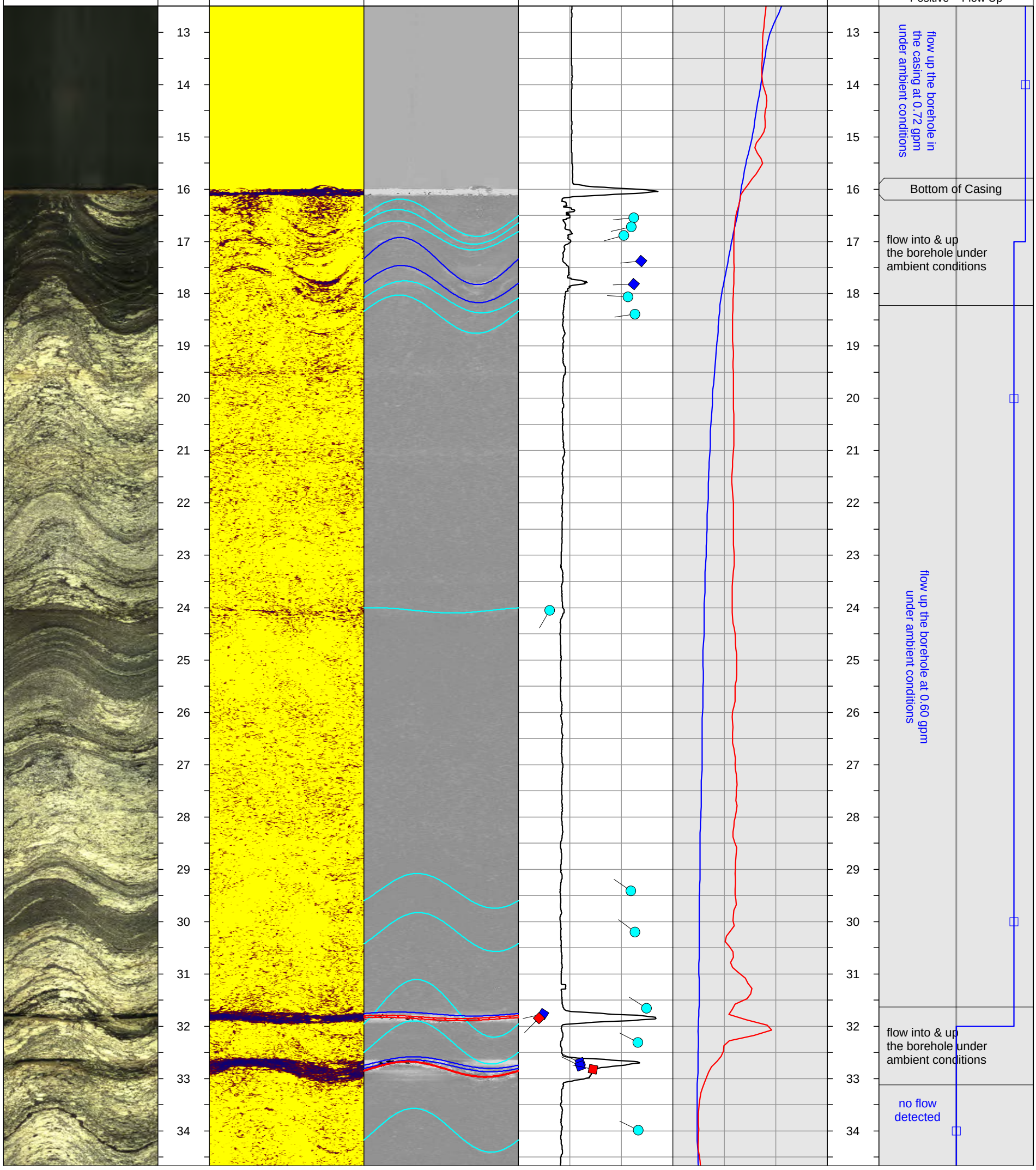
DATE(S) LOGGED: June 29, 2020

CLIENT:	CDM Smith	HRGS FILE:	20SG21A
PROJECT:	Greenwood Street Landfill	LOG DATUM:	Top of the 4-Inch Casing (PVC Coupling)
LOCATION:	Worcester, Massachusetts	TOP OF CASING:	2.7 Feet Above the Ground Surface
LOGGING GEOPHYSICIST(S):	Nick DeCristofaro & Mikko Aarnio	ORIENTATION REFERENCE:	True North (Magnetic Declination = 14.1° West)
PROJECT REP(S) ON-SITE:	Nick Castonguay	BOREHOLE DIAMETER:	4 Inches
LOGS PROCESSED BY:	Robert Garfield, P.G. & Nick DeCristofaro	WATER LEVEL DEPTH:	Flowing Artesian

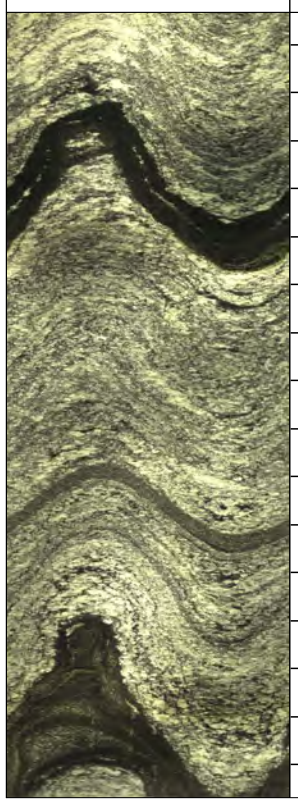
STRUCTURE LEGEND

Fracture Rank 1 Fracture Rank 2 Fracture Rank 3

MW-25D - Borehole Geophysical Logs

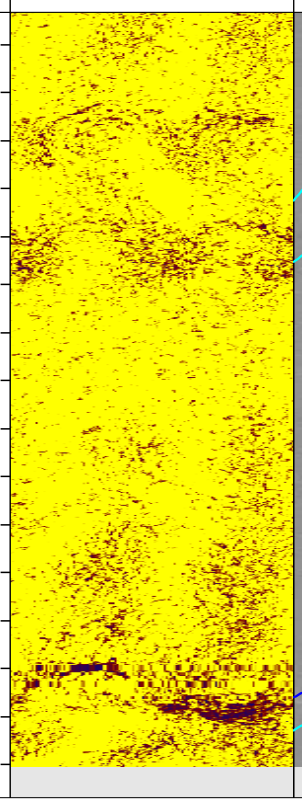


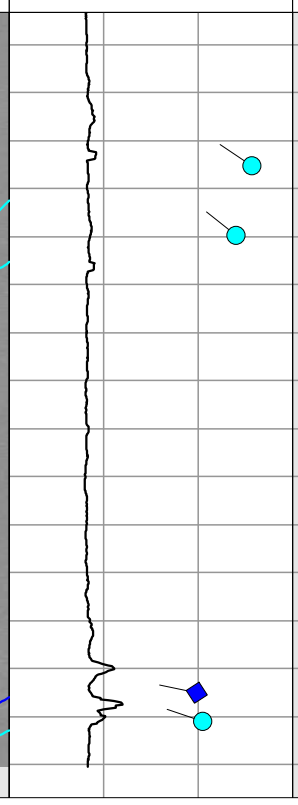
MW-25D - Borehole Geophysical Logs

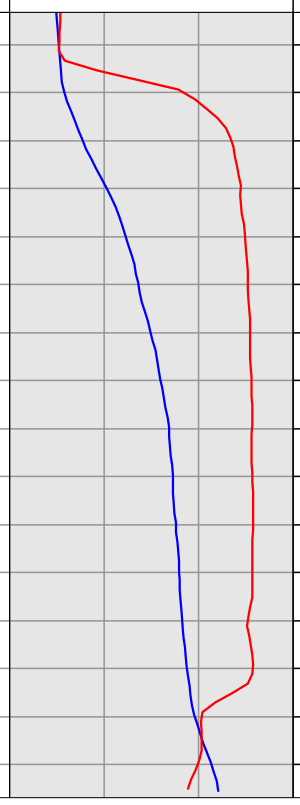


Depth (Feet)

35 36 37 38 39 40 41 42

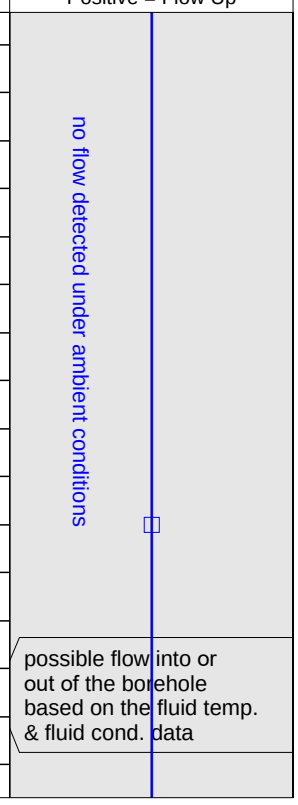






Depth (Feet)

35 36 37 38 39 40 41 42



HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire
Tel: 603.893.9944

Fords, New Jersey
Tel: 732.661.0555

MW-26D - BOREHOLE GEOPHYSICAL LOGS

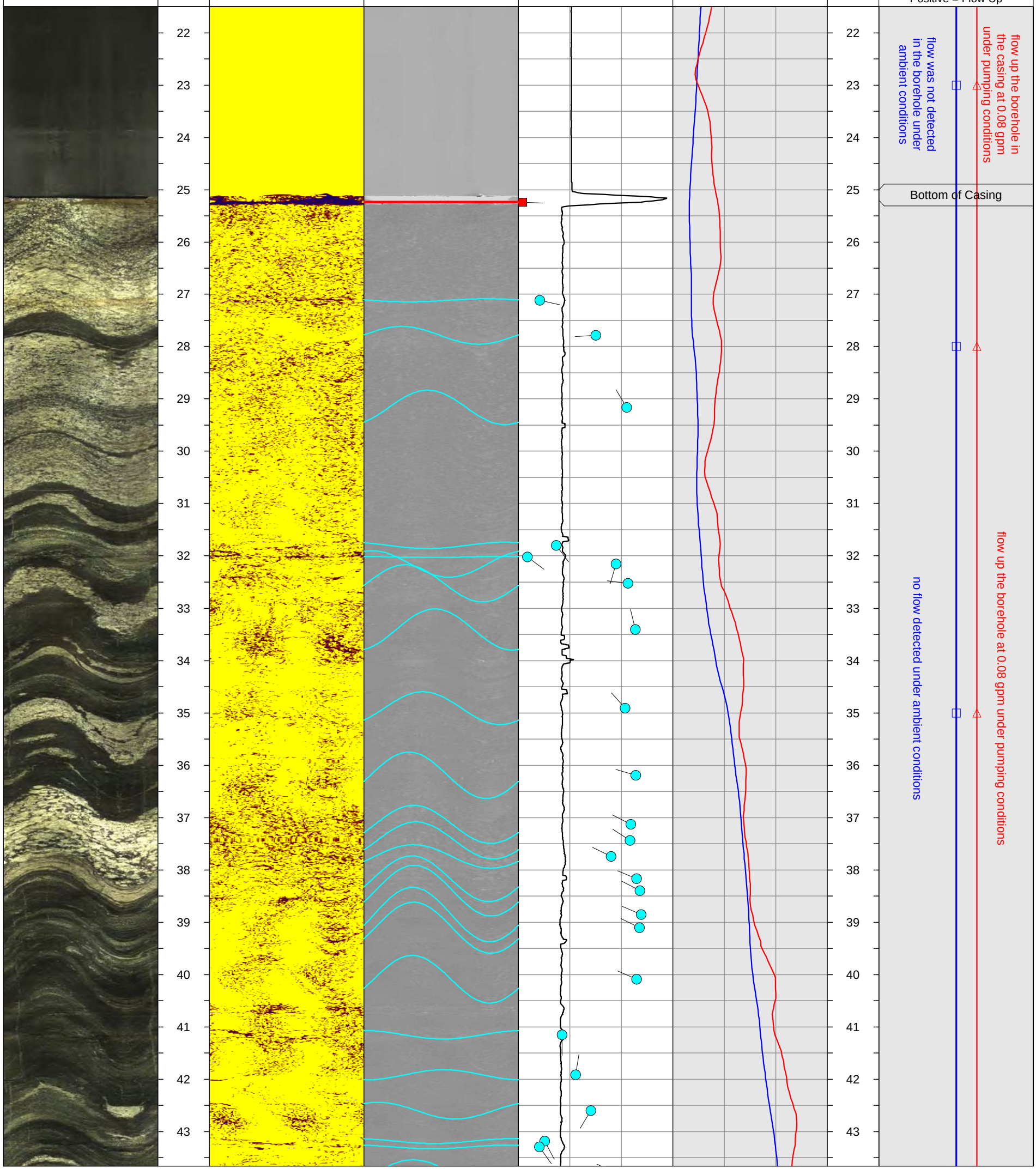
DATE(S) LOGGED: June 29 & 30, 2020

CLIENT:	CDM Smith	HRGS FILE:	20SG21A
PROJECT:	Greenwood Street Landfill	LOG DATUM:	Top of the 4-Inch Steel Casing
LOCATION:	Worcester, Massachusetts	TOP OF CASING:	2.1 Feet Above the Ground Surface
LOGGING GEOPHYSICIST(S):	Nick DeCristofaro & Mikko Aarnio	ORIENTATION REFERENCE:	True North (Magnetic Declination = 14.1° West)
PROJECT REP(S) ON-SITE:	Nick Castonguay	BOREHOLE DIAMETER:	4 Inches
LOGS PROCESSED BY:	Robert Garfield, P.G. & Nick DeCristofaro	WATER LEVEL DEPTH:	2.0 Feet

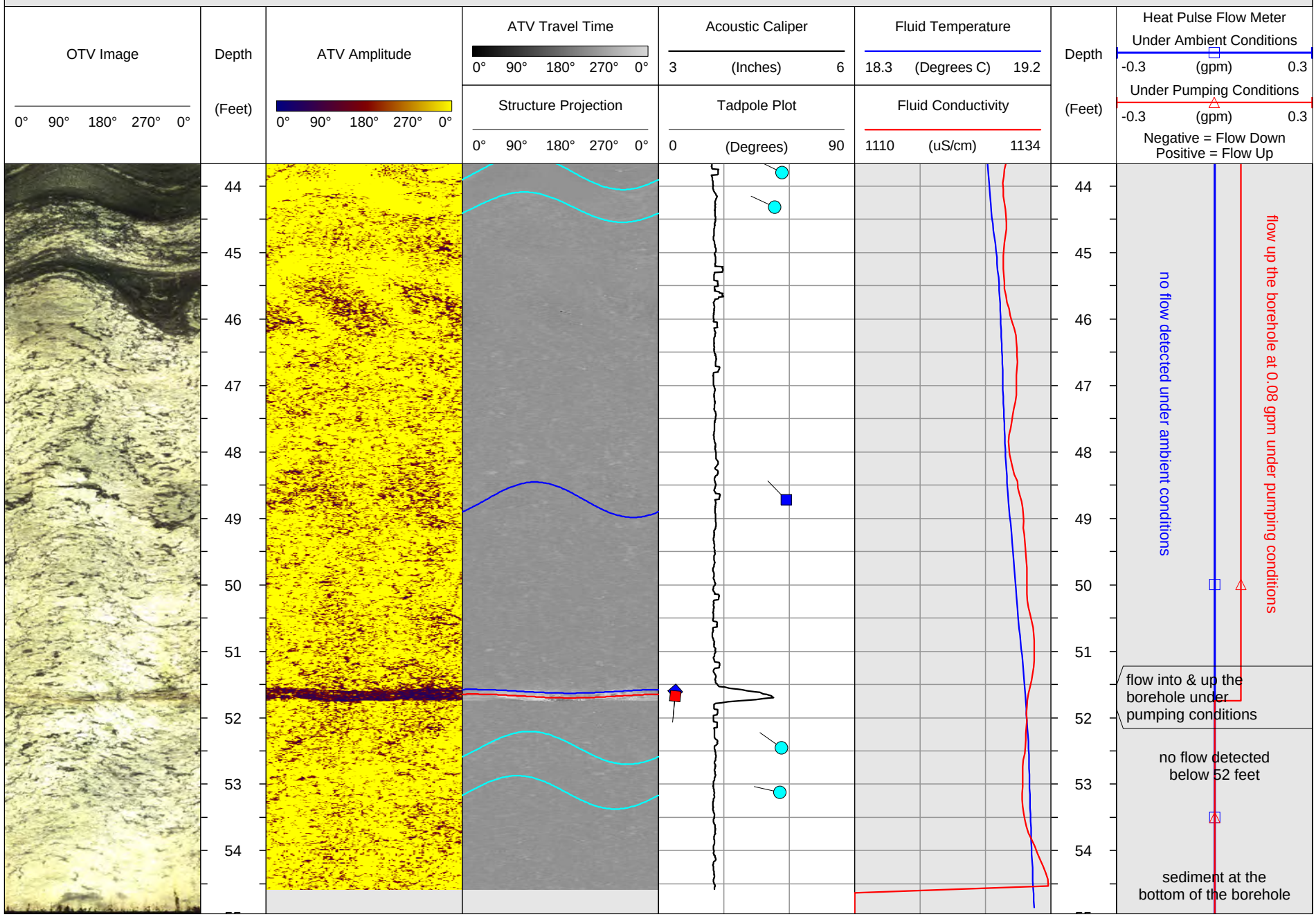
STRUCTURE LEGEND

Fracture Rank 1 Fracture Rank 2 Fracture Rank 3

MW-26D - Borehole Geophysical Logs



MW-26D - Borehole Geophysical Logs



HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire
Tel: 603.893.9944

Fords, New Jersey
Tel: 732.661.0555

MW-27D - BOREHOLE GEOPHYSICAL LOGS

DATE(S) LOGGED: June 29, 2020

CLIENT:	CDM Smith	HRGS FILE:	20SG21A
PROJECT:	Greenwood Street Landfill	LOG DATUM:	Top of the 4-Inch Steel Casing
LOCATION:	Worcester, Massachusetts	TOP OF CASING:	2.0 Feet Above the Ground Surface
LOGGING GEOPHYSICIST(S):	Nick DeCristofaro & Mikko Aarnio	ORIENTATION REFERENCE:	True North (Magnetic Declination = 14.1° West)
PROJECT REP(S) ON-SITE:	Nick Castonguay	BOREHOLE DIAMETER:	4 Inches
LOGS PROCESSED BY:	Robert Garfield, P.G. & Nick DeCristofaro	WATER LEVEL DEPTH:	3.0 Feet

STRUCTURE LEGEND

Fracture Rank 1 Fracture Rank 2 Fracture Rank 3

MW-27D - Borehole Geophysical Logs

OTV Image: 0° 90° 180° 270° 0°

Depth (Feet)

ATV Amplitude: 0° 90° 180° 270° 0°

ATV Travel Time: 0° 90° 180° 270° 0°

Structure Projection: 0° 90° 180° 270° 0°

Acoustic Caliper: 3 (Inches) 6

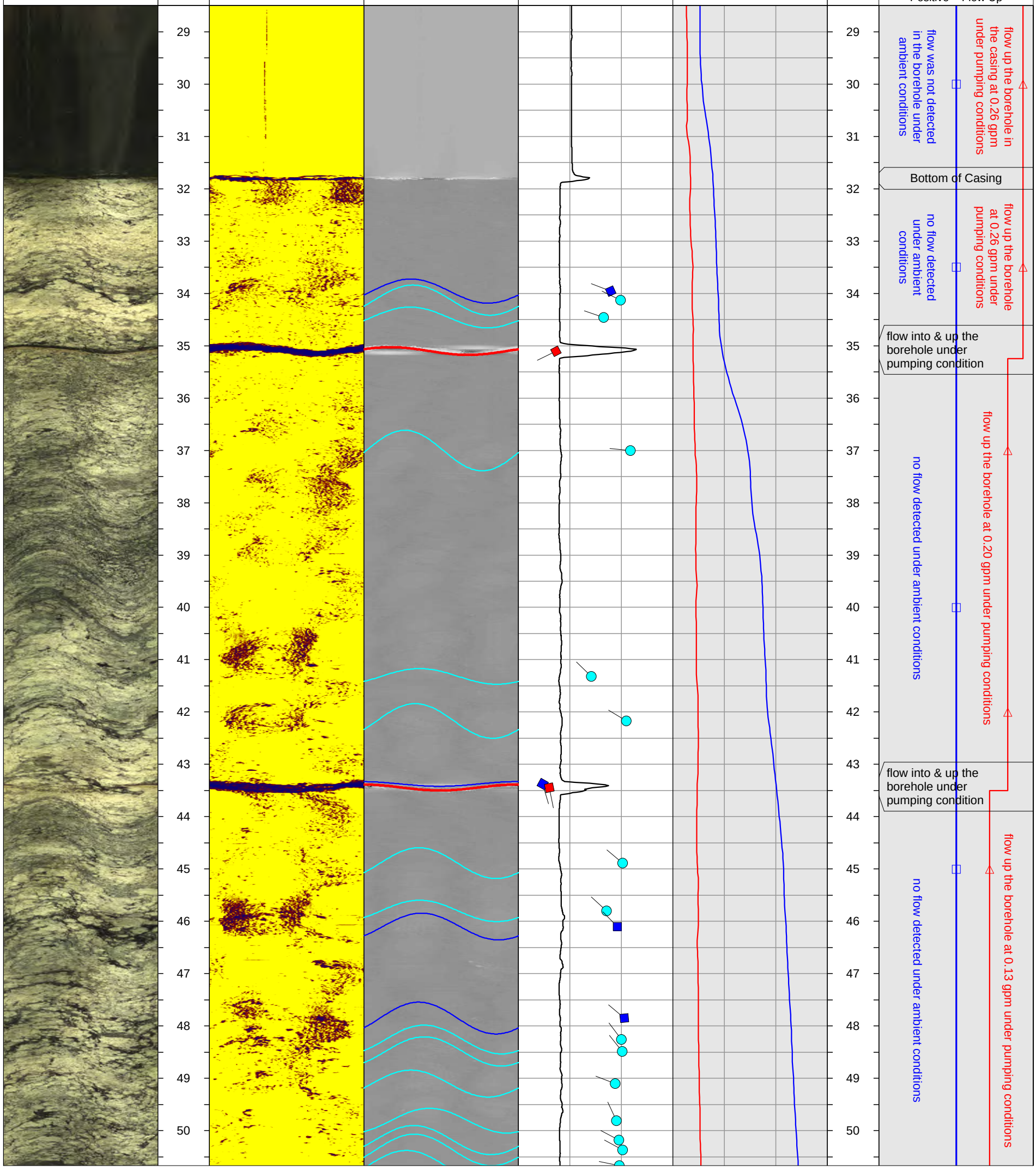
Tadpole Plot: 0 (Degrees) 90

Fluid Temperature: 18.8 (Degrees C) 19.4

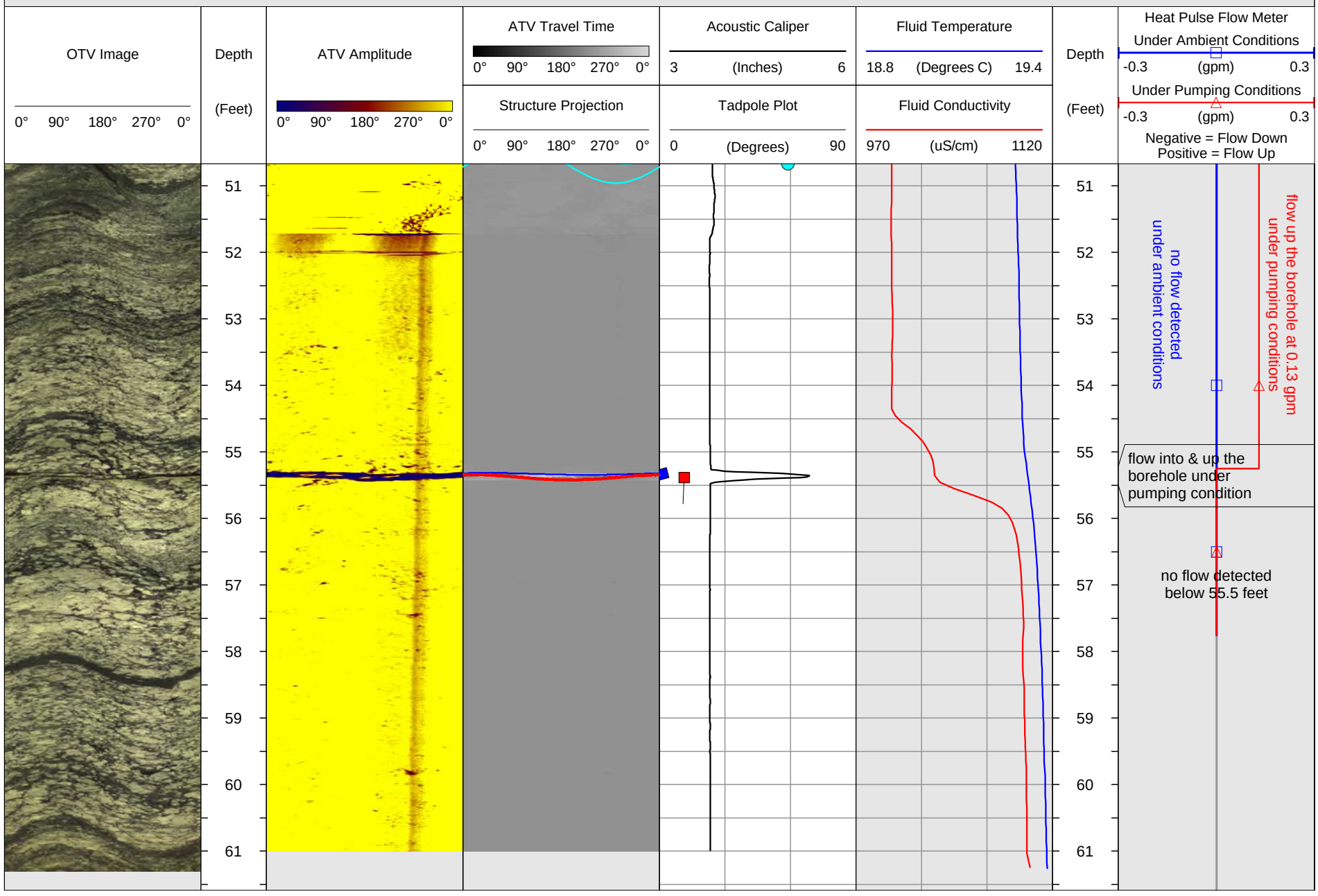
Fluid Conductivity: 970 (uS/cm) 1120

Depth (Feet)

Heat Pulse Flow Meter
Under Ambient Conditions: -0.3 (gpm) 0.3
Under Pumping Conditions: -0.3 (gpm) 0.3
Negative = Flow Down
Positive = Flow Up



MW-27D - Borehole Geophysical Logs



HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire
Tel: 603.893.9944

Fords, New Jersey
Tel: 732.661.0555

MW-28D - BOREHOLE GEOPHYSICAL LOGS

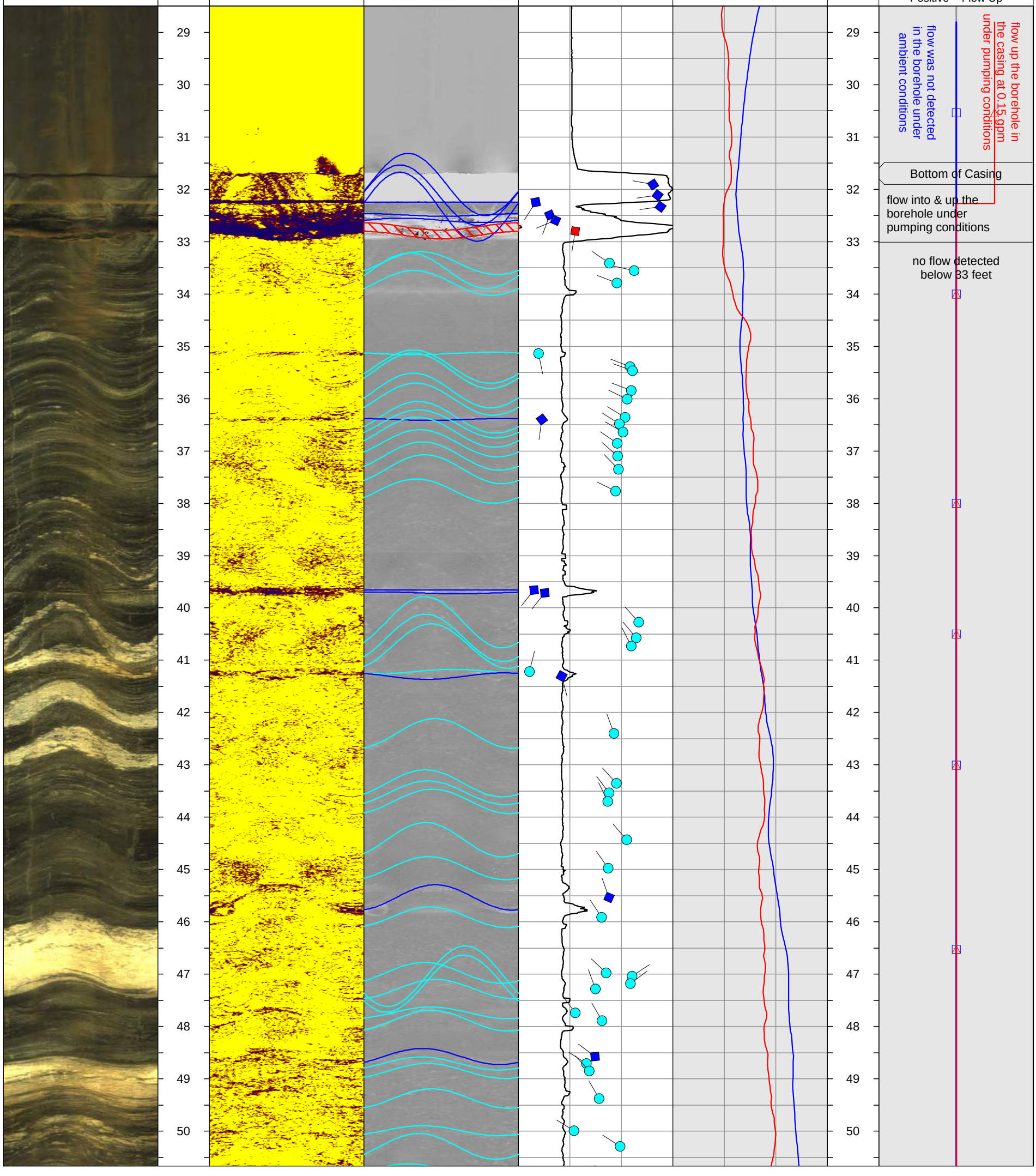
DATE(S) LOGGED: June 29, 2020

CLIENT:	CDM Smith	HRGS FILE:	20SG21A
PROJECT:	Greenwood Street Landfill	LOG DATUM:	Top of the 4-Inch Steel Casing
LOCATION:	Worcester, Massachusetts	TOP OF CASING:	2.0 Feet Above the Ground Surface
LOGGING GEOPHYSICIST(S):	Nick DeCristofaro & Mikko Aarnio	ORIENTATION REFERENCE:	True North (Magnetic Declination = 14.1° West)
PROJECT REP(S) ON-SITE:	Nick Castonguay	BOREHOLE DIAMETER:	4 Inches
LOGS PROCESSED BY:	Robert Garfield, P.G. & Nick DeCristofaro	WATER LEVEL DEPTH:	9.5 Feet

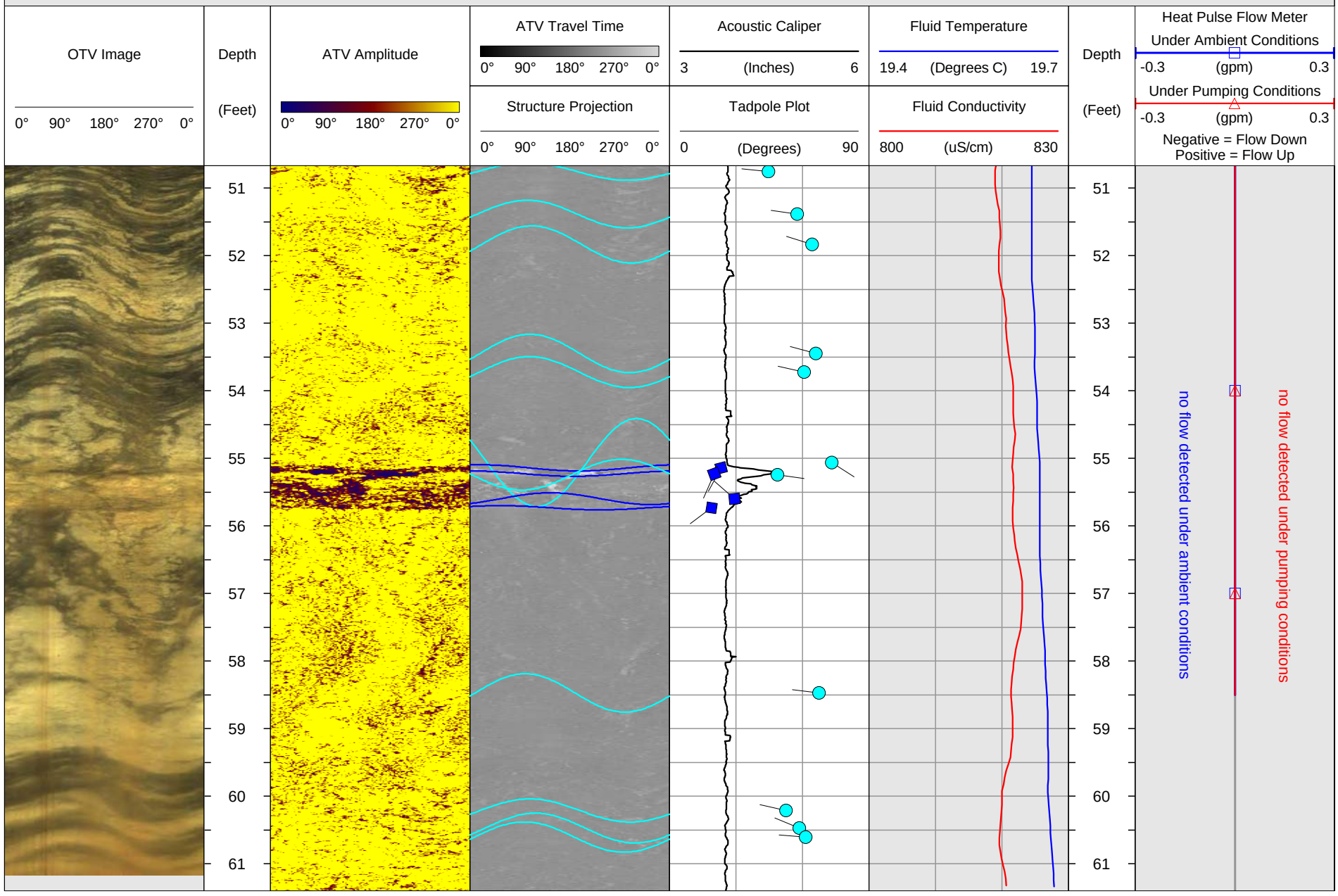
STRUCTURE LEGEND

Fracture Rank 1 Fracture Rank 2 Fracture Rank 3

MW-28D - Borehole Geophysical Logs



MW-28D - Borehole Geophysical Logs



HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire
Tel: 603.893.9944

Fords, New Jersey
Tel: 732.661.0555

MW-29D - BOREHOLE GEOPHYSICAL LOGS

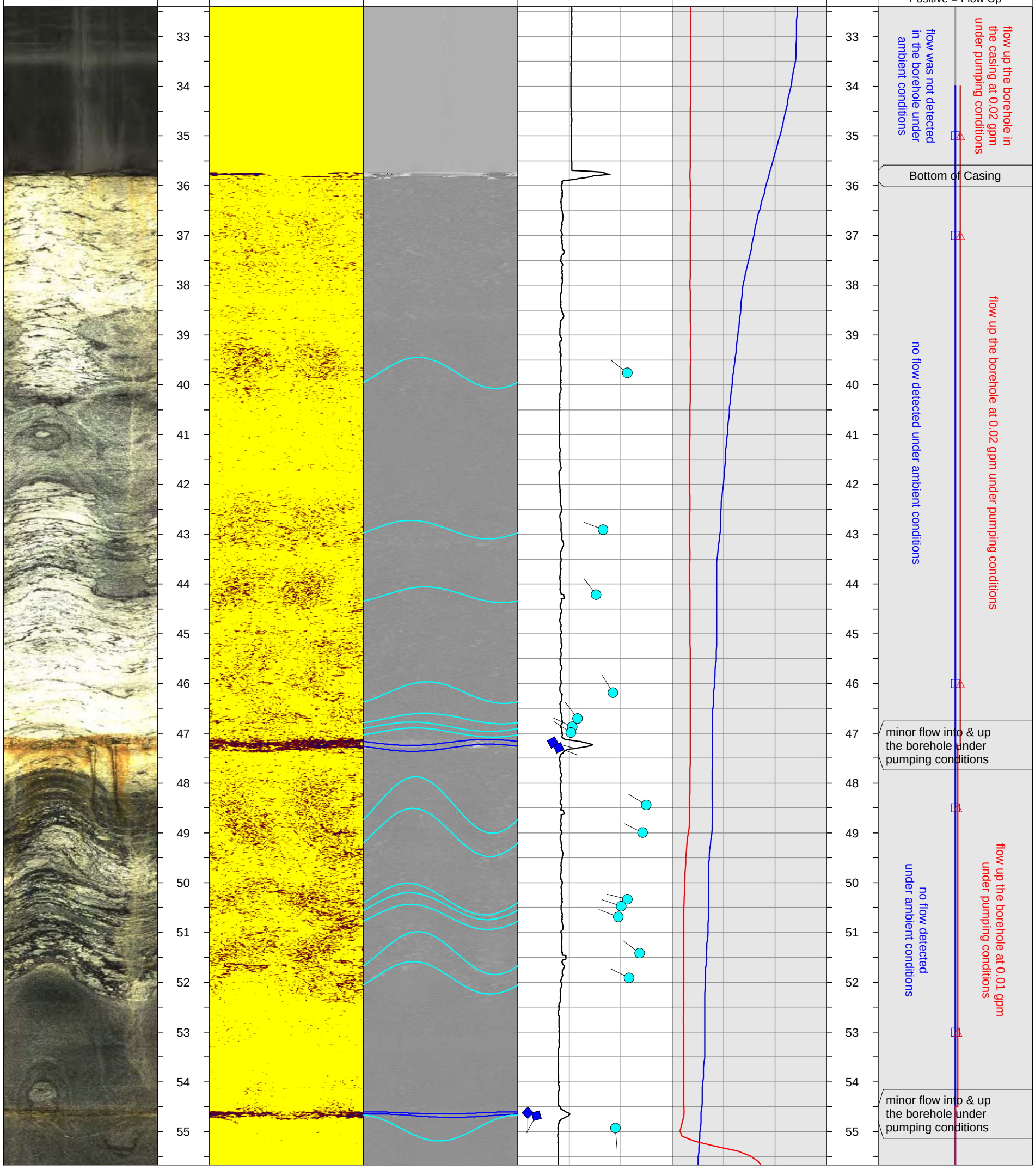
DATE(S) LOGGED: June 29, 2020

CLIENT:	CDM Smith	HRGS FILE:	20SG21A
PROJECT:	Greenwood Street Landfill	LOG DATUM:	Top of the 4-Inch Steel Casing
LOCATION:	Worcester, Massachusetts	TOP OF CASING:	2.0 Feet Above the Ground Surface
LOGGING GEOPHYSICIST(S):	Nick DeCristofaro & Mikko Aarnio	ORIENTATION REFERENCE:	True North (Magnetic Declination = 14.1° West)
PROJECT REP(S) ON-SITE:	Nick Castonguay	BOREHOLE DIAMETER:	4 Inches
LOGS PROCESSED BY:	Robert Garfield, P.G. & Nick DeCristofaro	WATER LEVEL DEPTH:	7.5 Feet

STRUCTURE LEGEND

Fracture Rank 1 Fracture Rank 2

MW-29D - Borehole Geophysical Logs



MW-29D - Borehole Geophysical Logs

OTV Image

0° 90° 180° 270° 0°

Depth (Feet)

ATV Amplitude

0° 90° 180° 270° 0°

ATV Travel Time

0° 90° 180° 270° 0°

Structure Projection

0° 90° 180° 270° 0°

Acoustic Caliper

3 (Inches) 6

Tadpole Plot

0 (Degrees) 90

Fluid Temperature

19.85 (Degrees C) 20

Fluid Conductivity

300 (uS/cm) 1500

Depth (Feet)

Heat Pulse Flow Meter

Under Ambient Conditions

-0.3 (gpm) 0.3

Under Pumping Conditions

-0.3 (gpm) 0.3

Negative = Flow Down
Positive = Flow Up